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

Chapter XIII

The Use of Nets in Wildlife Damage Management

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THE USE OF NETS IN WILDLIFE DAMAGE MANAGEMENT

EXECUTIVE SUMMARY

Nets are live capture devices used by USDA-APHIS-Wildlife Services (WS) for specific wildlife damage management projects. Birds were involved in 89% of the wildlife captured and virtually 100% of the dispersal. Fish and mammals were also involved in capture projects with take at 10% and 1%, respectively. Projects involving the use of nets were conducted primarily to protect aircraft from wildlife strikes, monitor wildlife for disease, and conduct research (e.g., capturing and marking or radio collaring birds and mammals to follow their movements). WS uses several netting systems including cannon/rocket nets, net guns, drop nets, mist nets and other netting systems. Cannon, air cannon, and rocket nets were the primary net system used, accounting for 66% of all wildlife captured using nets

Animal and Plant Health Inspection Service (APHIS) evaluated the potential human health and environmental risks from WS' proposed use of nets 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 and set up of nets, net explosives, and wildlife handling in accordance with WS Directive 2.625. Risks to the general population are negligible because site selection and timing of activities minimizes exposure to the public and the fact that WS personnel are always present at the site during netting operations. Nets are used to live-capture animals and are not methods that would contaminate water or result in the bioaccumulation of chemicals or other hazardous materials. Environmental hazards associated with nets generally are limited to the unintentional injury or death of target and nontarget species. Training of WS staff in animal handling techniques reduces the risks of injury or death to target and nontarget species. Risks are negligible for nontarget fish and wildlife based on how WS uses the nets, the activation of nets when only target species are present, and the release of any nontarget species caught in the nets.

Table of Contents

1 INTRODUCTION

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) Program uses many different styles of nets to capture or disperse animals to alleviate damage and for disease monitoring and research with most being used for bird damage management at about 96% of all activity. The method of capturing animals in nets may differ, but nets are designed to capture animals through entanglement, followed by extraction. The nets must be of the appropriate size for the target species. WS uses nets in both terrestrial and aquatic habitats, on both public and private lands, in rural and urban settings.

Netting systems are versatile and can capture a wide variety of species, ranging from bats, birds, and fish, to hooved animals for alleviating damage, or conducting surveillance and monitoring. Nets are frequently used in wildlife research for bird banding and population monitoring. WS primarily uses nets to capture birds and fish; however, feral swine[1] have been targeted in a limited number of drop net operations in the last few years. Drop nets may be used on feral swine more frequently in the future, with the increase in operations to remove feral swine. WS may relocate or euthanize animals caught in nets depending on the circumstances of capture and the species captured.

1.1 Netting Systems

Various netting systems are used by WS and commonly include cannon/rocket/air cannon nets, net guns, mist nets, drop nets, and hand nets[2]. The various systems consist of a net, poles, ropes, triggering devices, lights or shooting mechanisms. The nets can be (1) baited (rocket nets, drop nets), (2) used directionally to capture an animal (net guns, hoop nets, dip (fishing) nets), or (3) used passively (mist nets, gill nets, light nets). Often, the target animal or group of animals is baited with food to a site where the net is set to capture them. However, several species are not attracted to bait and are targeted with passive or directional systems. Less commonly used nets include hoop, gill, light, and fishing nets. Some nets are versatile and can be used as one style or another depending on the target species. The use of most nets requires specific permits from both State and Federal agencies. Captured animals typically are physically or chemically restrained, sampled (e.g., blood taken for disease monitoring), or marked (e.g., radio-collar attached or banded) and released, relocated, or euthanized on-site depending on the project intentions.

Figure 1. A cannon net projectile being placed on launcher.

Cannon/Rocket Nets[3], including air cannons, are nets carried by explosive- or compressed air-activated projectiles over

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

[2] Drive or herd traps often use netting, but WS typically use livestock panels, so these were considered in "*The Use of Cage Traps in Wildlife Damage Management*" Risk Assessment.

[3] Risks associated with the use of explosives is covered in "*The Use of Explosives in Wildlife Damage Management.*"

targeted species that are attracted to a specific area, usually a baited site or natural feeding site (Dill and Thornsberry 1950, Schemnitz et al. 2009). These can be rather large areas, covering up to 30 ft. x 60 ft. or larger. Cannon/rocket nets are accordion folded nets pulled rapidly by explosive-driven projectiles to cover a predetermined area to capture target animals present before they can escape. The net can be placed directly on the ground in a line (Figures 1 and 2) or can be folded and placed in a specially designed box (Grubb 1988). The projectiles are attached to the net, usually with small cords. The two netting systems differ in basic hardware and speed, which equates to the capacity to pull larger nets and the height of deployment.

Cannon nets use cannons (Figure 1) which are smoothly bored-out heavy projectiles that are placed on launch rods usually directed at about a 20 degree angle over the area. The charge (smokeless powder) is ignited with an electronic ignition from a detonator wire that runs from the end of a launch rod, along it, and to the detonator, which is usually an area where the WS personnel wait hidden from the target animal(s). WS personnel detonate the charge either at the detonator or from a remote location. Full-sized cannon nets usually require four projectiles, but three or more can be used depending on the size of the net.

