ENVIRONMENTAL ASSESSMENT
(FINAL)

MANAGING DAMAGE CAUSED BY MAMMAL AND REPTILE SPECIES IN PUERTO RICO

PREPARED BY:

UNITED STATES DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE WILDLIFE SERVICES

In consultation with:

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APRIL 2021

EXECUTIVE SUMMARY

Wildlife are an important public resource that can provide economic, recreational, emotional, and esthetic benefits to many people. However, wildlife can cause damage to agricultural resources, natural resources, property, and threaten human safety. When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance from other entities. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program is the lead federal agency responsible for managing conflicts between people and wildlife. Therefore, people experiencing damage or threats of damage associated with wildlife could seek assistance from WS. In Puerto Rico, WS has and continues to receive requests for assistance to reduce and prevent damage associated with several mammal and reptile species that are not native to the Commonwealth. In addition, WS could receive requests for assistance associated with several native bat species.

The National Environmental Policy Act (NEPA) requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes. Therefore, if WS provided assistance by conducting activities to manage damage caused by mammal and reptile species, those activities would be a federal action requiring compliance with the NEPA. The NEPA requires federal agencies to have available and fully consider detailed information regarding environmental effects of federal actions and to make information regarding environmental effects available to interested persons and agencies. To comply with the NEPA, WS prepared this Environmental Assessment (EA) to determine whether the potential environmental effects caused by several alternative approaches to managing mammalian and reptilian damage might be significant, requiring the preparation of an Environmental Impact Statement (EIS). WS developed this EA under the 1978 NEPA regulations and existing APHIS NEPA implementing procedures because WS initiated this EA prior to the NEPA revisions that went into effect on September 14, 2020.

Chapter 1 of this EA discusses the need for action and the scope of analysis associated with requests for assistance that WS receives involving several mammal and reptile species in Puerto Rico. Chapter 2 identifies and discusses the issues that WS identified during the scoping process for this EA and through consultation with Commonwealth and federal agencies. Issues are concerns regarding potential effects that might occur from proposed activities. Federal agencies must consider such issues during the decision-making process required by the NEPA. Chapter 2 also discusses the alternative approaches that WS developed to meet the need for action and to address the issues identified during the scoping process.

Issues of concern addressed in detail include: 1) effects on target mammal and reptile populations, 2) effects on nontarget species, including Threatened and Endangered species, 3) effects of management methods on human health and safety, and 4) humaneness and animal welfare concerns of methods. Alternative approaches evaluated to meet the need for action and to address the issues include: 1) continuing the current integrated methods approach to managing damage, 2) using an integrated methods approach using only nonlethal methods, 3) addressing requests for assistance through technical assistance only, and 4) no involvement by WS. Depending on the alternative approach, several methods would be available to manage damage caused by mammal and reptile species. Appendix B discusses the methods that WS could consider when responding to a request for assistance.

Chapter 3 provides information needed for making informed decisions by comparing the environmental consequences of the four alternative approaches in comparison to determine the extent of actual or potential impacts on each of the issues. WS will use the analyses in this EA to help inform agency decision-makers on the significance of the environmental effects, which will aid the decision-makers with determining the need to prepare an EIS or concluding the EA process with a Finding of No Significant Impact.

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ACRONYMS

APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CSJNR	Las Cabezas de San Juan Nature Reserve
CWCS	Comprehensive Wildlife Conservation Strategy
DNER	Department of Natural and Environmental Resources
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FY	Federal Fiscal Year
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
PEP	Post-exposure Prophylaxis
PRGAP	Puerto Rico Gap Analysis Project
PRDA	Puerto Rico Department of Agriculture
SWAP	Puerto Rico State Wildlife Action Plan
T&E	Threatened and Endangered
UAV	Unmanned Aerial Vehicle
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WS	Wildlife Services

CHAPTER 1: NEED FOR ACTION AND SCOPE OF ANALYSIS

1.1 INTRODUCTION

Wildlife are an important public resource greatly valued by people. In general, people regard wildlife as providing economic, recreational, emotional, and esthetic benefits. Knowing that wildlife exists in the natural environment provides a positive benefit to many people. However, the behavior of animals may result in damage to agricultural resources, natural resources, property, and threaten human safety. Therefore, wildlife can have either positive or negative values depending on the perspectives and circumstances of individual people.

