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

Chapter VI

THE USE OF FIREARMS IN WILDLIFE DAMAGE MANAGEMENT

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EXECUTIVE SUMMARY

The USDA-APHIS-Wildlife Services (WS) Program uses firearms to kill, capture, and disperse animals for specific wildlife management projects, mostly where a need exists to resolve a wildlife damage situation. Wildlife can cause damage to property, agriculture, and natural resources or cause human health and safety concerns; for example, firearms are used to reduce wildlife hazards at airports or collect wildlife for disease surveillance. WS uses firearms frequently for wildlife damage management operations. Firearms are used in all types of settings, including urban and rural areas, by employees who are trained and certified in the safe use of firearms in accordance with WS Directive 2.615. Potential human health and environmental risks from the proposed use of all types of firearms, including rifles, handguns, shotguns, and other firearm-like and ancillary devices, by WS has been evaluated by APHIS and determined that the risks to human health and the environment are negligible. Shooting is a target specific method and only has a minimal risk to people, pets, and nontarget species. WS personnel are trained and certified to use firearms to ensure operations are conducted safely. To ensure safe firearm use and awareness, WS employees who use firearms to conduct official duties are required to attend an approved firearms safety training, currently the National Rifle Association curriculum for basic pistol, rifle, or shotgun certification, before they can use firearms or firearm-like devices in their jobs; additionally, refresher training is required, thereafter (WS Firearms Manual and WS Directive 2.615). Further, WS employees who carry firearms, as a condition of employment, are required to verify that they meet the criteria as set forth in the Lautenberg Amendment, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence. The risk of a stray bullet inadvertently striking nontarget wildlife, an individual, or pet is virtually eliminated by WS precautionary measures, such as positively identifying target animals before shooting, ensuring a safe backstop is present should the bullet or shot miss, using rifles or shotguns that fire a single shot or load, using the correct firearm and ammunition for the situation, and using only specially trained personnel. The use of lead in ammunition is covered in the Lead Risk Assessment specifically.

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THE USE OF FIREARMS IN WILDLIFE DAMAGE MANAGEMENT

1 INTRODUCTION

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) employees are often involved in wildlife damage management (WDM) activities, which include the use of firearms or firearm-like devices. WS is not involved in sport hunting or law enforcement activities. WS is unique because firearms or firearm-like devices are used on a frequent basis, often daily, in rural and urban settings (National Security Academy 2008). Sometimes, the activities may be high profile and require extra safety precautions and high competency. Because WS personnel use firearms more frequently than many other professionals with duties that include the use of firearms, WS personnel receive intensive firearms training initially and thereafter.

WS personnel that use firearms as part of their duties are trained in the proper and safe use of firearms that includes both classroom and range instruction, followed by a requirement for continuing education on an annual basis. It should be noted that most WS personnel are already proficient at firearm use when hired. To ensure WS employees receive uniform firearms safety training, National Rifle Association (NRA) certified instructors and the NRA's curriculum for the basic pistol, rifle, and shotgun certification is the only officially recognized program for initial firearms safety training of new WS employees (about eight hours training per firearm type). The training requirement for firearm-like devices, at a minimum, includes the NRA's curriculum for the basic pistol, rifle, or shotgun certification that best fits the device's profile. New WS employees cannot use government or personal firearms in an official capacity until they have completed the NRA Basic Firearm Course pursuant to the firearms the employee will use on the job. Initial training includes an NRA curriculum based classroom session followed by a range session with the firearm or fire-arm-like device to be used in the field, about an 8 hour of training course for each. Once an employee has completed the NRA Basic Firearm Courses related to all the firearms they could use on the job, annual firearms safety continuing education is required. Continuing education, about eight hours annually, can be fulfilled by repeating any of the NRA basic firearms courses followed by a live fire session with the firearm typically used for WS Operational field work. Training and continuing education is documented per guidelines in the WS Firearms manual and WS Directive 2.615[1] and tracked in each programs official training or personnel files.

WS Directive 2.615 defines a firearm as any handgun, rifle, or shotgun that any WS personnel[2] uses for official Government business or transports or stores in a vehicle[3]. The directive also applies to firearm-like devices, including pyrotechnic pistols, net guns, paintball guns, dart guns, air rifles, arrow guns, and crossbows. Given the diverse definition of a firearm by WS, their use has many applications. WS personnel use many specific types of firearm for many different purposes. For example, personnel could use a shotgun to lethally remove a target animal and, at the same time, using the noise associated with the discharge of the shotgun to disperse target animals. In addition, personnel could use shotguns to fire pyrotechnics (*e.g.*, shell crackers). In another example, personnel could use paintball guns to strike and physically repel target animals or could use semi-frozen paintballs to destroy bird nests (*e.g.*, swallow nests made of mud) in difficult to reach areas (*e.g.*, under bridges) without harming the structure. Although WS personnel primarily use firearms during ground-

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

[2] WS Directive 2.615 defines WS personnel as "*all persons employed by WS or under the supervision of WS, including State employees and official volunteers*."

[3] WS Directive 2.615 defines a vehicle as "*any Government-owned, leased, or privately-owned vehicles leased or used for official Government business. This includes off highway vehicles and watercraft*."

based activities, personnel also use shotguns, rifles, and net guns from aircraft to conduct predator and feral swine damage management operations.

Dependent on the WDM methods being applied, firearms and firearm-like devices, used singly or in combination with other methods, can be used to kill, euthanize, live-capture, destroy nests, or disperse target animals. In general, firearms and firearm-like devices would be methods that propel a projectile using gunpowder, pneumatics, or kinetic energy. In some cases, WS personnel could use the noise associated with blanks (no projectile) fired from handguns, rifles, shotguns to disperse target animals. This assessment will only evaluate the risks and hazards associated with the firearm itself and using a firearm to propel a projectile but not specifically the components of the projectile itself, which are evaluated in separate risk assessments[4]. Brief descriptions of the different types of firearms, firearm-like devices, and the ancillary equipment (*e.g.*, scopes) that WS could use with those devices follow below.

1.1 Firearms

WS Directive 2.615 defines a firearm as any handgun, rifle, or shotgun. Although firearms are available in various sizes, designs, and compositions, the functionality of a firearm is the same. Firearms use a cartridge (also known as a round, shell, or ammunition) that consists of a case, bullet/shot, propellant, and an ignition primer. The case packages the bullet/shot, the propellant, and ignition primer together in order to produce a projectile. Most cases for shotguns are made of plastic with a metallic base (generally made of brass) but some older cartridges were paper with a metallic base. In addition, some shotgun cartridges are all plastic, especially 12 gauge cracker shells. Cases for rifles and handguns are entirely metallic (generally made of brass). The case holds and protects the bullet/shot, the propellant, and the ignition primer. Just like firearms, bullets and shot are available in a variety of sizes, weights, and composition. Bullets (*i.e.*, a single projectile) are generally associated with rifles and handguns but are available for shotguns (often referred to as "*slugs*"). Cartridges that contain a rubber bullet are also available for shotguns. Shot consists of numerous metallic pellets that are generally associated with cartridges used in shotguns and some small caliber rifles (*e.g.*, .22 caliber). Black powder is the propellant placed inside cartridges to propel the bullet or shot. Today, most black powder propellants are "smokeless" (*i.e.*, when burned, the black powder produces very little smoke and residue). The amount of black powder contained in a cartridge varies based on many factors (*e.g.*, type of black powder, size of cartridge, and bullet weight). When struck by a firing pin inside a firearm, the ignition primer produces a spark that ignites the propellant, which burns rapidly. The pressure that builds inside the case from the rapidly burning propellant causes the bullet/shot to exit the case and travel down the barrel of the gun to the aiming point. Barrels come in different lengths (16"-30" for rifles and shotguns and 4"-20" for pistols). Basically, shorter barrels are typically used for home defense while longer barrels are used for accuracy and speed. However, too long of barrels can reduce speed by creating too much friction prior to the bullet/shot exiting the barrel.

- **Rifles** derive their name from the rifling (*i.e.*, grooves inside the barrel) that twists the length of the barrel. After firing, the bullet travels through the bore (the inside of the barrel) and engages the rifling, which causes the bullet to spin. The spin imparted by the rifling stabilizes the bullet in flight, which increases accuracy. Rifles are available in a wide variety of calibers (*i.e.*, diameter of the bore or the inside of the barrel) that range generally from .17 caliber (0.17 inches) to .50 caliber (0.50 inches). Therefore, a .22 caliber rifles shoots a bullet that is 0.22 inches in diameter. To handle the normal applications encountered by WS, the .223 Remington, .243 Winchester, and the .308 Winchester are the

[4]For example, separate risk assessments evaluate the lead component of bullets or shot, pyrotechnics, immobilizing drugs (contained in darts), shooting from aircraft, and nets.

recommended calibers to have available for use for many species (Griffin et al. 2011). However, WS personnel could use other calibers depending on field situations and preferences. For example, WS personnel may use a larger caliber rifle to take black bears[5] or a smaller caliber rifle for squirrels. WS would base the selection of calibers on several factors, including the target animal, likely distance to target, humaneness, accuracy, safety, and noise. WS would generally use rifles to target animals accurately at greater distances than shotguns and handguns.

- **Shotguns** derive their name from the shot contained within cartridges, which consists of numerous round metallic pellets. Shotgun bores generally do not have rifling like rifles, but rifled shotgun barrels are available when using cartridges containing a single bullet (*e.g.*, slug, or rifled sabot[6] with a slug that is more accurate). For shotguns, gauge is the unit of measure for the diameter of the bore. Today, shotguns are available in 10, 12, 16, 20, and 28 gauges with the 12 gauge most commonly used in WDM activities. The .410 shotgun is a small caliber firearm that can fire shot and single bullets, but bases its unit of measure using the caliber rather than the gauge. Unlike rifles, the diameter of a shotgun barrel, with the exception of the .410, increases as the gauge number decreases. The gauge is determined by the number of lead balls equal to the size of the bore diameter that would equal a pound (e.g., a 12 gauge requires 12 lead balls that are equal to its diameter to make a pound whereas a 20 gauge is smaller because it requires 20 lead balls the diameter of its bore to make a pound). Thus, the barrel diameter of a 12 gauge shotgun is larger than the barrel diameter of a 20 gauge shotgun. In general, more similarly sized pellets fit inside the cartridge the smaller the shotgun gauge. For example, a 12 gauge cartridge containing the same shot size as a 20 gauge cartridge would contain more pellets because the diameter of the barrel is larger allowing for the use of a larger cartridge, which can accommodate more shot. The number of pellets in a cartridge also depends on pellet size. Pellets vary in diameter and the smaller the size, the more shot will fit into a cartridge. For example, a pellet in number 4 shot is 0.13 inches in diameter, which compares to 0.09 inches for pellets of number 8 shot. Similar to rifles, WS would base the selection of gauge and shot size on several factors, including the target animal, likely distance to target, humaneness, accuracy, safety, and noise. WS would generally use shotguns to target animals at distances less than 100 yards, and in most cases, less than 50 yards. WS personnel can also use shotguns as nonlethal methods. For example, shotguns are used to fire pyrotechnics (*e.g.*, shell crackers) to disperse target animals and discharge rubber projectiles to physically hit and deter animals.

- **Handguns**, as the name implies, are firearms that a person can hold with one hand or grip with both hands for increased stability. The barrel of a handgun is generally six to twelve inches in length but shorter and longer barrel lengths for handguns are available depending on the caliber and manufacturer of the handgun. The design and size allows a person to carry a handgun in a holster, which a person can easily attach to their belt and carry with them. Handguns operate similar to rifles but the length of cartridges tends to be shorter and more compact than rifles to accommodate the smaller size of handguns. Handguns are available in a wide variety of calibers similar to rifles. WS personnel use handguns primarily to euthanize target animals live-captured with other methods, such as foothold traps. WS personnel may also carry handguns for personal protection from predatory animals, such as bears. Given the use pattern of handguns by WS personnel, their use would generally be associated with taking target animals that are at close range.

1.2 Firearm-Like Devices

[5] See the Introduction to Risk Assessments – Chapter I for scientific names. These are only given if not used in that Section.
[6] Sabots are cups that carry slugs or other projectile out of the firearm, but falls away soon after the firearm is shot.

The term "*firearm-like devices*" encompasses a wider range of methods with much more diverse use patterns than traditional firearms. Firearm-like devices operate by propelling a projectile similar to a firearm; however, the mechanisms for propelling a projectile are generally different from traditional firearms that use a cartridge, which consists of a case, bullet/shot (projectile), propellant, and an ignition primer. Many firearm-like devices use pneumatics or kinetic energy to propel the projectile to the target, but some use firearm blank cartridges[7], which consist of an ignition primer and propellant.

- **Dart guns** often look and function similar to traditional firearms; however, dart guns generally use compressed air or cartridge blanks to propel a dart containing an immobilizing drug. Darts generally consist of a needle and a syringe or syringe-like device inside the dart that injects the immobilizing drug into the target animal upon impact. WS personnel could use dart guns on the ground or during aerial operations. Dart guns generally have an effective range of up to 40 yards and are generally most effective for immobilizing animals such as raccoons, white-tailed deer, and bears. Darts fired with a cartridge can generally be used out to a maximum of 100 yards.