Rocket nets use heavy pipe projectiles on “L-shaped” stands, or sleds, with a twist-off cap on one end where an explosive is inserted, usually a bag containing M6 howitzer propellant (mostly compressed nitrocellulose, otherwise known as guncotton) and black powder with an electronic match (Figure 2). The other end has many holes to allow the gases created by the blast to escape, which propels the rocket. The electronic match is attached

Figure 2. (A) Rocket net projectile on a sled, (B) a line of sleds being readied, and tundra swan being captured in a banding project where WS assisted.

to a wire which is run out of the projectile and attached to an electronic detonator that is activated from a hidden spot. These are often used with heavier netting for larger birds, especially those that can quickly get out of the way, and for larger size nets. Rocket nets typically require the use of three or more projectiles. The projectiles are reusable but require frequent cleaning because of the use of black powder.

Air cannons are a net system that uses a portable air compressor and is set out in a box similar to the cannon/rocket nets. Air cannons can be used where explosive charges would not be advisable, such as capturing oiled birds at an oil spill or birds in an urban environment where use of explosives is restricted. The air powered cannon is much quieter than cannon/rocket nets, but are sometimes slower pulling the nets, harder to hide, and more expensive. The air pressure in the cannons is adjustable so that different size nets can be fired. Some air cannon setups may be faster than cannon/rocket net systems. The projectiles are 4.5 pound and can pull up to a 40' x 60' net.

In addition to the cannon/rocket net, other equipment is necessary for the safe firing and storage of rocket nets and their charges. A blasting galvanometer (an instrument that tests an electric blasting circuit to ensure it is in working order), capacitor discharge machine (provides the electrical spark to ignite the charges), and electrical blasting line are standard supplies for safe operation. In addition, a portable explosives container is used for the safe transport of charges and an explosives magazine is required for long-term storage. WS follows all transportation and charge storage regulations of the U.S. Department of Transportation (DOT), U.S. Department of Alcohol, Tobacco, Firearms and Explosives (ATF), and state and local agencies (Explosives Law and Regulations, ATF P 5400.7 and 29 CFR, Part 1910.109).

WS usually pre-baits sites to increase attraction of target species and also places the cannon/rocket net, or something similar in appearance, in place to accustom the target species to its presence. When WS Specialists are ready to use the actual net, it is folded like an accordion in a line or packed in a net box with the rear or trailing edge of the net staked to the ground or attached to heavy weights by ropes and the leading edge of the net attached to a number of cannons/rockets via longer ropes. Cannons are placed on stands with the charges in the end and rockets are placed on the net box, staked to the ground, or on posts for additional elevation when taller animals are the target. After the placement of charges in the cannon/rocket, WS connects detonation wires to a shunted electrical blasting line. Once all the charges are connected, the line is tested for connectivity, and the area is safe for detonation, it is attached to the capacitor blasting machine. When the animals are in place, the operator activates the blasting machine and the electrical charge ignites the cannon/rockets, propelling the net over the animals. WS personnel then remove the animals from the net and process them per the project objectives.

Net Guns[4] are nonlethal hand-held or shouldered tools similar to a firearm designed to fire a net to entangle the target animal. These come in various styles and are powered by small arms blank cartridges or compressed air from small CO_2 cartridges or other source. Net guns have a long history of being used to capture wildlife, but especially for research purposes, or in simple damage situations such as capturing a feral dog that escapes hand capture. Net guns are usually used to capture mammals, but have also been used to capture birds (Schemnitz et al. 2009). They are especially useful in capturing aggressive birds in urban areas such as geese, wild turkeys, and gulls

[4] Risks from the use of net guns to people and environment, a firearm-like device, are discussed in "*The Use of Firearms in Wildlife Damage Management*." Risks to people and environment from aircraft if used to capture animals with a net gun are discussed in "*The Use of Aircraft in Wildlife Damage Management*."

which have been fed by people or are protecting a nest; they become accustomed to people feeding them and often attack people that don't feed them, or are protecting their nest. A net gun shoots a net as a blanket over the target animal. Weights are attached to the corners of the net causing the net to spread in a flattened arc, safely capturing the target animal. They can be shot from the ground or air.

Mist nets are commonly used by wildlife biologists to capture wild birds and bats for banding, disease surveillance, or other research projects (Low 1957, Gardener et al. 1989, Carter and Whitworth 2013) and to remove birds from industrial or commercial buildings where they are entrapped (*e.g.,* house sparrows in malls). Mist nets are typically made of nylon mesh suspended between two poles, resembling an oversized volleyball net. When properly deployed, the nets are virtually invisible (Keyes and Grue 1982). The grid size of the mesh netting varies according to the size of the species targeted for capture. Net dimensions are approximately 1–2 m high by 6–15 m long. A dho-gaza is a type of mist net used for larger birds, such as raptors. Mist net handling requires training and skill to avoid injury to the captured birds or bats. A 2011 research survey found mist nets to have a low rate of injury while providing high scientific value (Spotswood et al. 2011).

Mist netting is a popular and important tool for monitoring species diversity, relative abundance, population size, and demography (Dunn and Ralph 2004). Because mist nets allow scientists to examine species up close, they are often used in mark-recapture studies over extended periods of time to detect trends in population indices (Dunn and Ralph 2004). Mist nets also allow the humane capture and relocation of small birds or bats, tagging and tracking, and studies testing the health of bird or bat species.