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of wildlife and can be an integral component of wildlife management (Berryman 1991, Reidinger and Miller 2013, The Wildlife Society 2015) and the North American Model of Wildlife Conservation (Organ et al. 2010, Organ et al. 2012). Resolving damage caused by wildlife requires consideration of both sociological and biological carrying capacities. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988).

The cultural carrying capacity is especially important because it defines the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower or already met. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety. Therefore, the wildlife acceptance capacity helps define the range of wildlife population levels and associated damages acceptable to individuals or groups (Decker and Purdy 1988, Decker and Brown 2001).

Animals have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter, reproduce) where they can find a niche. If their activities result in lost value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance. The threshold triggering a person to seek assistance with alleviating damage or threats of damage is often unique to the individual person requesting assistance and many factors (*e.g.*, economic, social, esthetics) can influence when people seek assistance. Therefore, the threshold of damage that triggers a person to seek assistance is often unique to the individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with an animal or animals is actual damage requiring assistance (*i.e.*, has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the esthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person. The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management could occur from specific threats to resources.

When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance from other entities. The United States Department of Agriculture (USDA), Animal

and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program is the lead federal agency responsible for managing conflicts between people and wildlife (USDA 2019*a*)(see WS Directive 1.201)[1]. The primary statutory authority for the WS program is the Act of March 2, 1931 (46 Stat. 1468; 7 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353). WS' directives define program objectives and guide WS' activities when managing wildlife damage (see WS Directive 1.201, WS Directive 1.205, WS Directive 1.210). Therefore, people experiencing damage or threats of damage associated with wildlife could seek assistance from WS. The WS program has offices in Puerto Rico that provide assistance with managing damage caused by animals when people request such assistance.

1.2 NEED FOR ACTION

In Puerto Rico, WS has and continues to receive requests for assistance to reduce and prevent damage associated with several species of mammals and reptiles. WS has identified those species most likely to be responsible for causing damage in Puerto Rico based on previous requests for assistance and in anticipation of receiving requests for assistance in the future. Those species include Norway Rats (*Rattus norvegicus*), Black Rats (*Rattus rattus*), House Mice (*Mus musculus*), Rhesus Macaques (*Macaca mulatta*), Patas Monkeys (*Erythrocebus patas*), Squirrel Monkeys (*Saimiri sciureus*), Indian Mongooses (*Herpestes auropunctatus*), Feral and Free-ranging Cats (*Felis catus*), Feral and Free-ranging Dogs (*Canis familiaris*), Feral Swine (*Sus scrofa*), Feral Goats (*Capra hircus*), White-tailed Deer (*Odocoileus virginianus*), Spectacled Caimans (*Caiman crocodilus*), Green Iguanas (*Iguana iguana*), Yellow Anacondas (*Eunectes notaeus*), Boa Constrictors (*Boa constrictor*), Dumeril's Boas (*Acrantophis dumerili*), North African Pythons (*Python sebae*), Reticulated Pythons (*Malayopython reticulatus*), Indian Pythons (*Python molurus*), and Burmese Pythons (*Python bivittatus* [=*Python molurus bivittatus*]), which are species that are not native to Puerto Rico.

The number of invasive species introduced in the history of the United States has been estimated at 50,000 species (Pimentel et al. 2000, Pimentel et al. 2005). Beneficial impacts to society and economic gains can be derived from invasive species, especially those used and cultivated for human consumption. However, many invasive species, when introduced into a naive environment, can cause substantial economic and environmental damage. The introduction or release of invasive wildlife and plants into naive ecosystems often has harmful effects on native flora and fauna (Pimentel et al. 2000, Long 2003, Pimentel et al. 2005, Witmer and Jojola 2006). Invasive flora and fauna can also cause substantial economic consequences. For instance, Pimentel et al. (2005) estimated that damages associated with invasive species and their control amount to approximately $120 billion annually in the United States. Negative economic and environmental impacts are especially true if the invasive species exhibit generalist behaviors to which the native flora or fauna are not adapted, as is the case on many islands. Thus, invasive species have been identified as a primary cause of endangerment of at least 40% of the species listed as Threatened or Endangered in the United States (Wilcove et al. 1998).