- **Blowguns** also propel a dart containing an immobilizing drug but unlike dart guns, blowguns generally consist of just a long tube. When using a blowgun, the user propels the dart by placing their mouth over one end of the tube and blowing a burst of air into the tube instead of using compressed air or blanks to propel the dart to the target. These generally involve a lot of practice to generate enough force to propel a dart with accuracy. WS generally use blowguns to immobilize smaller animals at close range, such as an animal captured alive in a cage trap, a sick animal that has become incapacitated, or an animal confined in a window well. They are fairly effective to 10 yards.

- **Paintball guns** are similar in design and look to traditional firearms but a paintball gun uses compressed air to propel a paintball, the projectile. The discharge of the paintball gun combined with the sound of paintballs hitting the ground or trees may be effective in dispersing target animals, especially when combined with other harassment techniques. In addition, WS personnel have used frozen or partially frozen paintballs to remove bird nests in areas difficult to access. Paintballs do not actually contain paint, but consist of a water-based coloring in a non-toxic glycol that is mixed with a gelatin, which rapidly dissipates in the environment. Paintballs are generally not very accurate especially the further the paintball travels from the point of firing; therefore, WS personnel generally use paintball guns in areas where it is possible to approach target animals closely. Animals can be marked with the paint so they are recognizable for a short period.

- **Net guns** are also similar in appearance and function to traditional firearms; however, net guns use compressed air or firearm blanks to propel a net that envelopes and live-captures the target animal. WS personnel could use net guns during ground activities, as well as during aerial activities. Similar to the other firearm-like devices, net guns have a limited range and require the target animal to be within a short distance, generally within ten yards. Since net guns can make a loud noise, they are sometimes used to disperse animals without the net loaded (if carrying a net gun to capture particular animals, the blanks can be fired to disperse other wildlife). The use of nets is covered in the Net Risk Assessment, but the firearm portion is discussed here.

[7]Blanks are similar to a firearm cartridge but they do not contain a projectile. The case contains a propellant and an ignition primer. Upon ignition, the pressure associated with the rapid expansion of gases produced by burning the propellant pushes open the case and the escaping gas forces the projectile down the barrel.

- **Pyrotechnic pistols**, also called launchers, appear and function similarly to handguns, but fire pyrotechnics. In general, the pyrotechnic device is inserted part way into a receiver at the end of the pistol barrel and fires from the pistol using a blank ignition primer. When the firing hammer strikes the ignition primer, the spark produced from the primer ignites the pyrotechnic, which propels itself out of the barrel of the pistol travelling from 50 to 300 feet. Some pyrotechnic pistols fire cartridges that consist of the ignition primer and the pyrotechnic contained within a case, which generally have a range of approximately 1,000 feet. Pyrotechnics produce several different adverse noises, depending on the cartridge type (*e.g.*, report, screamer, whistler), which may elicit a flight response in target animals that disperses them from an area. Pyrotechnic launchers come in several models (single shot, revolvers, semi-automatics with clips) with some firing two or four cartridges at a time.

- **Air rifles and pistols** are similar in appearance to rifles and pistols but use compressed air, either from a scuba tank, CO_2 cartridge contained in the rifle, or from pumping the rifle to compress the air (usually 1 to 7 pumps), to propel single projectiles, pellets, or BBs. Air rifles and pistols generally are available in .177 caliber, .22 caliber, and .25 caliber guns. Air rifles and pistols are quieter than traditional firearms, but the effective shooting range is much closer for air rifles than traditional rifles. WS personnel primarily use air rifles to remove small animals lethally, such as pigeons, starlings, or sparrows at close range, generally a maximum of 100 yards. Since 2000, air rifle technology has improved significantly. Newer model air rifles are more accurate and more powerful. Newer models have a rechargeable cylinder in the fore end or stock of the rifle, which is recharged from a scuba tank. Generally, they can fire 30 to 40 rounds before they require recharging.

- **Air-activated bolt traps** are newly developed air-powered traps have been developed for use on invasive species in New Zealand. The trap uses compressed air to propel a bolt to kill target animals when they trigger the device (Goodnature© A12 Opossum Trap and A24 Rat + Stoat Trap), which in some respects make them similar to pneumatic firearms. These are not truly a firearm because they do not fire a free projectile and are discussed in the *Use of Quick-kill Traps in Wildlife Damage Management Risk Assessment*.

- **Archery** is among the oldest projectile firearm systems. The projectile is an arrow shot from a bow (the oldest), crossbow, or a gun.

    - **Bow and arrow,** often known as archery, is among the oldest projectile firearm systems. A bow is a flexible arc with a string attached. The arrow is nocked to the string and when drawn and released, can travel at relatively fast speeds (350 feet per second), dependent on the bow style and make (relying on kinetic energy for speed). Bows come as long bows, recurves, and compounds (use pulley systems to get faster speeds). The effective range of a bow is typically about 50 yards, with some accuracy beyond that. Though available, these are rarely, if ever, used by WS personnel.

    - **Crossbows** consist of a horizontal bow-like assembly mounted on a stock that fires an arrow (also known as a bolt or quarrel) using kinetic energy. Pulling the bowstring back, which attaches to the bow arms, causes the bow arms to flex backwards. The shooter pulls the bowstring backward and secures the string on the trigger assembly, which holds the string and bow arms under tension until the shooter releases the trigger. The arrow attaches to the bowstring and is placed atop a guide rail. Releasing the trigger causes the energy stored in the bow arms to release, which propels the bowstring and arrow forward at a maximum speed of 375 feet per second. Firing a crossbow produces very little noise. WS personnel would use crossbows to remove target animals lethally

when noise or other safety concerns are applicable. The general effective range of a crossbow is normally a maximum of 50 yards.

- **Arrow guns** are similar to the look and design of firearms but shoot an arrow. Arrow guns use firearm blanks or compressed air to propel the arrow down the barrel to the target. The arrows are often in sabots, a device that holds the arrow until it is out of the rifle, so that it can be fired accurately. The sabot separates from the arrow once shot.

1.3 Ancillary Devices and Methods

Ancillary devices and methods are those items that WS personnel could use in conjunction with firearms or firearm-like devices to aid in the use of firearms or allow WS personnel to apply firearms more selectively and efficiently. Ancillary devices and methods could include scopes, night vision equipment, forward looking infrared (FLIR) devices, illumination devices such as spotlights, range finders, electronic and mouth-blown calls, laser sights, suppressors, and decoy dogs. WS personnel can attach many of these items directly to a firearm to increase the capabilities of firearms, improve selectivity, effectiveness, improve humaneness, and enhance safety. For example, to reduce noise of some firearms, primarily rifles, suppressors can be used (internal or external). Additionally, to lure several species into range for shooting, calls (imitating howls, dying rabbit, or other lure) and decoy dogs (for coyotes, wolves, and red fox during breeding season because they will defend territory) are used.

1.4 Use Pattern

From FY11[8] to FY15, WS used several types of firearms and firearm-like devices with a variety of take (Table 1)[9]. Firearms used by WS included shotguns from the ground and air, rifles, and pistols[10], with or without ancillary devices, and some with rubber bullets. WS also used firearm-like devices such as air rifles, drug delivery devices, pyrotechnics, paint balls, net guns, and archery related equipment or air-triggered traps. However, if the primary method was a firearm, it is recorded as "firearm". Table 1 gives a breakdown of the animals taken with the different methods. As discussed, air triggered traps have not been used and are not given in Table 1.

Firearms, including those used with ancillary devices such as spotlights and decoy dogs, aerial shooting, but not including the use of firearms, primarily pistols, to euthanize animals in other devices such as foothold traps, and firearm like devices were used by WS personnel as an important WDM method (Table 1). Most animals involved in WDM with firearms or firearm-like devices are dispersed by WS (97.8%) with the remaining majority killed (2.2%); the remainder of target and nontarget animals is less than 0.001% of the take. A few animals are captured with tranquilizer guns or net guns and relocated/released. A few nests are taken annually where they are causing damage to resources, generally in hard to reach areas. Very few nontargets are killed or accidentally dispersed and represents less than 0.001% of all take. Thus, firearm use is highly selective.

Firearms specifically (rifles, pistols, and shotguns), with or without the use of ancillary devices, from the air and on the ground, and including blanks and rubber bullets accounted for the annual dispersal of 4,351,140

[8] 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 and is the federal Fiscal Year for 2011, 2012, and so on.
[9] Rounding errors occur, especially when separating out to species.
[10] The MIS does not separate the types of firearms used (i.e., shotgun, large or small caliber rifle) and whether or not an animal is subsequently euthanized with a firearm such as a small caliber pistol if taken with another method such as a cage or foothold trap.

animals, killed 423,231 animals, and destroyed an estimated 50 bird eggs for FY11 to FY15 (Table 1). Nontarget take with firearms was negligible at 4 animals shot. Pneumatics or air rifles were annually used for FY11 to FY15 to disperse 124,729 animals and lethally take 29,287 animals annually along with 21 eggs[11] with no nontargets taken (Table 1). Drug delivery devices, dart guns and blow pipes, were used annually to capture and euthanize 2 animals and capture followed by release of 34 animals annually (Table 1). For FY11 to FY15, WS annually averaged dispersing 15,449,882 animals with sound-scare devices including pyrotechnics from 15mm pistols and 12 gauge shotgun crackershells with 28 nontargets being dispersed (Table 1). Rubber bullets in firearms were used to disperse 507 animals annually for FY11 to FY15 (Table 1). Paint balls during this time were used to annually disperse 121,838 animals, kill 2, and destroy 9 eggs with about 1 accidentally killed (Table 1). Net guns were used to capture and euthanize 127 and relocate or sample and release 16 animals; these were also used to disperse 1,124 animal from the noise they make (Table1). In sum, WS dispersed about 20 million target animals, killed 450,000 target animals, took 80 target bird eggs, and released 50 target animals with 5 nontarget animals killed and 28 dispersed. This is a minimal number of nontarget species considering the numbers of target animals taken. For this risk assessment, only ground shooting with firearms, pneumatic rifles (air guns), and archery are discussed in the remaining text as other risk assessments that highlight other methods and take associated with them will discuss take in them (e.g., Use of Aircraft, Use of Nets, Use of Pyrotechnics, Use of Drugs and Drug Delivery Devices will discuss take associated with these methods). Other risk assessments will also address take with other methods that are not firearm related. For example, the Pyrotechnic Risk Assessment includes other pyrotechnic devices such as self-propelled rockets that are not fired from a firearm.

Table 1. The annual average number of target and nontarget animals taken with the variety of firearms used by WS during WDM from FY11 thru FY15.

ANNUAL AVERAGE SPECIES TAKEN WITH FIREARMS						
	TARGET				NONTARGET	
Method	Killed	Eggs	Released	Dispersed	Killed	Dispersed
Firearms (shotgun, rifle, pistol)	367,666	50	0	4,340,680	4	0
Firearms w/ Ancillary Devices (incl. decoy dog)	12,143	0	0	7,856	0	0
Firearms (shotguns aerial shooting)[1]	41,747	0	0	540	0	0
Firearms w/ Decoy Dogs[2]	1,675	0	0	0	0	0
Pneumatics (air rifles)	29,287	21	0	124,729	0	0
Dart Guns (drug delivery)[3]	1	0	34	0	0	0
Blowpipe (drug delivery)[3]	0.6	0	0.2	0	0	0
Pyrotechnic (pistol launcher)[4]	0	0	0	15,023,373	0	28
Pyrotechnic (12 gauge cracker shell)[4]	0	0	0	426,509	0	0
Firearm Blanks[4]	0	0	0	1,557	0	0
Firearms (rubber bullets)	0	0	0	507	0	0
Paint Balls	2	9	0	121,838	0.6	0
Net Guns[5]	127	0	16	1,124	0	0
Archery	0.4	0	0	0	0	0
TOTAL	**452,649**	**80**	**50**	**20,048,713**	**5**	**28**

1=Addressed in Aircraft Use Risk Assessment; 2=Addressed in Use of Dogs Risk Assessment; 3=Addressed in Immobilization and Euthanasia Risk Assessment; 4=Addressed in Pyrotechnics Risk Assessment; 5=Addressed in Capture Net Risk Assessment.

The most common species taken with firearms or firearm-like devices by WS in WDM activities for FY11 to FY15 that are discussed in the remainder of this risk assessment were rock pigeons (annual average of 53,206), European starlings (annual average of 50,624), and chestnut mannikins (annual average of 26,781), all non-native invasive species (Tables 2a, b, c, and d). In fact, invasive species accounted for about 55% of all take by WS associated with firearms. The most common mammalian species taken were black-tailed prairie dogs (annual average of 15,410) and coyotes (annual average of 10,618) (Table 2a). No single species was commonly taken as a nontarget, but most were birds associated with flocks of target species, or mammals and birds similar in appearance to other birds and mammals. Overall, between FY11 and FY15, WS use of

[11] Eggs were estimated for each species if nests taken were recorded, but during nesting season (abandoned nests are also recorded).

firearms from the ground during WDM, including the use of air rifles, lethally removed mostly birds (84.5%) (Tables 2b and 2c), some mammals (15.1%) (Table 2a), few reptiles amphibians and fish (0.4%) (Table 2d).