Drop nets are nets that have been suspended above a bait site with ropes and poles (Figure 3). Once the animal(s) are underneath the suspended net, an operator triggers the net. The net falls over the animals and the animals become tangled in the netting.

Figure 3. Feral swine under a drop net.

WS has used drop nets to capture white-tailed deer, feral swine (Figure 3), doves, and blackbirds, but they can be used for many more species, primarily those that are herding such as bighorn sheep, feral goats, peccaries, or flocking birds such as waterfowl and gulls. Net mesh size varies depending on the target animal; generally larger mesh is used for larger animals. Ramsey (1968) reported using 3.5 inch mesh to capture axis deer where Glazener et al. (1964) used both 2 and 3 inch mesh to capture wild turkey.

Sites for drop netting are typically pre-baited with food items to attract the target animal before the net is set up at the site. The drop net system is set up when animals become accustomed to feeding at a site. Baiting continues so that animals become comfortable feeding near the drop net. Once the animals are accustomed to feeding and enter the drop zone, WS drops the net.

Triggering systems for drop nets vary, some are manually operated while others are operated via a remote radio controller. In both situations the operator is located close enough to observe the animals and net. Manual systems use a rope or wire to manually pull a release allowing the net to drop. Remote operated triggering systems use a radio-controlled remote to operate a battery powered or magnet triggering mechanism.

Fish or dip nets are commonly used to capture animals, typically animals in close quarters or entrapped in buildings (birds and bats) and usually only individuals. These are normally moved quickly from the net into a container or outside where they are freed. They can also be used to retrieve fish captured on rod and reel (e.g., the northern pikeminnow project in Washington on the Columbia River). These nets have minimal risks to species because they are handled quickly after capture.

Nest Net Traps are used to capture Monk Parakeets (Figure 4) and can vary in effectiveness; overall they had a 51% success rate (Tillman et al. 2004). These are placed at night over entrance holes to their large stick nests. Birds that exit the nest in morning are captured in the long tubular nets. These nets may have application for other cavity nesters such as woodpeckers, starlings, and magpies.

Figure 4. Nest nets for monk parakeets placed in front of their entrance/exit holes on their massive stick nests.

1.2 Use Pattern

WS annually averaged 495 work tasks[5] associated with the use of nets to capture wildlife including the annual average lethal removal of 4,770 target animals, the release of 455 target animals, and the dispersal of 9,722 target animals for FY11[6]-FY15 (Table 1). An annual average of 4 (2 lethal and 2 released) nontarget animals were taken during this time. Table 1 includes the species taken or dispersed with all netting systems, the annual average number of target species killed, dispersed, and released or relocated after sampling, and nontarget species killed and released.

For FY11-FY15, WS used cannon/rocket nets to capture an annual average of 3,442 target animals of 25 species with European starlings and rock pigeons accounting for 49% and 35% of those captured, respectively (Table 2). Of those captured, WS euthanized 93% of the animals. WS captured an average of two nontarget species, which represents 0.1% of the animals captured, with the majority of these being released, but one in the five years died as a result of colliding with the net just after it was detonated. WS dispersed an average of 8,598 animals, but this is more incidental to the capture operation. Most of the birds dispersed were European starlings (97%).

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WS used net guns to capture an annual average of 143 target animals of 20 species for FY11-FY15 with no nontarget species taken (Table 2). In addition to captured birds, WS personnel used the blanks to disperse 1,123 species, all of these on airports. Net guns make a loud noise when shot that will disperse animals and is sometimes used as such when the targets are too far away to capture. Canada geese accounted for 81% of the captures and 67% of the species hazed.

[5] 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 considered and, thus, a Work Task could be 10 minutes to 10 hours in duration.

[6] FY11 equals the federal Fiscal Year 2011, which is October 1, 2010-September 30, 2011 (the year is denoted by FY11, FY12, and so on).

Table 1. The annual average number of target and nontarget animals captured with nets by WS in WDM activities from FY11 to FY15 throughout the United States. Nontargets killed by the nets could have been targets of the project but killed unintentionally. Targets killed could have been killed by nets, but it was the intention of the project to kill them and would not be documented.