WS could also receive requests for assistance from people that are concerned about bats inside structures, such as bats roosting inside the attic of a home. Bat species found in Puerto Rico include the Jamaican Fruit-eating Bat (*Artibeus jamaicensis*), Antillean Fruit-eating Bat (*Brachyphylla cavernarum*), Big Brown Bat (*Eptesicus fuscus*), Brown Flower Bat (*Erophylla bombifrons*), Eastern Red Bat (*Lasiurus borealis*), Velvety Free-tailed Bat (*Molossus molossus*), Greater Antillean Long-tongued Bat (*Monophyllus redmani*), Antillean Ghost-faced Bat (*Mormoops blainvillii*), Greater Bulldog Bat (*Noctilio leporinus*), Parnell's Mustached Bat (*Pteronotus parnellii*), Sooty Mustached Bat (*Pteronotus*

[1]At the time of preparation, WS' Directives occurred at the following web address: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_WS_Program_Directives.

quadridens), Red Fig-eating Bat (*Stenoderma rufum*), and Brazilian Free-tailed Bat (*Tadarida brasiliensis*). Bats are the only native mammal species in Puerto Rico.

As discussed in Section 1.1, when people seek assistance with managing wildlife damage, they may seek assistance from WS. Therefore, the need for action to manage damage and threats associated with target species in Puerto Rico arises from requests for assistance[2] that WS could receive to reduce and prevent damage from occurring. The target species found in Puerto Rico can cause damage to agricultural resources, natural resources, property, and pose threats to human safety. Except for the bat species, the target species addressed in this EA are non-native species in Puerto Rico and can be invasive throughout their introduced ranges.

Table 1.1 shows the target species associated with requests for assistance that WS could receive and the resource types those species could damage in Puerto Rico. Many of those target species listed in Table 1.1 could pose a threat to aircraft when those target species occur at or near air facilities. Aircraft strikes with mammals and reptiles can cause substantial damage to aircraft, which can require costly repairs. In addition, strikes with mammals and reptiles can lead to the catastrophic failure of aircraft, which can pose a threat to the safety of people. WS could provide assistance with projects to reduce damage or threats of damage to property. For example, many of the target species found in Puerto Rico can cause collisions with automobiles, landscaping damage by consuming expensive plants, and the undermining of sidewalks, roads, and bridges. Damage could also occur to agricultural resources, primarily from target species that consume livestock feed, feed on livestock, or pose disease risks to livestock. Similarly, threats to natural resources would primarily be associated with target species preying upon Threatened and Endangered (T&E) species or competing with other wildlife species for resources.

Table 1.1 – Target species that WS could address and the resource types damaged.

	Resource*					Resource*			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Norway Rat	X	X	X	X	**White-tailed Deer**	X	X	X	X
Black Rat	X	X	X	X	**Spectacled Caiman**	X	X	X	X
House Mouse	X	X	X	X	**Green Iguana**	X	X	X	X
Rhesus Macaque	X	X	X	X	**Boa Constrictor**	X	X	X	X
Patas Monkey	X	X	X	X	**Reticulated Python**	X	X	X	X
Squirrel Monkey	X	X	X	X	**North African Python**	X	X	X	X
Indian Mongoose	X	X	X	X	**Indian Python**	X	X	X	X
Feral Cat	X	X	X	X	**Burmese Python**	X	X	X	X
Feral Dog	X	X	X	X	**Yellow Anaconda**	X	X	X	X
Feral Swine	X	X	X	X	**Dumeril's Boa**	X	X	X	X
Feral Goat	X	X	X	X	**Bats (All species)**			X	X

*A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

Some of the species addressed in this EA are often found in large groups, especially in response to abundant food sources, available fresh water sources during a drought, or during the breeding season. Many of the species addressed in this EA may occur in large groups throughout the year. Large congregations of animals can present increased risks when those species occur near or on airport properties. Aircraft striking multiple target species not only can increase the damage to the aircraft but can also increase the risk that a catastrophic failure of the aircraft might occur. The following subsections of the EA provide additional information regarding the need to manage damage caused by target species.