Mammals are commonly killed with firearms (Table 2a), but not as frequently as birds (Tables 2b and c). Mammals are infrequently dispersed by firearms on the other hand, but birds are. This is primarily because mammal behavior following a dispersal shot is very unpredictable or minimal because they are in their home range. For example, deer can run in a direction not anticipated such as across a runway that they are being hazed to avoid or many mammals, such as prairie dogs, are already within their home range and will only disperse to their burrow. Of the 83 species and 1 group of mammals targeted with firearms for FY11 to FY15 (Table 2a), 95.9% were killed (annual average of 61,640) and 4.1% were dispersed. Just under an annual average of one (0.6) nontarget species was killed for FY11 to FY15 with firearms, a very minimal level of take. The most common nontarget species at 0.4 killed per year was the muskrat, sometimes mistaken at night for a small beaver. Table 2a lists all mammals taken with firearms and are given in the same order as the WS Risk Assessment Introduction (carnivores, hoofed mammals, aquatic rodents, terrestrial rodents and rabbits, other mammal categories).

Table 2a. The annual average number of target and nontarget mammals shot or hazed by APHIS-WS in WDM activities with firearms from the ground, including pneumatic rifles, between FY11 and FY15 throughout the United States and its territories. Nontargets taken are listed next to the species name because so few were taken (<0.01%).

ANNUAL AVERAGE MAMMALS TAKEN WITH FIREARMS INCLUDING PNEUMATIC FIREARMS, FY11 TO FY15					
SPECIES	TARGET		SPECIES	TARGET	
	Killed	Dispersed		Killed	Dispersed
Virginia Opossum^	147	4	California Ground Squirrel	3,348	17
Feral/Free-roaming Cat*	237	7	Rock Squirrel	58	0
Bobcat	84	0.6	Richardson's Ground Squirrel	959	81
Small Asian Mongoose*	21	0.2	Wyoming Ground Squirrel	83	0
Coyote^	10,624	158	Uinta Ground Squirrel	11	0
Northwestern Gray Wolf	27	0.4	Belding's Ground Squirrel	207	0
- Mexican Gray Wolf T&E **(0.2NK)**	0.4	0	Columbia Ground Squirrel	62	0
- Great Plains Wolf T&E	5	0	Thirteen-lined Ground Squirrel	149	0
- Feral/Free-Roaming Dog*	94	6	Mexican Ground Squirrel	50	0
Red Fox^	411	32	Round-tailed Ground Squirrel	138	0
Common Gray Fox	323	4	Northern Pocket Gopher	19	0
Arctic Fox	105	0.8	Eastern Fox Squirrel^	124	0.6
Black Bear	38	2	Eastern Gray Squirrel^	106	0
Grizzly Bear T&E	0.2	0	Douglas' Squirrel	12	0
River Otter	14	9	Brown (*Norway*) Rat*	75	601
Badger	49	2	Black Rat*	18	0
Raccoon	776	20	North American Porcupine	51	0
Striped Skunk	831	20	Desmarest's Hutia*	74	0
Other Predator (8T sp.)	18	0.6	Eastern Cottontail	1,048	149
Feral Swine*	4,573	168	Mountain Cottontail	72	0
Mule Deer (incl. Black-tailed Deer)	44	133	Desert Cottontail	5,884	32
White-tailed Deer (incl. captive)	5,386	377	Feral (*European*) Rabbit	34	0.4
Axis Deer*	376	516	White-tailed Jackrabbit	34	2
Other Hoofed (12T sp.)	26	78	Black-tailed Jackrabbit	1,457	62
Beaver^	3,877	6	Other Rodent & Rabbits (11T sp.)	20	0.2
Nutria*	867	21	Nine-banded Armadillo	188	11
Muskrat **(0.4 NK)**	389	18	Patas Monkey*	221	0
Black-tailed Prairie Dog	15,410	119	Rhesus Monkey*	281	0
Gunnison's Prairie Dog	552	0	Other Mammals (3T sp. and 1 group)	3	0
Woodchuck	691	10	**Ave. Annual Number of Mammals**	**61,650**	**2,669**
Yellow-bellied Marmot	868	0.6	**% of All WS Take with Firearm**	**15.1%**	**0.1%**

* Introduced Species ^ Introduced outside native range T/E Federal threatened or endangered species
T – Target NK = Nontarget Killed ND = Nontarget dispersed

[1] Individual accounts of species are only given for those species that had an annual average of more than 10 killed or 1,000 dispersed; additionally sensitive and T&E species are listed. Other animals are given in Appendix 1.

Birds are commonly taken with firearms (Table 2b and 2c), but are more frequently dispersed, especially at airports. Of the 294 species of birds targeted between FY11 and FY15 with firearms, 7.8% (annual average of 345,878) were killed and 92.2% (annual average of 4,470,589) were dispersed with few eggs destroyed (annual average of 72). An annual average of four nontarget species were taken lethally between FY11 and FY15 with firearms, a very minimal level of take.

Table 2b. The annual average number of target and nontarget landbirds killed or hazed, or their nests destroyed, with firearms and pneumatic rifles from the ground by WS in WDM activities for FY11 to FY15 throughout the United States and its territories.[1]

ANNUAL AVERAGE LANDBIRDS TAKEN WITH FIREARMS INCLUDING AIR RIFLES							
SPECIES	TARGET			SPECIES	TARGET		
	Killed	Nests	Dispersed		Killed	Nests	Dispersed
European Starling*	50,624	0	1,003,845	- Feral Domestic Chicken*	1,676	0	1,488
Red-winged Blackbird	22,504	0	1,043,061	Ring-necked Pheasant*	442	0	95
Yellow-headed Blackbird	716	0	7,922	Indian Peafowl*	12	0	0
Brewer's Blackbird	692	0	15,799	Other Gallinaceous (9T sp.)	15	0	134
Rusty Blackbird	0	0	10	Common Nighthawk	68	0	32
Common Grackle	2,373	0	56,947	Purple Martin	56	0	3,200
Boat-tailed Grackle	464	0	211	Tree Swallow	79	0	3,988
Great-tailed Grackle	1,458	0	1,774	Bank Swallow	102	0	1,439
Greater Antillean Grackle	65	0	0	Cliff Swallow	2,347	2	42,734
Brown-headed Cowbird	12,575	0	66,124	Barn Swallow	682	42	5,308
- Mixed Blackbirds	0	0	166,089	Other Aerialists (4T sp.)	4	0	24
Rock Pigeon*	53,206	12	143,676	Gila Woodpecker	68	0	0.4
Eurasian Collared-Dove*	2,989	0	3,863	Northern Flicker	62	0	28
Spotted Dove*	5,053	0	5,977	Rose-ringed Parakeet*	697	0	3,598
White-winged Dove	100	0	706	Other NonP Forest Birds (7T spp.)	8	0	13
Mourning Dove^**(0.8NK)**	16,914	0	96,891	Western Kingbird	330	0	3,274
Barred Ground-Dove (Zebra)*	15,770	0	15,729	Scissor-tailed Flycatcher	151	0	313
Other Dove (3T sp.)	1	0	0	Eastern Kingbird	38	0	83
Steller's Jay	47	0	0	Loggerhead Shrike	15	0	8
Black-billed Magpie	47	0	216	Horned Lark	2,109	0	53,447
American Crow	7,505	3	137,816	American Pipit	19	0	355
Northwestern Crow	36	0	1,487	Snow Bunting	13	0	247
Fish Crow	70	0	1,881	Lark Bunting	355	0	7,401
Common Raven	790	0	7,824	Savannah Sparrow	64	0	864
Other Corvids (3T sp.)	1	0	18	Eastern Meadowlark	1,188	0	5,675
Turkey Vulture	1,421	0	8,871	Western Meadowlark^	1,010	0	23,569
Black Vulture	2,029	0	13,596	Other Grassl. Passerines (15T sp.)	25	0	200
Osprey	64	0	90	Northern Mockingbird	55	0	29
Cooper's Hawk	33	0	17	American Robin	248	5	2,624
Northern Harrier	141	0	1,260	House Finch^	2,855	0	12,274
Bald Eagle	0	0	217	Northern Cardinal^	77	0	7
Mississippi Kite	91	0	282	Other Forest Passerine (15T sp.)	24	0	580
Red-shouldered Hawk	24	0	32	Eurasian Skylark*	597	0	1,108
Swainson's Hawk	78	0	1,499	Red-vented Bulbul*	1,027	0	1,335
Red-tailed Hawk	1,008	0	3,957	Common Myna*	6,542	0	15,695
Ferruginous Hawk	23	0	609	Common Waxbill*	749	0	2,359
Rough-legged Hawk	42	0	453	Red Avadavat*	1,179	0	2,044
Golden Eagle	0	0	29	Chestnut Mannikin*	26,781	0	153,043
Barn Owl^	181	0	51	Nutmeg Mannikin*	19,969	0	72,699
Great Horned Owl	13	0	30	Warbling Silverbill*	353	0	430
Short-eared Owl	11	0	13	Java Sparrow*	1,346	0	3,521
American Kestrel	402	0	1,314	Red-crested Cardinal*	2,815	0	1,812
Other Raptors (13T sp.)	29	0	65	House Sparrow *	2,335	3	3,797
Wild Turkey	252	0	588	Eurasian Tree Sparrow*	48	0	0
Black Francolin*	1,716	0	729	Other Invasive Passerine (2T sp.)*	7	0	3
Gray Francolin*	1,779	0	786	Unidentified Birds	0	0	93
Erckel's Francolin*	222	0	34	**Ave. Annual No. of Land Birds**	**282,497**	**67**	**3,243,452**
Red Junglefowl*	296	0	94	**% of All WS Take with Firearm**	**69.1%**	**95.8%**	**72.5%**

* Introduced Species ^ Introduced on Hawaii (House Finch also introduced in eastern U.S.): Lethal invasive species take = 167 barn owls, 117 W. meadowlark, 2813 house finches, 77 n. cardinal. T – Target NK = Nontarget Killed ND = Nontarget dispersed

[1] Individual accounts of species are only given for those species that had an annual average of more than 10 killed or 1,000 dispersed; additionally T&E or other sensitive species are listed. Other animals are given in Appendix 1.

The most common nontarget species taken annually were Brandt's cormorant (annual average of 1.4), mistaken for double-crested cormorants in-flight, and mourning doves (annual average of 0.8) taken in mixed flocks of birds. Tables 2b lists all landbirds taken or hazed while Table 2c gives those birds associated with water taken, but otherwise given in the same order as the WS Risk Assessment Introduction. Of the two groups, landbirds are more frequently killed (80.6% of all birds killed) and dispersed (73% of all birds dispersed) with the blackbird group being the species group most frequently taken by WS.

Table 2c. The annual average number of target and nontarget birds associated with water killed or hazed, or their nests destroyed, with firearms and pneumatic rifles from the ground by WS in WDM activities between FY11 and FY15 throughout the United States and its territories.[1]

ANNUAL AVERAGE WATER ASSOCIATED BIRDS TAKEN WITH FIREARMS INCLUDING AIR RIFLES							
SPECIES	TARGET			SPECIES	TARGET		
	Killed	Nests	Disperse		Killed	Nests	Dispersed
Bonaparte's Gull	63	0	1,681	Ruddy Duck	38	0	91
Laughing Gull	5,198	0	43,066	Other Waterfowl (15T sp.)	27	0	2,228
Franklin's Gull	311	0	5,698	Pied-billed Grebe	22	0	23
Mew Gull	138	0.6	1,331	American White Pelican	50	0	1,216
Ring-billed Gull	5,957	0	119,954	Double-crested Cormorant	19,642	0	98,113
Western Gull	251	0	892	Anhinga	17	0	15
California Gull	1,693	0	47,182	Other Waterbirds (13T sp.) **(2 NK)**	11	0	569
Herring Gull	4,615	0	239,418	American White Ibis	140	0	3,433
Glaucous-winged Gull	3,534	0	249,064	Glossy Ibis	10	0	206
Glaucous Gull	12	0	42	White-faced Ibis	10	0	1,506
Great Black-backed Gull	399	0	9,812	Black-crowned Night-Heron	31	0	158
Gull-billed Tern	16	0	31	Yellow-crowned Night-Heron	33	0	53
Black Tern	41	0	81	Green Heron	24	0	12
Other Larids (15T sp.) **(0.4 NK)**	29	0	512	Western Cattle Egret^	5,417	0.2	22,374
Black-bellied Whistling-Duck	22	0	65	Great Blue Heron	587	0	4,615
Greater White-fronted Goose	41	0	1,517	Great Egret **(0.2 NK)**	327	0	4,645
Graylag Goose (Domestic)*	23	0	1	Little Blue Heron	16	0	139
Snow Goose	28	0	4,892	Snowy Egret	150	0	680
Brant	256	0	1,531	American Coot	787	0	9,191
Canada Goose^	5,609	2	278,045	Sandhill Crane	20	0	2,928
Cackling Goose	10	0	388	Other Wading Birds (5T sp.)	15	0	12
Mute Swan*	1,767	0	73	Black-necked Stilt	36	0	50
Wood Duck	33	0	777	- Hawaiian Stilt[T&E]	0	0	0.4
Gadwall **(0.2NK)**	44	0	1,827	American Golden-Plover	22	0	212
American Wigeon	34	0	1,174	Gray (*Black-bellied*) Plover	13	0	130
American Black Duck	39	0	817	Semipalmated Plover	25	0	105
Mallard	2,290	0	30,856	Killdeer	2,089	0	6,245
- Feral Duck*	37	0	102	Wilson's Snipe	30	0	77
Mottled Duck	23	0	31	Whimbrel	16	0	1,059
Blue-winged Teal	117	0	2,164	Long-billed Curlew	22	0	1,678
Cinnamon Teal	12	0	85	Upland Sandpiper	381	0	1,028
Northern Shoveler	74	0	4,217	Greater Yellowlegs	22	0	275
Northern Pintail	35	0	3,058	Lesser Yellowlegs	21	0	186
Green-winged Teal	119	0	1,565	Willet	10	0	44
Redhead	13	0	454	Sanderling	12	0	610
Ring-necked Duck	23	0	612	Semipalmated Sandpiper	16	0	431
Greater Scaup	61	0	2,502	Least Sandpiper	77	0	702
Lesser Scaup	29	0	2,711	Dunlin	53	0	637
Bufflehead	35	0	616	Other Shorebirds (21T sp.)	35	0	1,081
Barrow's Goldeneye	14	0	802	**Ave. Annual Number of Waterbirds**	**63,381**	**3**	**1,227,137**
Hooded Merganser	35	0	563	**% of All WS Take with Firearm**	**15.5%**	**4.2%**	**27.4%**
Common Merganser	47	0	171	**Total WS Firearm All Bird Take-**	**345,878**	**72**	**4,470,589**