ANNUAL AVERAGE SPECIES TAKEN WITH NETS					
SPECIES[1]	**TARGET**			**NONTARGET**	
	Killed	**Freed**	**Dispersed**	**Killed**	**Freed**
Canada Goose	223	20	846	0	0
Mallard (incl. domestic Mallard*)	10	27	1	0	0
Other Waterfowl (8T – 8 sp.)[1]	0.8	11	0	0	0
Whooping Crane[T&E XN]	0	0.2	0	0	0
American Coot	27	0.2	0	0	0
Laughing Gull	66	0	0	0	0
Ring-billed Gull	93	1	0	0	0
Herring Gull	23	11	447	0	0
Other Water Associated Bird (5T – 5 sp.)[1]	6	0.4	5	0	0
Bald Eagle	0	9	0.6	0	0
Golden Eagle	0	0	0.8	0	0
Other Raptor (16T – 16 sp.)[1]	1	9	12	0	0
Greater Sage-Grouse	0	106	0	0	0
Wild Turkey	9	25	0	0.2	0
Feral Rock Pigeon*	1,707	18	15	0.8[3]	0
Eurasian Collared-Dove*	84	3	0	0	0
Mourning Dove	247	0.2	0	0	2
Other Terrestrial Non-passerine Bird (2T – 2 sp.)[1]	1	0.8	4	0	0
European Starling*	1,274	1	8,380	0	0
Red-winged Blackbird	24	0	0	0	0
Common Grackle	81	0	0	0	0
Great-tailed Grackle	152	0	0	0	0
American Crow	1	71	10	0	0
Barn Swallow	9	1	0	0	0
American Robin	0	15	0	0	0
House Sparrow*	202	81	0	0.6[3]	0
Other Passerines (4T -4 sp.)[1]	9	0.4	0	0	0
Feral Swine*	14	0	0	0	0
Unknown Bat (1 T – 1 sp.) (1 max of 10 sp. possible - incl. 3 T&E MO)[2]	0	0.2	0	0	0
Unknown Bat (18 max of 21 sp. possible – NM, WY)[2]	3	0.6	0	0	0
Other Mammal (5T predator, 1T hoofed, 3T rodent/rabbit, 2T bat – 11 sp.)[1]	1	3	0.2	0	0
Common Snapping Turtle	0	0.2	0	0	0
Goldfish*	112	0	0	0	0
Unidentified Sucker (Longnose, Mountain, or White)	40	0	0	0	0
Brown Trout*	0	40	0	0	0
Bluegill	350	0	0	0	0
AVERAGE ANNUAL NET TOTAL (74T, 4NT – 74sp. [up to 93 sp.])	**4,770[7]**	**455**	**9,722**	**2**	**2**
% TARGET AND NONTARGET SPECIES TAKEN	**91.2%**	**8.7%**	**N/A**	**0.04%**	**0.04%**

***** Introduced Species **T** – Target **NT** – Nontarget **T&E** – Threatened/endangered sp. **XN** – Experimental Pop.
(# T & NT species - # sp. in group including T and NT – Species are listed in Appendix 1)

[1] Accounts of species are given only for those species that had an annual average of more than 10 taken, target and nontarget numbers combined. Federally listed threatened, endangered, or candidate species and eagles are included.

[2] Bats could be recorded as bats (all) in the MIS and, thus, are unknown. Some specialists identified the species in remarks.

[3] In one project targeting European starlings for disease surveillance, the recorded nontarget house sparrows and feral pigeons were intentionally killed for the property owner in a CO_2 chamber, but unintentionally taken in mist nets. Thus, while killed, they were not killed by the mist nets.

Mist nets and seines/gill nets were used by WS during FY11-FY15 to capture an annual average of 589 target animals of 20 species (Table 2). Two nontarget species were unintentionally captured in mist nets but were euthanized as they were targeted on the property. Nontarget take with mist nets

[7] Numbers are subject to rounding errors, depending on the parameters selected to receive data. Tables 1 and 2 have slight differences.

was relatively minor (0.2%). House sparrows were the most common species captured in mist nets at 71% of all take while goldfish were the most common fish taken in seines/gill nets at 58%.

WS used drop nets and cast nets to take 951 target animals of 13 species for FY11-FY15 (Table 2) Drop nets were primarily used on an airbase where the most commonly captured birds included mourning doves (38%) and great-tailed grackles (24%). Drop nets were used to capture an annual average of 13 feral swine. Bluegill were the only species of fish captured in cast nets; a pond was being drained on an airport and all the fish were moved to a pond off the airport (bluegill themselves attract species such as herons and egret which are a strike threat. WS did not take any nontarget species with drop or cast nets.

Hand nets such as dip or fish landing nets are typically used to capture a random assortment of species since, depending on the target species, most animals captured are suffering from injuries, entrapped, or juveniles. Certain species are dangerous such as injured eagles or bobcats and need to be captured, especially where the public could encounter them. Species entrapped indoors such as bats and starlings are common and typically freed outdoors. Young are often captured where they have been separated from their mothers and returned to a nest or rehabilitator. The only exceptions are the direct capture of particular species such as Canada geese during primary molt (they lose their ability to fly during the molt of their wing feathers) and rock pigeons at night on nests since these can easily be taken with hand nets in specific situations. For FY11-FY15, WS captured an annual average of 101 animals of at least 43 species with a maximum of 62 species (Table 2). The number of species taken with hand nets is variable because bats could be recorded as "Bats (All)" in the WS MIS[8]. An average of 4 bats were taken that were not identified in the MIS.

In total, WS captured 4,770 (rounding error between Tables 1 and 2) target animals which were euthanized and 456 which were mostly relocated. Of these, rock pigeons (33%) and European starlings (24%) accounted for most take, both invasive species.

2 HAZARDS

Many specific hazards associated with the use of nets are analyzed in other risk assessments because they align more closely with those risks. For example, net guns are a firearm-like device and, therefore, risks of using firearms is discussed in "*The Use of Firearms in Wildlife Damage Management*" and rocket/cannon net explosives risks in "*The Use of Explosives in Wildlife Damage Management*." These were denoted in footnotes in Section 1.

2.1 Human Health and Safety

Human health and safety hazards associated with the use of nets in the WS program are generally minor since nets are only used with WS personnel present or close by, with the exception of drop nets that may be set out for several days prior to use to habituate the target species to its presence. Several risks are discussed in other risk assessments as noted above and safety operation procedures are in accordance with WS Directive 2.625.

[8] MIS - Computer-based Management Information System used for tracking APHIS-WS WDM activities nationwide.