[2]WS would only conduct target species damage management after receiving a request for assistance. Before initiating target species damage activities, WS and the cooperating entity must sign a Memorandum of Understanding, work initiation document, or another comparable document that lists all the methods the property owner or manager would allow WS to use on property they own and/or manage.

1.2.1 Need to Resolve Damage to Agricultural Resources Caused by Target Species

Agriculture is an important industry in Puerto Rico. During 2018, the National Agricultural Statistics Service (NASS) reported 473,734 acres were devoted to agricultural production in Puerto Rico with a market value of agricultural products sold estimated at approximately $485 million (NASS 2020). The top three farm commodities for sales were livestock, poultry, and their products; milk and other dairy products from cows; and grains or field crops (NASS 2020). The cattle inventory in the Commonwealth in 2018 was over 234,000 individuals and the sale of cattle and calves accounted for $37.7 million in sales while milk and other dairy products from cows accounted for $172.2 million in sales (NASS 2020). There were nearly 46,000 domestic swine across 464 farms in Puerto Rico, with an estimated $6.2 million in sales (NASS 2020). There were also nearly nine million poultry in the Commonwealth during 2018 with nearly $20.1 million in sales (NASS 2020).

The production value of crops sold in Puerto Rico accounted for approximately $242.4 million in sales (NASS 2020). A variety of crops are grown including: coffee; pineapples; plantains; bananas; grains or field crops; root crops or tubers; fruits and coconuts; vegetables and melons (including hydroponic crops); nursery and greenhouse crops, floriculture, and sod; and grasses. The market value of aquaculture products was estimated at $136,000 in 2018 (NASS 2020). The aquaculture industry in the Commonwealth primarily focuses on tilapia, which accounted for $130,000 in sales (NASS 2020).

Numerous wildlife species can cause damage to agricultural resources. Damage can occur through direct consumption of agricultural crops, the contamination of resources from fecal droppings, or the threat of predation or disease transmission to livestock and poultry. During 2001, crop and livestock losses from wildlife in the United States totaled $944 million, with field crop losses totaling $619 million, livestock and poultry losses totaling $178 million, and losses of vegetables, fruits, and nuts totaling $146 million (NASS 2002). As shown in Table 1.1, many of the target species addressed in this EA have been identified as causing damage to or posing threats to agricultural resources in Puerto Rico.

Damage and Threats to Livestock Operations

Many of the target species found in Puerto Rico present risks to livestock operations, primarily through potential disease transmission. Feral Swine are potential reservoirs for several diseases that are known to be transmissible between Feral Swine and domestic livestock (Wood and Barrett 1979, Corn et al. 1986, Beach 1993, Davidson 2006). For example, Corn et al. (1986) found Feral Swine tested in Texas were positive for pseudorabies, brucellosis, and leptospirosis. A study in Oklahoma found samples from Feral Swine tested positive for antibodies of porcine parvovirus, swine influenza, and porcine reproductive and respiratory syndrome virus (Saliki et al. 1998). Cholera, trichinosis, and African swine fever are additional diseases that can be transmitted between livestock and Feral Swine.

Disease transmission is likely to occur where domestic livestock and Feral Swine have a common interface, such as at water sources and livestock feeding areas. Despite concerns about disease transmission, Feral Swine are often found on properties with livestock operations. In a survey of livestock producers from 13 states, Anderson et al. (2019) reported that Feral Swine were present on 37% of livestock operations within the previous three years. Furthermore, 30% of livestock producers indicated that Feral Swine had access to the same areas that livestock were kept (Anderson et al. 2019).