* Introduced Species T – Target NK = Nontarget Killed ND = Nontarget dispersed 3149 of 5,417 cattle egrets were HI invasive

[1] Individual accounts of species are only given for those species that had an annual average of more than 10 killed or 1,000 dispersed; additionally T&E and other sensitive species are listed. Other animals are given in Appendix 1.

WDM for landbirds is mostly conducted at airports and to protect crops and livestock. Blackbirds, mainly starlings and red-winged blackbirds, were the most common species controlled, followed by doves and pigeons, and invasive species in Hawaii, which includes several of the gallinaceous birds. Table 2b gives all the landbirds managed between FY11 and FY15.

WDM for water-associated birds is mostly conducted at airports where they are a strike hazard (strikes cause millions of dollars of damage annually and have the potential to be catastrophic and result in the loss of human life), and for a few species, to protect crops, aquaculture, and threatened and endangered species. Larids, mainly gulls, were the most common species controlled, followed by waterfowl. Larids and waterfowl are two of the most common wildlife groups responsible for bird aircraft strike hazards (Dolbeer et al. 2016). Table 2c lists most species and all groups managed between FY11 and FY15.

WS conducts very little WDM for other vertebrates with the exception of invasive reptiles, primarily iguanas and brown tree snakes (Table 2d). Most take of these species is for the protection of natural resources as well other resources. Several of these species were accidentally introduced, but the bullfrog was intentionally introduced to several states in the West where it has contributed to serious declines in native species.

Table 2d. The annual average number of target and nontarget birds associated with water killed or hazed, or their nests destroyed, with firearms and pneumatic rifles from the ground by WS in WDM activities for FY11 to FY15 throughout the United States and its territories.[1]

ANNUAL AVERAGE REPTILES, AMPHIBIANS, & FISH TAKEN WITH FIREARMS INCLUDING AIR RIFLES					
SPECIES	TARGET		SPECIES	TARGET	
	Killed	Dispersed		Killed	Dispersed
Black Spinytail Iguana*	501	0	American Bullfrog**	2	0
Green Iguana*	1,044	0.4	Fish* (2 sp.)	3	0
Brown Basilisk*	11	0	**Ave. Annual Number of Animals**	**1,580**	**0.4**
Other Reptiles (13T sp.)	19	0	**% of All WS Take with Firearm**	**0.4%**	**<0.0%**

* Introduced Species ** Introduced populations T – Target

[1] Individual accounts of species are only given for those species that had an annual average of more than 10 killed; additionally T&E or other sensitive species are listed. Other animals are given in Appendix 1.

Paint balls and rubber bullets are frequently used to physically disperse wildlife, as well as provide a sound-scare stimulus (Table 3). Most paint balls break on contact with birds (99.5% of all paint ball use) and mammals (0.5% of paint ball use), but provide a stimulus to leave an area. They are often used frozen to destroy nests; the few target and nontarget animals killed by paint balls were mostly associated with this activity. Paint balls are used to destroy nests to protect structures, such as bridges where bullets could cause damage to the structure, and birds are sometimes taken on nests. It should be noted that one paint ball fired can disperse a group of birds or mammals so every animal dispersed does not represent a paint ball fired.

2 HAZARDS

2.1 Human Health and Safety

Human health and safety hazards associated with the use of firearms and firearm-like devices are highly variable, but especially dependent upon the skill of the user and the method type. Hazards to the user from the use of rifles, shotguns, and handguns would include bruises from firearm recoil (primarily shoulder and face), hearing damage from sustained noise exposure without proper hearing protection, eye damage from fired ammunition debris, accidental gunshot wound from improper handling, purposeful self-inflicted gunshot, and accidental or purposeful death. Additionally, users can inhale or absorb lead as well as other metals from breathing gun smoke or handling ammunition or residues, but these risks are covered in the Lead Risk Assessment. Hazards to a non-user include hearing and eye damage, if in close proximity to the

firearm user or gunshot wound or death. The user and non-users could also experience lead exposure from bullets and shot; however, this would be highest in personnel that reload their own ammunition and potentially inhale lead dust. Becoming sick from exposure to noxious fumes or chemicals during the cleaning of firearms could also occur. An explosion from a defective firearm or defective ammunition could cause lacerations, punctures, loss of extremities or eye damage, and even death from the shrapnel produced. Shrapnel and similar injuries could also occur if a barrel ruptured due to an obstruction such as a previously fired squib load (*e.g.*, improper manufacturing causing bullet or wad to stay in rifle or shotgun) or barrel being plugged with mud and debris from personnel falling or setting the barrel down improperly.

Table 3. The annual average number of target and nontarget birds and mammals hazed with paint balls and rubber bullets, and the number of nests destroyed with paint balls by WS in WDM activities for FY11 to FY15 throughout the United States. Nontargets taken are listed next to the species name because so few were taken.

ANNUAL AVERAGE ANIMALS TAKEN/DISPERSED WITH PAINT BALLS AND RUBBER BULLETS							
SPECIES	TARGET			SPECIES	TARGET		
	Killed	Eggs	Disperse		Killed	Eggs	Disperse
PAINTBALL USAGE				Northern Shoveler	0	0	607
European Starling*	0	0	69,193	Northern Pintail	0	0	245
Red-winged Blackbirds	0	0	4	Green-winged Teal	0	0	174
Mourning Dove	0	0	81	Canvasback	0	0	172
Rock Pigeon* **(0.4 NK)**	0	0	634	Greater Scaup	0	0	1,420
American Crow	0	0	356	Lesser Scaup	0	0	496
Northwestern Crow	0	0	1,738	Bufflehead	0	0	234
Common Raven	0	0	5,370	Common Goldeneye	0	0	652
Other Corvids (3T sp.)	0	0	38	Barrow's Goldeneye	0	0	251
Black Vulture	0	0	570	Other Waterfowl (16T sp.)	0	0	151
Bald Eagle	0	0	3,258	Waterbirds (9T sp.)	0	0	92
Other Raptors (15T sp.)	0	0	77	Wading Birds (6T sp.)	0	0	75
Gallinaceous Birds (2T sp.)	0	0	20	Least Sandpiper	0	0	198
Cliff Swallow	0.4	1	233	Shorebirds (19T sp.) **(0.2NK)**	0	0	268
Barn Swallow	0	2	0	Grizzly Bear[T&E]	0	-	0.2
Non-passerine Forest (2T sp.)	0	0	4	Other Predators (9T spp.)	0	-	29
Savannah Sparrow	0	0	200	Moose	0	-	214
Other Passerines (16T sp.) **(0.2NK)**	0	6	230	Mule Deer	0	-	100
Laughing Gull	0	0	310	Other Hoofed Animals (4T spp.)	0	-	43
Ring-billed Gull	0	0	531	Rodents (4T spp.)	1	-	3
California Gull	0	0	100	**AVE. ANNUAL NUMBER**	1	9	121,840
Glaucous-winged Gull	0	0	3,406	**RUBBER BULLET USAGE**			
Herring Gull	0	0	2,000	Black Bear	0	0	8
Other Larids (6T sp.)	0	0	225	Grizzly Bear[T&E]	0	0	0.4
Brant	0	0	248	California Sea Lion	0	0	381
Canada Goose	0	0	25,923	Steller Sea Lion	0	0	117
American Wigeon	0	0	821	Moose	0	0	1
Mallard (incl. domestic mallard)	0	0	846	**AVE. ANNUAL NUMBER**	0	0	507

* Introduced Species T – Target NK = Nontarget Killed

[1] Individual accounts of species are only given for those species that had an annual average of more than 100 dispersed or alone in category; additionally T&E or other sensitive species are listed. Other animals are given in Appendix 1.

WS requires training and certification for employees to use firearms (WS Firearms Manual and WS Directive 2.615). WS personnel have had accidents and incidents with all uses of firearms, which include aerial shooting accidents, as well as ground shooting accidents, with most personnel injured from accidental discharge. Though fundamentally similar, there are many differences from the use of firearms in WDM and hunting, but hunters have accidents as well. Hunters had an annual average of about 275 accidents annually between 2005 and 2012 (Steve Hall[12], pers. comm. 2017). The 10 most common hunting accident situations are given in Figure 1.

[12] Steve. Hall was the Executive Director of the International Hunter Education Association, Denver, Colorado, and is now the Hunter Education Coordinator for Texas Parks and Wildlife (TPWD), Austin, Texas.

Ten Most Common Hunting Incident Causes

Hunting Incident Data Analysis (2005-2012)

1. **FALLS FROM ELEVATED STANDS** - Falls from Elevated Stands/Failure to Use Haul Line/Safety Harness (n=589)
2. **FAILURE TO POINT MUZZLE IN SAFE DIRECTION** - Careless Handling of Firearms/Failure to Control Muzzle (n=549)
3. **FAILURE TO OBSERVE SAFE ZONE-OF-FIRE** - Shooter Swinging on Game Outside of a Safe Zone of Fire (n=513)
4. **VICTIM BEYOND TARGET** - Victim Out of Sight of Shooter/Failure to Check Background (n=465)
5. **VICTIM MISTAKEN FOR GAME** - Failure to Properly Identify Target (n=391)
6. **STUMBLING/DROPPING FIREARM** - A Shooter Stumbled and Fell/Dropped Firearm (n=169)
7. **TRIGGER CAUGHT ON OBJECT** - Trigger Caught on Object (n=165)
8. **VICTIM IN FRONT OF TARGET** - Victim in Line of Fire (n=146)
9. **LOADING/UNLOADING FIREARM IMPROPERLY** - Improper Loading/Unloading of Firearm (n=139)
10. **LOADED FIREARM IN OR AROUND VEHICLE** - Removing/Placing Firearm in Vehicle/Discharge in Vehicle (n=125)

Figure 1 - The most common hunting incidents that occurred from 2005 to 2012 (S. Hall, TPWD, pers. comm. 2017).

Hunting accidents were similar to the accidents that WS personnel had (most involved #s 2, 7, 9, and 10). Four personnel (0.8 annually) were injured between FY11 through FY15 in all WDM firearm activities, including aerial shooting. One injury was to the leg from a .22 caliber pistol, one to a foot from an air rifle, and two to hands and face from defective ammunition. Six additional personnel were injured in accidents from FY04 to FY10. Two additional injuries were to the leg (one a pellet from an air and one from a high-powered rifle), three injuries were to hands, face, and eardrums from rounds going off in the barrel, and one, an accident involving a pyrotechnic launcher, was an injury that resulted in the loss of the pinky finger and part of the ring finger of a WS employee[13].

In addition to accidents that injured employees, WS also tracks other accidents where a firearm caused property damage and incidents such as ammunition or gun misfire or damage to a firearm (mostly mechanical malfunction). Accidents and associated injuries and between FY11 and FY15 (Table 4) occurred in most categories; however, no accidents occurred during aerial operations nor with the use of paint balls, rubber bullets, and net guns (Table 4), but some occurred in these categories prior to FY11. The use of firearms in aerial operations has additional inherent dangers and these are discussed in the Use of Aircraft in WDM Risk Assessment.