Table 2. The annual average number of target and nontarget animals captured with nets by WS in WDM activities from FY11 to FY15 throughout the United States. Species killed by nets may have been killed intentionally after capture or possibly accidentally killed by the nets; a wild turkey (0.2 average) was known to be killed accidentally by the use of a net.

ANNUAL AVERAGE SPECIES TAKEN WITH NETS					
SPECIES	**TARGET**			**NONTARGET**	
	Killed	**Release**	**Dispersed**	**Killed**	**Release**
AIR/CANNON/ROCKET NETS					
Canada Goose	72	15	96	0	0
Mallard (incl. feral domestic Mallard*)	7	13	0	0	0
American Coot	27	0	0	0	0
Laughing Gull	66	0	0	0	0
Ring-billed Gull	93	0	0	0	0
Herring Gull	12	0	97	0	0
Bald Eagle	0	9	0	0	0
Greater Sage-Grouse	0	104	0	0	0
Wild Turkey	3	19	0	0.2	0
Feral Rock Pigeon*	1,671	4	15	0	0
Mourning Dove	18	0	0	0	2
European Starling*	1,207	0	8,380	0	0
American Crow	1	71	10	0	0
Other Bird (12T - 12 sp.)**	20	10	0.2	0	0
CANNON/ROCKET NET TOTAL (25 T, 2 NT – 25 sp.)	**3,197**	**245**	**8,598**	**0.2**	**2**
NET GUNS					
Feral/Free-roaming Dog*	0	0.8	0.2	0	0
Eastern Cottontail	0.2	0	0	0	0
Canada Goose	116	0.2	750	0	0
Herring Gull	10	10	350	0	0
Whooping Crane[T&E XN]	0	0.2	0	0	0
Bald and Golden Eagles	0	0	1	0	0
Other Bird (13T - 13 sp.)**	0.8	5	22	0	0
NET GUN TOTAL (19T – 19 sp.)	**127**	**16**	**1,123**	**0**	**0**
MIST NETS AND SEINES					
Feral Rock Pigeon*	7	13	0	0.8[2]	0
European Starling*	64	1	0	0	0
American Robin	0	15	0	0	0
House Sparrow	202	81	0	0.6[2]	0
Other Birds (7T -7 sp.)	10	4	0	0	0
Goldfish*	112	0	0	0	0
Unidentified Sucker (all were Longnose, Mountain, or White)	40	0	0	0	0
Brown Trout*	0	40	0	0	0
MIST NET AND SEINES TOTAL (14T, 2 NT - 14-16 sp.)	**435**	**154**	**0**	**1**	**0**
DROP AND CAST NETS					
Feral Swine*	14	0	0	0	0
Feral Rock Pigeon*	16	0	0	0	0
Eurasian Collared-Dove*	84	0	0	0	0
Mourning Dove*	228	0	0	0	0
Red-winged Blackbird	24	0	0	0	0
Common Grackle	76	0	0	0	0
Great-tailed Grackle	143	0	0	0	0
Other Bird (5T – 5 sp.)	12	4	0	0	0
Bluegill	350	0	0	0	0
DROP AND CAST NET TOTAL (13T – 13 sp.)	**947**	**4**	**0**	**0**	**0**
HAND NETS					
Mammals (4T Predators, 1T Hoofed, 2T Rodents, 2 T Bats– 9 sp.)	0.8	2	0	0	0
Unknown Bat (1 max of 10 sp. possible - incl. 3 T&E MO)	0	0.2	0	0	0
Unknown Bat (18 max of 28 sp. possible – NM, WY)	3	0.6	0	0	0
Canada Goose	33	1	0	0	0
Mallards (incl. feral domestic Mallard)	2	14	0	0	0
Wild Turkey	6	5	0	0	0
Bald Eagle	0	0.2	0	0	0
Feral Rock Pigeon*	13	0.4	0	0	0
Other Birds (26 T – 26 sp.)	7	12	0	0	0
Common Snapping Turtle	0	0.2	0	0	0
HAND NET TOTAL (40 Known T + Unknown Bats)	**65**	**36**	**0**	**0**	**0**
AVE. ANNUAL ANIMALS TAKEN WITH ALL NETS	**4,771**	**455**	**9,721**	**1**	**2**
% TARGET AND NONTARGET SPECIES TAKEN	**91.2%**	**8.7%**	**N/A**	**0.02%**	**0.04%**

***** Introduced Species **T** – Target **NT** – Nontarget #(T, NT – All species in group)

[1] Accounts of species are given only for those species that had an annual average of more than 10 taken as in Table 1.

[2] Unintentional take by method, but targeted on property so euthanized.

Potential hazards associated with the use of nets include: minor strains and sprains from setting the tension and height of the net; entrapment by the net or injury from projectiles, particularly during a premature triggering of the net; punctures, bruises, and wounds (bites, scratches, and kicks) from handling or restraining captured animals. Handling of wildlife from nets could also result in disease and parasite transmission from wildlife (Animal Care and Use Committee 1998).

2.2 Environmental

All components of the netting systems do not contaminate water or result in the bioaccumulation of chemicals or other hazardous materials. Environmental hazards associated with nets include the unintentional stress, injury, or death of target and nontarget species including stress-related capture myopathy. Capture myopathy is expressed in wild animals as a metabolic syndrome that arises from the extreme stress suffered during and after capture, handling, restraint, and transport (e.g., Moberg and Mench 2000, Breed et al. 2000). Stress can kill animals especially if they become overexcited, are improperly handled, the body condition of the animal is poor (e.g., at end of winter), are older aged, and when environmental factors such as temperature, time of day, and where physical terrain is not optimal. Injury or death of target and nontarget species usually struggle to free themselves from the netting. Injuries would primarily be limited to extremities such as wings and legs. WS personnel are present nearby during netting activities which reduces the length of time animals are in restraint and under stress. Stress and capture myopathy are inherent conditions capturing animals, but with the use of several techniques such as quick release, use of tranquilizers, especially the use of long-acting tranquilizers post-capture, and minimizing environmental conditions (e.g., capturing animals midday in summer) can reduce capture mortality (Breed et al. 2019). The "*Introduction to Risk Assessments for Methods Used in Wildlife Damage Management*" discussed humanness and stress in more detail.

It should be noted that net guns are sometimes used during aerial operations, but WS did not from FY11-FY15. Aircraft often cause animals to run, which increases the risk of injury.

3 RISKS

Many specific risks associated with the use of nets are analyzed in other risk assessments as denoted in footnotes in Section 1, including firearms, explosives, aircraft, and cage traps. The greatest risks, which are not discussed in-depth in this risk assessment, are associated with the use of firearms and explosives.

3.1 Human Health and Safety

Risk to human health and safety is restricted to WS employees who are well trained for proper uses of various nets. Activities are generally conducted when human activity is minimal (*e.g.*, early mornings) or in areas where human activity is minimal (*e.g.*, in areas closed to the public). A WS employee will be near the project area during netting activities and would warn any member of the public approaching the net zone not to enter the area. WS may also place warning signs in the project area. The net systems are monitored by WS employees so unintentional triggering or firing of the nets by the public is avoided. In addition, the net is unlikely to trap a person because WS triggers the net only after they observe the target species in the capture area and safe firing conditions are confirmed.

WS did not cause any injuries to the public as a result of using nets. No data is available to suggest that the public has been injured by the use of nets by other agencies or others.

WS field and office employees filed an annual average of 79 Office of Workmen's Compensation (OWCP) claims for strained backs, lacerations, animal bites, burns, and other injuries that occurred on the job from FY13 to FY15. Of these, an annual average of 0.3, a compression injury, was related to using a hand net; the specialist fell while capturing an animal. Additionally, 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. None of these injuries were associated with any specific activity such as setting nets. Considering the number of employees (~1,900), these claims are relatively few for the number of hours spent afield; OWCP claims from FY13 to FY15 also includes office employees and injuries such as carpal tunnel syndrome. Thus, risks of setting or using nets are relatively minor to employees.

The risk of injury from captured animals is also minimal. The highest risk is typically from animals that are captured in nets where the animal has to be secured and given a tranquilizer while in the net. Few employees over many years have been injured by such captured animals. WS personnel approach animals in nets cautiously, to reduce the chance of panic. A more obvious risk is associated with the release of captured animals. WS employees usually carry a catch-pole (a pole with a cable loop that can hold an animal prior to release) so that they can move the animal safely. Catch-poles are very effective in handling wildlife, but an animal's behavior following release, though mostly predictable, is a primary concern. If an animal is too large, is in an area where the use of firearms would cause a safety concern, or is being trapped for a research project, the animal may be immobilized or euthanized with drugs; though usually not a problem, drugged animals can also be a risk[9] which will be discussed separately under the Immobilization and Euthanasia Risk Assessment.

From FY13 to FY15, WS operational field personnel averaged 3 bites or injuries annually from animals, but none of these were directly related to an animal captured in a net. One, likely captured in a hand net, was a bat that was caught by another agency; the bat bit a WS employee while it was being sampled for a variety of diseases (primarily rabies). Of these, two were dog bites that occurred at private residences while WS personnel were contacting people requesting WS assistance. For context, WS operations annually killed 43,576 and released 11,432 predators with methods conducive to being bitten from FY13 to FY5. Thus, an average of 2.3 bite incidents were related to capturing them 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 disease sampling (0.3). For bite incidents that occurred from released animals (2.0), WS had a ratio of one bite per 5,700 releases. For animals to be euthanized, the ratio was much less at 1 bite for 145,000 animals killed. Overall, the bite ratio was 1 bite for every 18,000 animals captured with methods where the animal would be captured alive. This is a minimal risk.

It should be noted that 2 bites in three years occurred as dog attacks; this again is a minimal number as the Centers for Disease Control (2015) estimates 4.5 million dog bites alone occur annually throughout the United States. Thus again, we believe these risks are minimal and well within the norms.

[9] WS personnel are trained and certified to use immobilization and euthanasia drugs and risks associated with their use are discussed in the Immobilization and Euthanasia Drug Risk Assessment.

In addition to field personnel, from FY13 to FY15, NWRC personnel received 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. It is not known whether these particular animals were from animals netted from research that was being carried out in the field.