Considering the number of firearms used by WS and the number of rounds fired (in the hundreds of thousands annually), few accidents and incidents occurred and the risk of injury is low. In summary for FY11 to FY15, WS personnel had an annual average of 3.0 accidents (of these 0.8 resulted in injury – 0.4 to face and eyes as a result of faulty ammunition, and 0.2 to a leg and 0.2 to a foot as a result of personal error), 7.2 incidents, and 1.2 thefts with firearms (Table 4). Some accidents and incidents (3.0), of the few that occur, result from error on the part of the employee, especially complacency, and can be avoided. However, some accidents and most incidents, those that involved mechanical failure of the firearm or ammunition (6.6), would not likely be avoided. It should be noted that many potential accidents are avoided by inspecting the ammunition and firearm prior to use (when something abnormal is found, it is marked as an incident).

For contrast, from 2005-2012, about 15 million hunters per year averaged 50 fatal and 500 nonfatal accidents in the field (S. Hall, pers. comm. 2017). Most injuries that WS tracks[14] such as hearing problems are not tracked by hunter organizations and many accidents and most incidents, especially manufacturing defects,

[13] A firearm accident is defined by policy as an event that results in an injury or property damage whereas in an incident neither occurs.
[14] WS tracks as much information as possible, but Personally Identifiable Information (PII) issues does not allow WS collect all information.

go unreported, thus a good comparison cannot be made. Additionally, it is unknown how many days afield hunters have throughout the United States, and thus, a comparison cannot be made, but it illustrates that accidents occur with firearms while afield.

Table 4. The annual average number of accidents and incidents with firearms and firearm-like devices used by WS in WDM for FY11 thru FY15.

AVERAGE ANNUAL ACCIDENTS AND INCIDENTS WITH FIREARMS FOR FY11 TO FY15 BY WS IN WDM						
Method	**Injury**	**Pers. Error**	**Mechanical**	**Ammunition**	**Mishaps**	**Thefts**
Shotgun (ground)	0.2#	1.0	1.0	0.8	-	
Shotgun (aerial)[1]	-	-	-	-	-	
Rifle	0.2#	0.8	1.2	0.8	-	
Rifle with Suppressor	-	-	2.0	0.2	-	
Pistol	0.2^	0.6	0.2	-	-	
Pneumatics (air rifles)	0.2^	0.6	-	-	0.2	
Pyrotechnic (pistol launcher)[1]	-	-	-	0.4	-	
Pyrotechnic (12 gauge cracker shell)[1]	-	-	-	0.4	-	
Paint Balls, Rubber Bullets, Dart & Net Guns	-	-	-	-	-	
Thefts[2]						1.2
TOTAL BY CATEGORY	**0.8**	**3.0**	**4.4**	**2.6**	**0.2**	**1.2**
TOTAL OF ACCIDENTS/INCIDENTS		**10.2**				

1=Addressed in Pyrotechnics Risk Assessment 2=Thefts often involved a variety of firearms (including one that stole an entire safety box that was bolted to vehicle while employee was in immediate area responding to a damage request).
#=Injury associated with an ammunition failure ^=Injury resulting from personal error

Firearm-like devices also present hazards. The primary hazards associated with the use of dart guns and blowguns would be accidental exposure of the user or non-users to the immobilizing drug. Lacerations, punctures, loss of extremities or eye damage, and even death from shrapnel could occur if a dart gun, paintball gun, net gun, pyrotechnic pistol, air rifle, arrow gun, or crossbow malfunctioned. If a paintball, net, or pyrotechnic struck the user or a non-user, the impact could cause bruising, abrasions, lacerations, or if struck in the eye, eye damage and blindness could potentially occur. Projectiles fired from air rifles, arrow guns, and crossbows could cause serious injuries, such as puncture wounds, and even death. Without proper ear protection, firing pyrotechnics could cause hearing damage with repeated exposure.

Shell casings for rifles and handguns are generally made of brass, which consists primarily of copper and zinc alloys, with copper being the primary component. The brass used for some casings and primers may contain traces of lead to make them more malleable. Unfired primers contain small amounts of copper, antimony (antimony sulfide), zinc, iron, lead (lead styphnate, lead thiocyanate), and barium (barium nitrate). Primers consist of a metal capsule that completely seals the various components within the capsule. Therefore, under normal handling of primers, no exposure to the various components would occur. Lead styphnate, lead thiocyanate, and barium nitrate are part of the explosive powders contained within the ignition primer that ignite when the firing pin of the firearm strikes the primer. When burnt, the lead and barium compounds likely form metallic oxides. When firing a primer, a small amount of airborne particles may be generated that could be slightly irritating to the eyes and the respiratory tract. These airborne particles may contain trace amounts of lead, barium, and other components. Therefore, the primary route of exposure would be inhalation of particulates and exposure to the eyes and skin. However, these are not anticipated to cause any problems.

The Use of Lead in WDM Risk Assessment that WS developed for lead-use in ammunition discusses the human health hazards associated with lead. Large doses of barium compounds can cause cyanosis, skeletal muscle paralysis, respiratory arrest, irregular heartbeat, and hypertension. Inhalation of high concentrations of metallic copper dust or fumes may cause nasal irritation, nausea, vomiting, and stomach pain. Inhalation of high concentrations of antimony sulfide may cause dizziness, headache, and nausea. Zinc may cause irritation to the eyes, skin, and respiratory tract and in sufficient amounts, may cause fever, chills, muscular

pain, nausea, and vomiting. Iron dust, in high concentrations, can cause pneumoconiosis and may cause eye, skin, and respiratory tract irritation. In addition, high concentrations of iron dust may cause irritation to the gastric tract.

Most shotgun cases consist of plastic with a brass base that houses the primer. The plastic portion of the case generally consists of a high-density polyethylene plastic and in some shotgun cases, a low-density polyethylene plastic. Shotgun shells also contain a wad that holds the shot, slug, or rubber bullet as the projectile travels down the barrel and exits toward the target. The wad eventually falls away as the projectile travels down range toward the target. Most wads are also made of plastic but can consist of paper. Plastic wads are generally made of polyethylene and are completely contained within the casing until fired. Polyethylene is a common plastic found in many everyday items that people use. Exposure would occur from direct contact with the plastic as WS employees handled cases, such as loading and unloading the firearm. No health hazards would be associated with the plastic used in unfired shotgun cases or wads. Spent cases or wads could contain residues, but no exposure to the wad would occur until after firing when retrieval of the wad or spent case for disposal could occur.

2.2 Environmental

Firearms and firearm-like devices are mechanical devices; therefore, the devices themselves would not cause environmental hazards. Firearms and firearm-like devices would not contaminate water or result in the bioaccumulation of chemicals or other hazardous materials. However, environmental hazards associated with firearms and firearm-like devices could result from the various projectiles discharged and the noise produced during the discharge of a device. Separate risk assessments evaluate the environmental hazards associated with lead ammunition, immobilizing drugs, nets, and pyrotechnics; therefore, this evaluation does not discuss the hazards of those devices in detail.

Depending on the use pattern of the device, WS personnel use firearms and firearm-like devices to remove, live-capture, immobilize, or disperse target animals. Firearms and firearm-like devices are very selective for the target animals, since identification of the target occurs prior to application of the method. When using rifles, shotguns, handguns, air rifles, arrow guns, and crossbows, WS employees lethally remove target animals resulting in the death of the animal; however, misplaced shots or unexpected alterations in the flight path of the projectile (*e.g.*, grazing a tree limb) could result in gunshot/arrow wounds to target animals. In addition, the flight response of a target animal if misses occurred could cause temporary stress in the animal.

If paintballs inadvertently struck a target or nontarget animal in the incorrect place, bruises, lacerations, blindness, broken bones, or death could occur. In addition, the flight response of a target animal from harassment could lead to temporary stress in the animal. Paintballs do not actually contain paint, but are marking capsules that consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. Although the ingredients may vary slightly depending on the manufacturer, paintball ingredients may include polyethylene glycol, gelatin, glycerin (glycerol), sorbitol, water, ground pig skin, dipropylene glycol, mineral oil, and dye as the colorant (Donaldson 2003).

Paintballs are considered non-toxic to people and do not pose an environmental hazard, as described on product labeling and Safety Data Sheets[15]. Paintballs are biodegradable and soluble in water and many of the components are food grade ingredients. However, consumption of several paintballs may cause toxicosis in dogs, which is potentially fatal without supportive veterinary treatment (Donaldson 2003). Little is known

[15] Safety Data Sheets were commonly known as Material Safety Data Sheets (MSDS), but the name has been changed recently.

about the mechanism of action and lethal dose for dogs that consume paintballs, but it is suspected that there is an osmotic diuretic effect resulting in an abnormal electrolyte and fluid balance (Donaldson 2003). Most affected dogs recovered within 24 hours (Donaldson 2003).

Hazards to nontargets from the use of firearms and firearm-like devices would be confined to animals that were mistakenly identified or those animals that inadvertently enter the path of a projectile. In some cases, the noise associated with the discharge of a firearm or firearm-like device, if occurring near nontargets, could elicit a flight response, and disperse those nontargets from an area.

When shooting a firearm, the operation of a firearm generally ejects the fired shell casing from the firearm, which then falls to the ground. If a shell casing was irretrievable or if casings were left on the ground, those casing could be exposed to environmental conditions and deteriorate. Shell casings for rifles and handguns are generally made of brass, which consists primarily of copper and zinc alloys, with copper being the primary component. Shell casings for shotguns are generally plastic with a brass base. Shell casings also contain primers, which are also generally made of brass.

The brass used for some cases and primers may contain traces of lead to make them more malleable. When lead is present in brass casings, the lead component generally comprises 0.01 to 0.5% of the brass. The Risk Assessment that WS developed for lead from use in ammunition discusses the environmental hazards associated with lead. Brass is generally resistant to corrosion, which would limit any environmental hazards associated with the lead in cases. Brass cases tend to oxidize over a long period of time, but are relatively stable and would not add significant amounts of toxic substances to the environment as it is a very slow process.

The ignition primers, which are a component of the case, are also made primarily of brass. Unfired primers contain small amounts lead (lead styphnate, lead thiocyanate), barium (barium nitrate), antimony sulfide, and other metallic compounds (*e.g.*, copper, zinc, iron), which are part of the explosive powders contained within the ignition primer that ignite when the primer is struck by the firing pin of the firearm. Therefore, when the firing pin strikes the primer, the compounds ignite causing a very small explosion, which causes the black powder inside the case to burn and the pressure from the burning black powder propels the projectile forward and out of the gun barrel to the target. When burnt, the lead, barium, and the other metallic compounds found in the primer likely form metallic oxides, which expel from the firearm. Therefore, particulates that occur from the burning of the metallic compounds could settle on to the ground. Discussion of the environmental hazards associated with lead occurred in the Risk Assessment for lead from the use in ammunition. The environment hazards associated with particulates of the other metallic compounds that result from firing an ignition primer would be nearly non-existent since only trace amount of metallic oxides would form. In addition, those particulates that form would likely disperse in the air and would settle in a widely scattered pattern.

Most shotgun cases consist of plastic with a brass base that houses the primer. The plastic portion of the case generally consists of a high-density polyethylene plastic and in some shotgun cases, a low-density polyethylene plastic. If a WS employee does not retrieve shotgun cases or the cases were irretrievable, the plastic component of the case is likely to photodegrade over a time when exposed to sunlight. The amount of time required to completely photodegrade the plastic case is unknown but the process could possibly require many years depending on environmental factors. As the plastic photodegrades, the plastic becomes brittle, cracks, and breaks into smaller and smaller pieces over time until only very small granules remain.

Shotgun shells also contain a wad that holds the shot, slug, or rubber bullet as the projectile travels down the barrel and exits toward the target. The wad eventually falls away as the projectile travels down range toward

the target. Most wads are also made of plastic but can consist of paper. The wad falls away to the ground down range from where the plastic case lay; therefore, locating the wad down range can be difficult and WS employees rarely purposefully retrieve the wads. Paper wads likely biodegrade quickly when exposed to environmental conditions. Plastic wads are generally made of polyethylene and likely photodegrade when exposed to sunlight. Depending on environmental conditions, plastic wads likely require many years to degrade fully. The metallic composition of the brass base and primer of the shotgun shell is similar to the metallic composition of brass cases for rifle and handgun ammunition and would represent similar environmental risks as discussed.

Fireworks and pyrotechnics often contain barium nitrate to produce a green flame. The risks associated with pyrotechnics will be discussed the Use of Pyrotechnics Risk Assessment.

3 RISKS

3.1 Human Health and Safety

Risks from the use of firearms could occur to WS employees and the public. WS personnel who use firearms are subject to new applicant drug testing, random drug testing, reasonable suspicion testing, and post-accident testing. As a condition of employment, WS employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC § 922(g)(9)). WS minimizes risks to human health and safety by implementing extensive training and safety practices highlighted in WS Directive 2.615 and as discussed in Section 1. Separate risk assessments evaluate the environmental risks associated with lead from bullets and shot, immobilizing drugs, nets, and pyrotechnics; therefore, this evaluation does not discuss the hazards of those devices in detail.