WS personnel could be exposed to animals carrying diseases such as rabies. All recorded bites from FY13 to FY15 and an annual average of two lacerations/splashes were from potentially diseased animals (rabies). None of the animals involved in the incidents was identified as subsequently rabid with the exception of fluids from tissue from a known rabid skunk that splashed into the eye of a researcher. Thus, a potential for 5 animals per year caused concern potentially for exposure to rabies from FY13 to FY15. Personnel that have the potential for exposure to rabid animals, have the option of obtaining the rabies prophylactic series with follow up boosters to reduce the potential for contracting the disease if exposed through a bite, laceration, or contact with animal fluids. General exposure to animals is common for many WS employees, but considering the number of animals captured or handled, the risk of contracting a wildlife-borne disease is minimal.

Thus, risk of injury from the use of nets is expected to be minimal. Only one OWCP was noted to be as a result of using a net.

While WS employees may be exposed to bites, scratches, and kicks from restraining netted animals, the risk of injury is minimal. Risks to employees handling captured animals are reduced by using multiple personnel to handle animals, especially larger ones such as deer, and limiting the captures per net. Some animals may be restrained, sedated, or euthanized soon after capture while still under the net to minimize stress to the animal and for the safety of personnel handling the animals. WS personnel handling wildlife from nets could also be exposed to hazards associated with disease and parasite transmission from wildlife. 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 disease safety and personal protective equipment (PPE) training. Use of PPE while handling wildlife can greatly minimize exposure to many zoonotic diseases. Injuries to WS personnel from animals captured by nets are anticipated to be minimal during any given year. In general, the use of nets is a low risk to human health and safety.

Cannon/rocket nets require regulated explosive materials for firing the nets. WS Directive 2.625[10], "*Pyrotechnics, Rocket Net Charges, and Incidental Explosive Materials*," contains specific safety, security, storage, transportation, and records maintenance procedures to ensure the safe handling and use of these explosive materials by WS employees. Use, storage, and transportation of explosives by WS complies with applicable Federal, State, and local laws. Explosive materials will be stored and transported in accordance with the procedures provided in WS Directive 2.625

3.2 Environmental

Environmental risks are limited to the unintentional stress, injury, or death of target and nontarget animals that are trapped in nets. The risk of stress occurs with most wild animals captured and is minimized by quickly getting animals out of nets and having enough personnel to do so, not chasing animals for extended periods, proper handling techniques, and covering heads with a cloth where appropriate. Certain species are more prone to stress such as cottontail rabbits. The risk of target

[10] 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.

and nontarget animals injuring themselves while struggling in the net can be minimized by proper training of animal handling techniques for employees, maintaining the proper number of personnel on site to efficiently handle captured animals, and limiting the number of animals captured per net. When using drop nets, Conner et al. (1987) suggest limiting the number of white-tailed deer captures per drop to fewer than 10 animals to reduce injury and capture myopathy. Stress and potentially capture myopathy is an inevitable outcome of capture with any method (Northeast Wildlife Disease Cooperative 2017); WS personnel attempt to process animals as fast as possible to reduce stress.

Risks to nontarget animals are minimized by proper bait selection, proper site selection, and the selectivity of the net operator. The operator selects the optimum time to trigger the net to maximize the number of target animals captured and avoid the capture of nontarget animals. WS will not trigger the net if nontarget animals are in the capture area, unless they are common and could be freed quickly, and may even abandon the area if nontarget animals frequent the site. As shown in Table 1 for FY11-FY15, WS caught (killed or released) an average annual total of 5,225 target animals (99.9%) and 4 nontarget animals (0.1%) using nets, showing the risk of capturing nontarget species is minimal. Unintentional deaths during this time was 0.2 wild turkeys, suggesting a minimal number of deaths from stress and injury of nontarget species from being captured in nets is minimal. Since WS personnel are present on site during the use of nets any nontargets captured could be immediately released on-site or euthanized if injured.

4 UNCERTAINTIES AND CUMULATIVE IMPACTS

Uncertainty in this risk assessment is negligible as APHIS-WS has at least 50 years using various styles of nets for WDM activities and understands potential risks of using nets. The knowledge gained from this experience has helped reduce risks associated with nets especially with regards to human health and safety with cannon/rocket nets and to captured animals from the standpoint of injuries with the variety of nets.

Cumulative impacts could occur to target and nontarget animals. However, cumulative impacts are addressed in National Environmental Policy Act documents[11] and found not to be significant to any native population. 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, the use of nets in WDM will not have any known cumulative impacts.

5 SUMMARY

WS uses nets including cannon/rocket nets, net guns, drop nets, and mist nets as well as others to capture animals as a component of an integrated approach to WDM. WS uses netting systems for specific projects such as disease monitoring and research, and less commonly used for WDM activities. WS trains its employees on the proper use of netting systems and has several directives guiding their use of netting systems and handling of wildlife. WS use pattern for netting systems poses negligible risk to WS personnel, the public, and nontarget species.

[11] 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.

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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 Nets in Wildlife Damage Management” peer reviewed. WS worked with the Association of Fish and Wildlife Agencies to have experts review the documents from state agencies with the appropriate expertise.

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

Arizona Game and Fish Department
Nevada Department of Wildlife
Ohio Division of Wildlife
Texas Parks and Wildlife Department

Peer *7.3.2 Comments*

Peer reviewers provided a few editorial comments on the manuscript. These were appreciated and incorporated into the final document. Comments regarding concerns with the risk assessment and a response:
:

1. **Comment:** Stress to the animal seems to only be mentioned twice in a passing note. A short paragraph should be dedicated to this topic within the Environmental section.
   Response: This was discussed in Chapter 1 for the risk assessments and mentioned in passing in this chapter. We added more discussion in Sections 2.2 and 3.2. When an animal is going to be captured, minimization of stress is always a concern of WS and used in the decision to conduct WDM.

2. **Comment:** Comment from the Drop Nets section, last sentence from the first paragraph; “Captured animals are typically physically or chemically restrained, sampled (e.g., blood taken for disease monitoring), or marked (e.g., radio-collar attached or banded) and released, relocated, or euthanized on-site depending on the project intentions.” This can be said about most techniques.
   Response: We agree and moved that sentence to the initial paragraph in Section 1.1.

3. **Comment:** In Tables 1 and 2, “Killed” animals are listed. Were these killed as part of the project or a result of the use of the listed type of net? Does that matter? If so, should that be indicated in a note?
   Response: We do not know whether target animals that are slated to be euthanized were killed as a result of the net or the project but assume these are few. In general, looking at the number of target and nontarget animals freed and nontarget species killed indicates that animals killed by nets accidentally are minimal. Comments have been added to both tables. Of the methods, mist nets had the highest incidence of nontarget mortality (1.4 birds of 154 freed). In a disease surveillance project targeting European starlings at a dairy, the dairyman wanted the pigeons and house sparrows killed rather than freed and therefore they were euthanized in a CO_2 chamber. Thus, they were target species for the property, but unintentionally taken in the mist net for the disease surveillance project. While they are considered unintentional for the method, they were intentionally killed.

4. **Comment:** Under the Net Guns Section it doesn’t specify the possible uses including both ground and aerial situations but would seem appropriate. In addition, mention of injury risk from aerial operations should be noted.
   Response: The use of d net guns from the ground and during aerial operations was added in Section 1.1 under Net Guns and Section 3.2. WS did not use net guns aerially from FY11-FY15, and believe net guns will be used rarely, if ever, in WDM. Their use from aircraft typically are more applicable to many other wildlife management projects. Net guns use from the air, especially for long legged animals potentially running, can result in injuries and WS personnel are cognizant of such use.

5. **Comment:** Mist Nets mentions “The use…requires specific permits from both state…” This would likely be applicable to all net uses, not just mist nets.
   Response: We added that into the Section 1.1 prior to discussion of different methods.

6. **Comment:** The use of corral nets, especially when used for capturing geese during molt, doesn’t seem mentioned in any of the net types.
   Response: Corral traps and drive traps (WS considers corral traps using livestock panels or netting as drive traps) are considered in “The Use of Cage Traps in Wildlife Damage Management Risk Assessment.” This was noted in this risk assessment.

7. **Comment:** Under Fish or Dip Nets, it might be worthwhile to mention that this net type is typically utilized on individuals and not multiple animals at a time.
   Response: We included this statement in that section.

8. **Comment:** In Section 2.1 under Human Health and Safety it mentions hazards are “minor.” While in general this is true, it should be noted that some net types (ex. rocket/cannon nets) do pose a hazard to employees.
   Response: We agree and note that we did not explain that many risks are discussed in other risk assessments where it was more appropriate. We added reference to where this information is discussed. For example, risks from the use of rocket/cannon net explosives, a primary risk from their use, is being considered in the Use of Explosives in Wildlife Damage Management Risk Assessment.

Comments received not requiring a response.

1. **Comment:** I have reviewed “The Use of Nets in Wildlife Damage Management” and cannot fathom a reason to limit net use for wildlife capture and management.

2. **Comment:** Overall this document is well written and adequately covers the use of nets in wildlife damage management.

3. **Comment:** I have reviewed “The Use of Nets in Wildlife Damage Management” and believe the methods described are adequate.

Appendix 1. "Other Species" Included in Tables.

Table 1

Other waterfowl = feral goose*, mute swan*, feral Muscovy duck*, wood duck, American wigeon, northern pintail green-winged teal and common eider

Other water associated bird = California gull, great black-backed gull, western gull, common loon and killdeer

Other raptor = turkey vulture, black vulture, sharp-shinned hawk, Cooper's hawk, northern harrier, red-shouldered hawk, Swainson's hawk, red-tailed hawk, rough-legged hawk, ferruginous hawk, barn owl, snowy owl, great horned owl, barred owl, short-eared owl and American kestrel

Other terrestrial non-passerine bird = feral chicken* and rose-ringed parakeet*

Other passerine bird = brown-headed cowbird, eastern meadowlark, Carolina wren and gray catbird

Other mammal = feral cat*, feral dog*, red fox, black bear, raccoon, collared peccary, muskrat, woodchuck, eastern cottontail, Brazilian free-tailed bat and big brown bat

Unidentified bat possibilities MO = big brown, hoary, eastern red, evening, and silver-haired bats, eastern pipistrelle, and little brown, gray (T&E), Indiana (T&E) and northern (T&E) myotises

Unidentified bat possibilities NM/WY = Peter's ghost-faced, big free-tailed, Brazilian free-tailed, big brown, hoary, western red, Townsend's big-eared, spotted, pallid and silver-haired bats, western pipistrelles (canyon bat), and Arizona, little brown, California, fringed, long-eared, long-legged, dark-nosed small-footed, western small-footed, southwestern and Yuma myotises