Knowing a firearm's "*maximum projectile range*" is critical to their safe use. The maximum projectile range is the distance a firearm's projectile could cause injury or damage to people, animals, or property. Learning to estimate distances and knowing the projectile range of the firearm or firearm-like device is important. Figure 2, 3, and 4 provide the projectile range for many rifle and handgun calibers, along with the projectile range of different shot sizes available for shotguns.

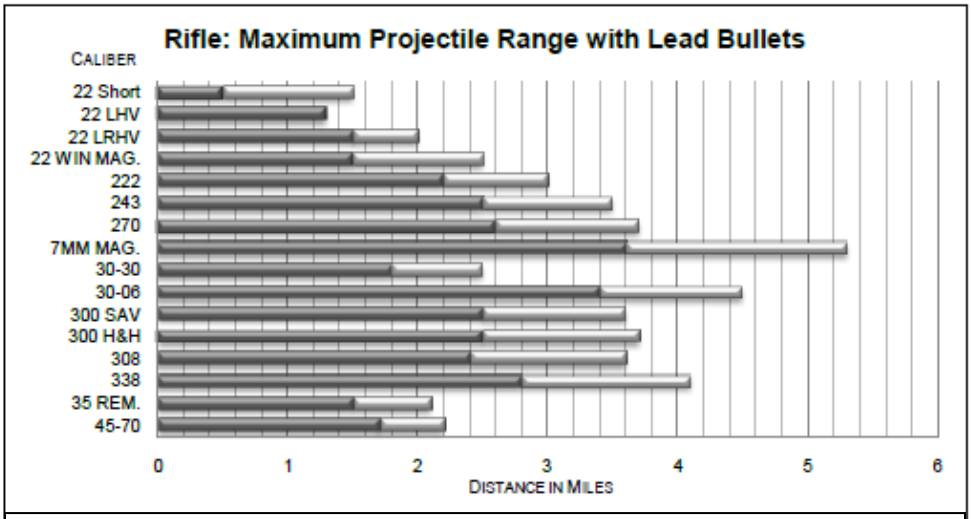

Figure 2. The range of standard rifle ammunition (Source:NSSF/SAAMI).

WS personnel injured with firearms, as discussed in Section 2.1, mostly involved accidental discharge. Most accidents involving user error, of the few that occur, result from complacency on the part of the employee

and can be avoided, but some accidents and most incidents, those that involved mechanical failure, would not likely be avoided. WS personnel also had aerial shooting accidents prior to FY11; two were in airplanes where the crewmember accidentally shot the strut, but the planes landed safely. WS also has had some incidents in aircraft; most notably steel shot ricocheting off rocks and hitting the aircraft; these are found on inspection of the plane and usually are not noticed as they happen.

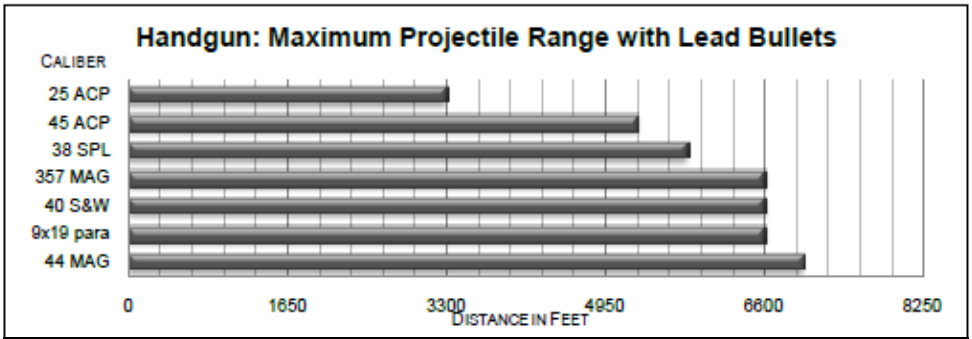

Figure 3. The range of conventional handgun ammunition (Source: NSSF/SAAMI).

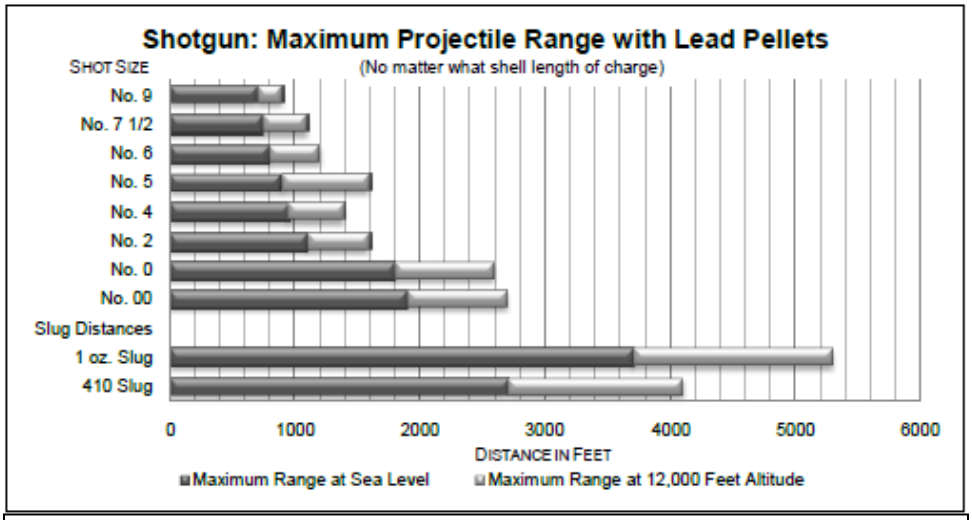

Figure 4. The range of standard shotgun ammunition (Source: NSSF/SAAMI).

To avoid most, if not all, firearm accidents as described above, WS employees are trained to adhere to the NRA's three basic rules including always pointing the firearm in a safe direction, always keeping fingers off the trigger until ready to shoot, and always keeping the gun unloaded until ready to use. In addition to these basic rules, WS employees consider many additional safety measures when using firearms and firearm-like devices. Those measures include knowing what is beyond the target, knowing how to use the device safely, ensuring the device is safe to operate, and using only the correct components for the device. Other measures that WS employees abide by include wearing eye and ear protection, as appropriate, never using alcohol or drugs before or while using a device, and storing devices so they are not accessible to unauthorized persons.

Some firearm injuries have been to hearing (none of the recent documented injuries has been to aircraft personnel). These primarily occur over time from shooting in general, but can occur because of a mechanical failure of sorts, such as a round going off in the barrel or a faulty shell that creates an exceptional amount of noise near the ear. In addition to shotgun noise, pilots and crewmembers also have noise from the aircraft. As a result of the frequent, high-decibel noise levels, WS initiated a Hearing Conservation Program to minimize hearing loss and monitor employees subjected to frequent noise. Pilots and crewmembers receive routine audiometric testing at the aviation training center prior to and during their time as a WS employee. To protect against hearing loss, all aircraft crewmembers that fly below 500 feet must wear a Federal Aviation Administration approved helmet with noise attenuation capabilities that meet or exceed military SPH-4 helmet specifications. In addition, all aircraft crewmembers are issued earplugs that can be used in addition to the flight helmet. Thus, with these in place, hearing loss is anticipated to be minimal.

As shown in Table 4, the risks to human safety associated with the use of firearms and firearms-like devices by WS employees are minimal. Between FY11 and FY15, about one injury per year on average has occurred involving firearms and firearms-like devices. Those injuries occurred during the use of shotguns, rifles, pistols, and pyrotechnics. No injuries occurred from the use of paintballs guns, dart guns, blowguns, net guns, and archery equipment. Nearly 30% of the accidents and incidents that involve WS employees and firearms occur for unknown reasons, with 50% of those occurrences involving suppressors. Nearly 46% of the accidents and incidents involving WS employees occur from mechanical failure of the firearm and defective ammunition. Accident and incident reporting is mandatory in WS and incident and accident reports are filed and utilized by the WS Firearms Committee to develop safety bulletins and alerts for other firearm users and by the WS Firearms Instructors as training aids and to emphasize safety awareness.

In comparison, there were an estimated 600 unintentional firearm fatalities (all unintentional fatalities involving a firearm including non-hunting) and 6,759 injuries associated with hunting with firearms in the United States during 2011 (National Shooting Sports Foundation 2013). The most common hunting accidents involving firearms are failure to point the muzzle of the firearm in a safe direction, failure to observe the safe zone-of-fire, not knowing what is in front of or beyond the target, misidentification of the target, dropping the firearm, the trigger being caught on an object, improper loading/unloading, and carrying a loaded firearm in vehicle (S. Hall, TPWD, pers. comm. 2017).

As was mentioned previously, the brass cases and primers of firearm ammunition can contain metallic compounds that could be hazardous to people in high concentrations, including lead and barium. Brass is generally resistant to corrosion, which would limit any health hazards associated with the lead in cases. Primers consist of a metal capsule that seals the various components within the capsule. Therefore, under normal handling of ammunition and primers, no exposure to any harmful materials would occur. Upon firing, the burning of the explosive components in the primer may generate a small amount of particles that could be slightly irritating to the eyes and the respiratory tract. The particles generated by the burning of the explosive components of primers could contain trace amounts of lead, barium, and other metallic compounds, primarily in the form of metallic oxides. Shooting non-jacketed lead bullets can also create airborne lead particles caused by the contact between the rifling and the lead bullet as it travels down the bore. The primary risk of exposure would be to WS employees who use firearms with the primary route of exposure occurring from inhalation and airborne particles settling on the skin after firing. However, it is unlikely that the amount of particles that a person would be exposed to from the firing of a primer would be sufficient to cause any of the effects discussed in the human hazards section. WS employees most always use firearms in well-ventilated situations such as outdoors where the small amount of particulates would likely disperse in the air. Even in a closed environment, such as a shooting room or a vehicle, enough air space occurs in those areas that the particulates likely disperse.

3.2 Environmental

The use of firearms and firearm-like devices would essentially be selective for the target species since identification of the target occurs prior to application. WS use of firearms and firearm-like devices does not usually affect nontarget species, except for the misidentification of target species, taking a target species unexpectedly with a method that would be accidental (paintball guns and pyrotechnics), or scaring that may result from discharging a firearm or firearm-like device (Table 1). In cases of accidental dispersal, nontarget wildlife may temporarily leave the immediate vicinity of scaring, but would most likely return after conclusion of the action in the absence of direct reinforcement. The use of firearms or firearm-like devices in proximity to nontarget species is not likely to occur at a high frequency or at a high magnitude. For harassment to occur from the noise associated with the discharge of a firearm or firearm-like device a nontarget species would

have to be present within hearing distance at the time the device was discharged and the resulting noise would have to elicit a negative response. Although paintballs break easily and velocity rapidly decreases with distance, firing at close range would be discouraged to avoid harming target animals.

Since WS employees identify the target animal or animals prior to the application of firearms or firearm-like devices, the likelihood of taking a nontarget species unintentionally using firearms or firearm-like devices is minimal. Environmental risks are greatest for those nontarget animals similar in appearance to target animals, especially when they are present in mixed flocks of birds. The risk of misidentifying animals is minimized through training of WS personnel in species identification, resulting in the use of firearms and firearm-like devices being highly selective. Between FY11 and FY15, WS reported an annual average of 5 nontarget animals killed while 452,649 target animals were killed (0.001%) and 28 nontarget animals were dispersed while 20,048,713 animals were dispersed (0.0001%). This is an extremely low percentage representing a highly effective tool. None of the nontarget species inadvertently killed by WS using firearms were federally listed threatened or endangered species, except in FY13 when a Mexican wolf pup was mistaken for a coyote.

Shooting can also be used in conjunction with an illumination device at night, which is especially useful for nocturnal mammals, such as coyotes, deer, or feral swine. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and FLIR devices can also be used to detect and shoot target animals at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and FLIR equipment aid in locating wildlife at night when wildlife may be more active. WS personnel most often use this technology to target mammals in the act of causing damage or likely responsible for causing damage. These methods aid the use of other methods or allow other methods to be applied more selectively and efficiently. Night vision and FLIR equipment allow for the identification of target species during night activities but are not actual methods of lethal removal.

Although the American Veterinary Medical Association (AVMA) guideline lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, the use of firearms has a greater chance of not consistently producing a humane death (AVMA 2013). Parker et al. (2006) considered shooting beaver with a center-fire rifle to be humane and Lewis et al. (1997) concluded that shooting free-ranging impala (*Aepyceros melampus*) at night was a satisfactory method concerning animal welfare. WS personnel that employ firearms to address damage or threats to human safety receive training in the proper placement of shots to ensure a timely and quick death in accordance with WS Directive 2.505. Other factors can also influence the humaneness of using firearms and firearm-like devices to remove target animals, such as using the appropriate firearm and the distance to the target animal.

Despite the training received by WS personnel and their consideration of humaneness and animal welfare concerns, the wounding of animals can occur from the use of firearms and firearm-like devices. Wounding could occur if the projectile strikes an animal in an area of the body that does not cause the death of the animal or where death occurs over time from complications associated with the wound. In general, most animals die from wounds relatively quickly, but some wounds can result in an extended time to death or the animal could survive.

WS does not track wounding rates from the use of firearms or firearm-like devices by employees. However, wounding rates by WS employees are at most similar to those rates that occur by the public during hunting seasons, but in reality are likely much lower since WS employees receive training. Parker et al. (2006) found a wounding frequency of 4.3% occurred by hunters harvesting beaver with center-fire rifles in Norway. Bradshaw and Bateson (2000) found that 11% of the red deer killed by hunters in an area of southwestern

England required two or more shots and 7% of the deer killed took 2 to 15 minutes to die, while 2% of the deer escaped wounded. Lewis et al. (1997) stated that 93% of the 856 impala killed by sharpshooters at night died "*instantaneously*" from the first shot. Reports of wounding rates for white-tailed deer from hunters that use a bow and arrow have been 12% in Michigan (Langenau and Aho 1983), 17% in Iowa (Gladfelter 1982), and 48% in South Dakota (McPhillips et al. 1985). Hunters using a bow and arrow may have a wounding rate of white-tailed deer that is 1.5 times greater than hunters who harvest deer using a firearm (Stormer et al. 1979).

WS personnel that use firearms as part of their duties are required at a minimum to complete 8 hours of training initially, typically the completion of the NRA curriculum for basic pistol, rifle, and shotgun certification. WS also requires that personnel that use firearms complete annual training or continuing education which can be a repeat of the NRA course or any of a number of advanced coursework offered through NRA or other venue. At a minimum, the continuing education must include a review of WS Directive 2.615, the WS Firearms Manual's Chapter 3 (WS Firearm Safety Rules) and Chapter 12 (WS Firearm Bulletins), a review of any WS firearm accidents or incidents included in the WS Firearms Manual, live fire, and written exam (about 4-8 hours). Additional training for particular personnel may include firearm specific training such as use of pyrotechnic launchers, net guns, and dart guns, or advanced training (e.g., advanced riflery and WS Certified Firearms Instructor certifications). Specific positions may require a higher level of proficiency and certification such as the Pro-Marksman rating for sharpshooters involved in projects such as urban deer removal or aerial shooting.

Over a three-year period, DeStefano and Rusch (1986) estimated the average annual wounding rate for ruff grouse by hunters in northeastern Wisconsin was 13%, with a range from 7% to 18% annually. Shulz et al. (2006) reported wounding rates of 10% to 14% for mourning doves during the hunting season. Parker (1991) estimated that 25% to 38% of the annual juvenile American black duck mortality occurred from juveniles that hunters did not retrieve or that hunters wounded. Anderson and Burnham (1976) estimated the national wounding rate average for all waterfowl was 20%. During a waterfowl hunting study in Louisiana, Hebert et al. (1984) found wounding rates of waterfowl were higher for steel shot compared to lead shot, with 22% of the ducks shot with lead shot resulting in wounded birds and nearly 31% of the waterfowl wounded by steel shot. However, other studies have failed to find a difference in wounding rates between lead and steel shot (Humburg et al. 1982). In addition, projectiles may imbed under the skin of target animals, but those animals survive. For example, Hicklin and Barrow (2004) found that 25% of the 1,624 waterfowl examined alive had shotgun pellets imbedded under their skin. Limited information on the long-term effects of pellets imbedded under the skin of waterfowl is available; however, Madsen and Riget (2006) were not able to detect chronic effects associated with shotgun pellets imbedded under the skin of geese. Van Dyke (1981) concluded that less than 3% of the mallards crippled (*i.e.*, mallards wounded but not retrieved) at a marsh complex in Wisconsin healed and recovered.

Despite the training and proficiency that WS employees receive, employees could wound target animals during the use of firearms or firearm-like devices. However, because of the training and proficiency of WS employees in the use of firearms and firearms-like devices, wounding rates should be minimal and is likely much lower than those wounding rates occurring by the public during hunting seasons.

Another risk from the use of firearms and firearm-like devices is the deposition of projectiles in the environment and hulls ejected. Deposition occurs from firearms, including rifles, handguns, shotguns, and pneumatics where bullets, pellets, or shot pass through or miss target animals. Separate risk assessments evaluate the potential environment risks associated with many of the projectiles that WS employees could discharge from a firearm or firearm-like device, including bullets/shot, immobilizing drugs, nets, and

pyrotechnics. Therefore, discussion in this evaluation will focus on paintballs, rubber bullets, arrows, and darts (not the immobilization drugs being carried), which are projectiles not discussed in other risk assessments. However, based on the use patterns of these firearm-like devices, WS does not use these methods at a magnitude where large amounts of the projectiles would be deposited and they would be in such a limited area that large accumulations of these projectiles would not occur in the soil. Paintballs, rubber bullets, arrows, and darts are not composed of materials that would result in high risks of environmental contamination and are not likely to be concentrated into such a small area that bioaccumulation would occur. Therefore, the risks associated with projectiles that could enter the environment from WS activities would be minimal.

Paintballs, as noted, if were in a large quantity and were not broken and ingested by a dog or other animal in mass quantities (likely associated with inappropriate storage and a dog that has pica disorder, frequently chews and swallows items such as socks) could get toxicosis. This has not been reported by any WS employee.

Attempts are made to retrieve all darts following their use. Extra time is taken to retrieve darts, thus it is expected that few are lost. Darts are typically lost when target animals are missed altogether or when animals flee, especially in heavy cover, and the dart gets hung up in the vegetation. One study (Roelle and Ransom 2009) found that 7 out of 117 darts fired (6%) missed the target animal and none of them were recovered. Additionally, four darts that properly struck animals were lost to delayed ejection, rapid animal movement, thick vegetation, or a combination of these factors; none of these darts were recovered as well. Thus, during their study 9.4% of the shots taken were not recovered). WS trains on the use of firearms, and specifically dart guns if used, and thus minimizes misses. Additionally, they search diligently for the darts in the event of a loss. Darts that miss likely expel the contents once it hits something such as a tree; however, this may not be as true with thicker contents (a mayonnaise consistency or thicker which are more difficult to expel) such as those emulsified. Thus, the dart itself, if lost, would not present a hazard to the environment, but drugs not evacuated from the dart could. At most, a dart could puncture a nontarget animal that stepped on it, if it were in a near upright position, or a human that picked it up. However, this risk is very low, if realistic. Therefore, risks to the environment, as well as people, have been deemed to be inconsequential.

The WS program primarily uses paintballs and rubber bullets as non-lethal harassment methods to disperse target animals in areas where damage or threats of damage were occurring (Table 1). Between FY11 and FY15, the WS program dispersed an average of 121,838 animals per year using paintball guns and 507 animals per year using rubber bullets. Although primarily nonlethal methods, a paintball or rubber bullet hitting a target animal unintentionally in a vulnerable area of the body could lead to injuries or death of the animal. No deaths or injuries to animals have occurred from the use of rubber bullets by WS personnel from FY11 through FY15; therefore, the risks of injury or death to target and nontarget animals associated with the use of rubber bullets would be minimal to non-existent. As shown in Table 1, WS killed an annual average of 0.6 target animals unintentionally between FY11 and FY15 using paintball guns.

Although available, the WS program rarely uses archery equipment (bow/arrow, crossbow, arrow guns) to manage the damage that animals cause. Between FY11 and FY15, the WS program used archery equipment to take an annual average of 0.4 common carp (2 in 5 years). When used by WS employees, the application of archery equipment is limited to isolated areas. In addition, in most cases, a WS employee would attempt to retrieve arrows. Arrow shafts are primarily composed of aluminum or carbon fibers with the fletching and knock consisting of plastic; however, the fletching could consist of actual bird feathers. Similarly, dart guns and blowguns are not one of the more common methods that WS employees use to alleviate damage or threats of damage associated with animals. On average, the WS program employed dart guns to capture 35

target animals and blowpipes 0.8 animals annually between FY11 to FY15. In all cases, the WS employee attempts to retrieve darts. Darts primarily consist of plastic with some darts having aluminum components or consisting of aluminum tubes. Therefore, the environmental risks associated with arrows and darts that a WS employee did not retrieve or were irretrievable would be minimal based on the limited use and the limited geographical scope of application of those methods.

In addition to the deposition of projectiles, the deposition of casings from the use of shotgun, rifle, and handgun ammunition could occur if a WS employee did not or was unable to retrieve the casing. As shown in Table 1, firearms are one of the most commonly used methods by WS employees to target animals causing damage or posing threats of damage. The WS program does not specifically track the number of cartridges that WS employees use and does not track the number of casings that WS employees do not retrieve or are irretrievable. Based on the frequency of firearm use by WS employees, the potential exists for WS to deposit a high volume of cases in the environment. However, based on the ammunition capacity of firearms and the nature of addressing animal damage with a firearm, it is unlikely a high number of cases would occur in a localized area if an employee did not retrieve those cases or if those cases were irretrievable. In some cases, WS employees may use a shell catcher to collect shells as the firearm ejects those shells, such as during activities requiring shooting from an aircraft. Retrieved cartridges would be disposed of at a landfill or a WS employee could re-use the casings by reloading the casing with new components (reloading is common, especially for rifle ammunition, which enhances the accuracy).

As discussed in Section 2.2, the ignition of primers results in metallic compounds being released. Given the very small amounts of metallic oxide that form after firing, the environmental risks associated with the primers would be low.

Most shotgun cases consist of plastic with a brass base that houses the primer. The metallic composition of the brass base and primer of the shotgun shell is similar to the metallic composition of brass cases for rifle and handgun ammunition. The plastic portion of the case generally consists of a high-density polyethylene plastic and in some shotgun cases, a low-density polyethylene plastic. If a WS employee does not retrieve shotgun cases or the cases were irretrievable, the plastic component of the case is likely to photodegrade over a time when exposed to sunlight. The amount of time required to completely photodegrade the plastic case is unknown but the process could possibly require many years depending on environmental factors. As the plastic photodegrades, the plastic becomes brittle, cracks, and breaks into smaller and smaller pieces over time, and is eventually absorbed into the environment. Metal portion are likely to remain intact for much longer. However, it is believed that this would cause negligible risk to the environment.

Shotgun shells also contain a wad that holds the shot, slug, or rubber bullet as the projectile travels down the barrel and exits toward the target. The wad eventually falls away as the projectile travels down range toward the target. Most wads are also made of plastic but can consist of paper. The wad falls away to the ground down range from where the plastic case lay; therefore, locating the wad down range can be difficult and WS employees rarely purposefully retrieve the wads. Paper wads likely biodegrade quickly when exposed to environmental conditions. Plastic wads are generally made of polyethylene and likely photodegrade when exposed to sunlight. Depending on environmental conditions, plastic wads likely require many years to degrade fully. Similar to cases, based on the ammunition capacity of firearms and the nature of addressing animal damage with a firearm, it is unlikely a high number of wads would occur in a localized area.

4 UNCERTAINTIES AND CUMULATIVE IMPACTS

Uncertainty in this risk assessment is negligible as WS has over 90 years using firearms and firearm-like devices for WDM activities and understands potential risks from using those methods. The knowledge gained from this experience has helped reduce risks associated with the use of firearms and firearms-like devices and has shaped policies and standard operating procedures to minimize risks associated with the use of those methods.

Cumulative impacts could occur to target and nontarget animals. However, cumulative impacts are addressed in National Environmental Policy Act documents (*e.g.*, see Environmental Assessments at USDA 2017) and found not to be significant to any native population. From a human health perspective, the use of firearms in WDM will not have any known cumulative impacts.

5 SUMMARY

Firearms and firearm-like devices are very selective for target animals and used frequently in WDM for many different species. WS personnel receive training in the proper use of firearms and firearm-like devices pursuant to WS directives. With proper training, WS employees are effective and efficient at using these to focus their efforts to specific target animals and can use those methods with very low risks to human safety and to the environment. WS personnel have been very effective in using firearms and relatively few personnel have been injured and few accidents and incidents have occurred as a result of the use of firearms. Few nontarget species, mistaken identity for the most part, have been taken. Thus, it is concluded that the use of firearms is of low risk to WS personnel, the public, nontarget species, and environment.

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7 PREPARERS: WRITERS, EDITORS, AND REVIEWERS

7.1 APHIS WS Methods Risk Assessment Committee

Writers for "Use of Firearms in Wildlife Damage Management Risk Assessment":

Writer: Thomas Hall
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Fort Collins, CO
Education: BS Biology (Natural History) and BA Psychology – Fort Lewis College; MS Wildlife Ecology – Oklahoma State University
Experience: Special expertise in wildlife biology, identification, ecology, and damage management. Thirty 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 and including aerial operations in OR, OK, and NV. Expert in preparing environmental documents for WS programs to comply with the National Environmental Policy Act and the Endangered Species Act. For firearms specifically, have used and trained with all types of firearms and ancillary devices, been crewmember in helicopters and fixed wing, and was a Certified NRA Instructor. In prior experience, ran rifle, pistol, black-powder, and shotgun range for Outdoor Horizons which was open to the general public and taught hunter safety. Audited Teaching Shooting Sports at Colo. State Univ.

Writer: Ryan Wimberly
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Madison, TN
Education: BS Wildlife Management and Ecology – Northwest Missouri State University
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Editors/Contributors for "Use of Firearms in Wildlife Damage Management Risk Assessment":

Editor/Contributor: Shelagh DeLiberto
Position: USDA-APHIS-Wildlife Services (WS), National Wildlife Research Center (NWRC), Wildlife Biologist, Fort Collins, CO
Education: BA Biology and Environmental Science – Ithaca College; MS Wildlife Biology – Colorado State University
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Education: B.A. Biology – Colorado College; M.S. Environmental Management – University of Maryland

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

Data Contributor: Joey Millison
Position: USDA-APHIS-WS Information and Technology (IT), Junior Applications Developer
Education: Information and Technology coursework from various sources
Experience: Eleven years of experience in APHIS, WS Management Information System (MIS) Group. Retrieves WS field data from the MIS for writers, reviewers, and editors.

7.2 Internal Reviewers

Reviewer: Mark Jensen
Position: USDA-APHIS-WS, State Director, Reno Nevada
Education: BS Wildlife Biology – Iowa State University
Experience: Special expertise in wildlife biology, ecology, and damage management. Twenty two years of service with APHIS Wildlife Services operations conducting a wide variety of programs, including bird damage management, endangered species protection, livestock protection, invasive species management, wildlife hazard management at airports, property, and natural resource protection in NJ, OK, IL, CA, OR, and NV. Expert in firearms use and instruction. USDA-APHIS-WS representative on the 2008 Safety Review for firearms. NRA certified firearms safety instructor for rifle, shotgun, and pistol. Past chairman and co-chairman, and current member of the USDA-APHIS-WS Firearms Safety Committee. Crewmember for both helicopter and fixed wing aircraft. U.S. Army expert in rifle and other weapon systems.

Reviewer: Steve Greiner
Position: USDA-APHIS-WS Nat'l Wildlife Research Center, Safety and Occupational Health Specialist, Fort Collins, CO
Education: BA Environmental Biology – University of Colorado
Experience: Twenty seven years of service with APHIS Wildlife Services. Certified Occupational Health and Safety Technologist through the joint Board of Industrial Hygiene and Certified Safety Professionals since 1996. National Rifle Association Certified Instructor since 2007. Special expertise in occupational, chemical, biological, and radiological safety and health, environmental management, hazardous waste disposal, hazardous materials shipping, emergency response, workers compensation, and animal welfare regulations.

7.3 External Reviewers

An external reviewer with expertise in firearms and their risks was asked to review the document prior to the peer review process because he could not have been a peer reviewer due to particular APHIS rules.

Reviewer: Steve Hall
Position: Hunter Education Coordinator, Texas Parks and Wildlife, Austin Texas
Experience: Executive Director, International Hunter Education Association-USA, Denver, CO., Executive Director Texas Rifle Association, Austin, TX; Education Director Texas Parks and Wildlife, Austin, TX (retired).

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

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

Arizona Game and Fish Department
Louisiana Department of Wildlife and Fisheries
South Dakota Game, Fish and Parks
Tennessee Wildlife Resources Agency
Wyoming Game and Fish Department

7.3.2 Comments

Comments regarding the quality of the risk assessment and concerns with a response:

1. **Comment:** Training requirements should be explained in document more thoroughly, specifically requirements and qualifications for 'Continued Proficiency.' How many hours of training are required? Is it hands on training? Is this conducted in house or at a gun range?
   Response: Included in Section 1.

2. **Comment:** It would also be nice to know how records of firearms proficiency are kept within the agency to prove safe weapon handling training and proficiency testing is tracked.
   Response: This is tracked in each personnel training files, and available to supervisors and management.

3. **Comment:** I would suggest not citing information that is not easily found through searches; I could not locate: B. Griffin, K. Davis, and B. C. West *Advanced Riflery for the Wildlife Professional: Recommended Best Practices*.
   Response: We left this document in the risk assessment because it was an important resource. We did try to find a link for it on the internet, but were unable as well. This document is available through the USDA APHIS WS National Wildlife Research Center library.

4. **Comment:** This document might serve best as a chapter in a book on risk assessment where the chapters on these and other risks could be referenced and found easily.
   Response: The Risk Assessments will be posted on the WS website on-line in Chapter format.

5. **Comment:** The quality of these figures (*Figures 2, 3, and 4*) could be better.
   Response: We found a better source and changed them.

6. **Comment:** Are the three basic rules of firearm safety a written policy? How is this enforced?

Response: The three basic rules are the foundation of safe firearm handling, which is a policy. Supervisors have the latitude of requiring additional training, not allowing use of a firearm based on poor handling, or initiating personnel actions, depending on the gravity of a particular situation.

7. **Comment:** Is there a process for investigating accidents and incidents?
   Response: The WS Firearms Committee tracks and reviews all firearms accidents and incidents, including site-visits as necessary. More discussion of these was provided in several sections of the document.

8. **Comment:** Kill and euthanize are the same thing, pick one.
   Response: In the context of the risk assessment, kill refers to removing an animal through shooting which can include euthanasia, but euthanize specifically refers to an animal captured with another WDM method such as a foothold trap or approached due to injury and killed, or more appropriately euthanized, *via* shooting.

9. **Comment:** I wouldn't consider a raccoon a "larger" animal.
   Response: This was clarified in the document, but raccoons, though typically small (12-25 pounds), can be considered large when they exceed 50 pounds, which occurs.

10. **Comment:** Need more information (e.g., how they work and kill animals) and clarification on air-activated bolt traps ("Goodnature").
    Response: This is discussed in detail in the *Use of Quick –kill Traps in Wildlife Damage Management Risk Assessment* and was dropped from discussion in this Risk Assessment. They are mentioned because they are a pneumatic device that functions similar to air rifles, but are activated by the animal and not a person.

11. **Comment:** "…*many mammals, such as prairie dogs, are already within their home range and will only disperse to their burrow*" contradicts the statement immediately above where it was stated that 15,410 prairie dogs were killed.
    Response: This paragraph in Section 1.4 was edited for clarification.

12. **Comment:** Perhaps explain why larids and waterfowl are hazardous.
    Response: Both groups of species are especially hazardous at airports where they cause many aircraft strikes resulting in millions of dollars damage annually in the United States. Large, flocking birds are especially dangerous because they have the highest potential to cause catastrophic losses of aircraft and their passengers. Additional information was inserted into the risk assessment.

13. **Comment:** Would suggest you remove this "*WS requires stringent firearm training of employees, which has likely resulted in fewer accidents*", unless you can document or verify.
    Response: This statement was removed, but we believe WS has relatively few accidents as a result of training.

Commenters provided editorial suggestions and these were appreciated and corrected. They also gave comments on the risk assessment not requiring a response, including:

1. **Comment:** I reviewed the risk assessment and believe the methods described are adequate and safe. Thank you for the opportunity to participate in this review.

2. **Comment:** Other than noted comments, I think this document is thorough and well done.

3. **Comment:** I and some of my selected staff have reviewed the risk assessment. We believe the methods and techniques described are safe and comprehensive. We have no other comments.

4. **Comment:** Good comprehensive review and it appears all aspects were properly addressed.

Appendix 1. "Other Species" Included in Tables.

Table 2a

Other predator = mountain lion, mink, long-tailed weasel, short-tailed weasel (ermine), coati, hog-nosed skunk, hooded skunk, and western spotted skunks.

Other hoofed mammal = peccary, elk, red deer, fallow deer*, Philippine deer, caribou, moose, pronghorn, feral cattle*, goat*, bighorn sheep, and feral sheep*

Other rodent and rabbit = white-tailed prairie dog, spotted ground squirrel, Cascade golden-mantled ground squirrel, Botta's pocket gopher, Plains pocket gopher, eastern chipmunk, red squirrel, western gray squirrel, Mexican woodrat, swamp rabbit, and snowshoe hare

Other mammal = coast mole, big brown bat, little brown Myotis, and unknown bat (0.4 lethal take).

Table 2b

Other dove = island collared-dove*, common ground-dove, and band-tailed pigeon

Other corvid = blue jay, California scrub-jay, and yellow-billed magpie

Other raptor = white-tailed kite, swallow-tailed kite, sharp-shinned hawk, Harris's hawk, broad-winged hawk, great gray owl, snowy owl, barred owl, burrowing owl, caracara, merlin, prairie falcon, and peregrine falcon

Other gallinaceous bird = guinea fowl*, scaled quail, California quail, Gambel's quail, northern bobwhite, sharp-tailed grouse, willow ptarmigan, chukar, and gray partridge*

Other aerialist = lesser nighthawk, chimney swift, violet-green swallow, and northern rough-winged swallow

Other forest bird = greater roadrunner, belted kingfisher, acorn woodpecker, golden-fronted woodpecker, pileated woodpecker, monk parakeet, and yellow-headed Amazon

Other grassland passerine = black phoebe, Say's phoebe, great gray shrike, Lapland longspur, chipping sparrow, field sparrow, lark sparrow, grasshopper sparrow, fox sparrow, song sparrow, Lincoln's sparrow, golden-crowned sparrow, dark-eyed junco, dickcissel, and bobolink

Other forest passerine =Bohemian waxwing, cedar waxwing, white-breasted nuthatch, gray catbird, brown thrasher, curve-billed thrasher, eastern bluebird, western bluebird, Swainson's thrush, American dipper, gray-crowned rosy-finch, purple finch, American goldfinch, pine siskin, and blue grosbeak

Other invasive passerine = red-whiskered bulbul* and saffron finch*

Table 2c

Other larid = black-legged kittiwake, red-legged kittiwake, Heermann's gull, Thayer's gull, lesser black-backed gull, Caspian tern (0.2 NK) , royal tern (0.2 NK), sandwich tern, least tern, arctic tern, common tern, Forster's tern, parasitic jaeger, long-tailed jaeger, and black skimmer

Other waterfowl = Taiga bean goose, Ross's goose, trumpeter swan, tundra swan, Eurasian wigeon, Eurasian teal, canvasback, common eider, harlequin duck, surf scoter, white-winged scoter, black scoter, long-tailed duck, common goldeneye, and red-breasted merganser

Other waterbird = red-throated loon, Pacific loon, common loon, Laysan albatross, red-necked grebe, horned grebe, eared grebe, western grebe, brown pelican (0.2 NK), Brandt's cormorant (1.4 NK), pelagic cormorant, marbled murrelet (AK), and parakeet auklet

Other wading bird= roseate spoonbill, American bittern, yellow bittern*, tricolored heron, common gallinule

Other shorebird = black oystercatcher, American oystercatcher, American avocet, Pacific golden-plover, American woodcock, short-billed dowitcher, long-billed dowitcher, Hudsonian godwit, marbled godwit, solitary sandpiper, spotted sandpiper, ruddy turnstone, black turnstone, surfbird, western sandpiper, white-rumped sandpiper, pectoral sandpiper, rock sandpiper, buff-breasted sandpiper, Wilson's phalarope, and red-necked phalarope

Table 2d

Other reptile = American alligator, spectacled caiman*, pond slider**, common snapping turtle**, black spinytail iguana*, black-and-white tegu*, Nile monitor*, gophersnake, copperhead, cottonmouth, western diamond-backed rattlesnake, prairie rattlesnake, and Indian python*

Table 3

Other corvid = gray jay, black-billed magpie, and yellow-billed magpie

Other raptor = turkey vulture, osprey, white-tailed kite, northern goshawk, northern harrier, Swainson's hawk, red-tailed hawk, rough-legged hawk, snowy owl, great horned owl, great gray owl, northern hawk owl, short-eared owl, American kestrel, and merlin

Gallinaceous bird = ring-necked pheasant and wild turkey

Other non-passerine forest bird = belted kingfisher and northern flicker

Other passerine = scissor-tailed flycatcher, great gray shrike, Lapland longspur, snow bunting, Lincoln's sparrow, dark-eyed junco, eastern meadowlarks, western meadowlarks, Bohemian waxwing, Swainson's thrush, American robin, American dipper, common redpoll, pine siskin, yellow warbler, and yellow-rumped warbler

Other larid = Bonaparte's gull, mew gull, great black-backed gull, western gull, Thayer's gull, and Caspian tern.

Other waterfowl = greater white-fronted goose, snow goose, trumpeter swan, tundra swan, gadwall, American black duck, blue-winged teal, redhead, ring-necked duck, harlequin duck, surf scoter, white-winged scoter, black scoter, long-tailed duck, hooded merganser, and common merganser

Other waterbird = red-throated loon, Pacific loon, common loon, red-necked grebe, horned grebe, brown pelican, pelagic cormorant, double-crested cormorant, and anhinga.

Other wading bird = cattle egret, great blue heron, great egret, snowy egret, American coot, and sandhill crane

Other shorebird = American and Pacific golden-plovers, gray plover, killdeer, Wilson's snipe, short- and long-billed dowitchers, whimbrel, long-billed curlew, upland sandpiper, greater and lesser yellowlegs, spotted sandpiper, semipalmated sandpiper, western sandpiper, pectoral sandpiper, rock sandpiper, and red-necked phalarope

Other predator = feral cat, bobcat, coyote, feral dog, red fox, black bear, river otter, mink, and coati

Other hoofed mammal = peccary, white-tailed deer, caribou, and pronghorn

Other rodent = beaver, red squirrel, porcupine, and black rat.