Although several diseases that are carried by swine are also transmissible to other livestock, the primary concern is the potential transmission of diseases from Feral Swine to domestic swine. Pseudorabies is a viral disease associated with an extremely contagious herpes virus that can have negative effects on reproduction in domestic swine. Brucellosis is a bacterial disease that can also have negative effects on reproduction in swine. Many of the other diseases associated with Feral Swine also negatively affect the

health and marketability of domestic swine that can lead to economic losses to the livestock producer. A disease outbreak not only has negative economic implications to the individual livestock producer, but also can cause economic losses that can negatively affect the nationwide swine industry. The United States is one of the world's largest producers of pork and is the second largest exporter of pork. Pork production in the United States accounts for about 10% of the total world supply. The retail value of pork sold to consumers exceeds $30 billion annually. In addition, the pork industry supports more than 600,000 jobs. An economic analysis estimated that the annual cost of pseudorabies to pork producers in the United States at more than $30 million annually in lost production as well as testing and vaccination costs (USDA 2008*a*).

Feral Cats are another species that could transmit diseases to livestock. Cats can transmit *Toxoplasma gondii* to both domestic and wild animal species. Cats are important reservoirs and the only species known to allow for the completion of the life cycle for the protozoan parasite *T. gondii* (Wang et al. 2012, Cornell University 2018). Both feral and domiciled cats may be infected by this protozoan, but this infection is more common in Feral Cats. Fitzgerald et al. (1984) documented that Feral Cats transmitted *T. gondii* to sheep in New Zealand, resulting in ewes aborting fetuses. The authors also found *Sarcocystis* spp. contamination in the musculature of sheep. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *T. gondii* on swine farms in Illinois. The main sources for infecting cats are thought to be birds and mice (Dubey et al. 1995).

Indian Mongooses also serve as a reservoir for many pathogens that can be transmitted to livestock, such as *Salmonella* spp. and rabies. Salmonellosis in livestock is often subclinical. However, young calves, piglets, lambs, and foals may develop both the enteritis and septicemic form of salmonellosis (Gruenberg 2015). Adult cattle, sheep, and horses commonly develop acute enteritis, and chronic enteritis may develop in growing pigs and occasionally in cattle (Gruenberg 2015). Cattle may also experience dehydration and a drop in milk production (Wray and Davies 2000). Pregnant livestock may abort unborn fetuses (Wray and Davies 2000, Gruenberg 2015). Rabies is another disease that mongoose can transmit to livestock. Although rare, rabies has been documented in several livestock species in Puerto Rico, including swine, cattle, horses, and goats (Tierkel et al. 1952, Everard and Everard 1992). Mongooses often build dens in proximity to human residences and farms (Horst et al. 2001), increasing the chances that rabies, *Salmonellosis* spp., or other pathogens and diseases are transmitted to livestock.

Wildlife can also present other threats to domestic livestock. In 2015, the USDA (2017) reported cattle and calf losses from animal predation totaled approximately 280,570 head in the United States according to livestock producers. Animal predation represented approximately 2.4% of adult cattle and 11.1% of calf economic losses reported by livestock producers in 2015 totaling $183.6 million in economic losses. For producers in the United States that spent money on control methods, the average amount spent on nonlethal methods was $3,000 and about $300 for lethal methods (USDA 2017). The primary nonlethal method employed by livestock producers was the use of guard animals with a reported 8.3% of producers using guard animals. Producers also reported using exclusion fencing, frequent checking, culling, and carcass removal as additional employed methods for reducing predation (USDA 2017).

Many of the wildlife species that caused the most damage to livestock throughout the United States are not found in Puerto Rico. However, one species found in Puerto Rico that caused considerable damage is dogs, which accounted for 11.3% of livestock predation throughout the United States (USDA 2017). Feral and Free-ranging Dogs are documented to predate on sheep, goats, and cattle (Carter 1990, NASS 2000, Bergman et al. 2009). A national survey of sheep losses due to predators reported that 15.1% of all losses were due to dogs, resulting in nearly $3 million in losses in 1999 (NASS 2000). Furthermore, Carter (1990) reported that Feral Dogs caused over $5 million in damages to livestock during 1989 in Texas alone.

Feral Swine are also known to predate on livestock, including calves, kids, lambs, and poultry (West et al. 2009, Stevens 2010). Seward et al. (2004) reported that Feral Swine cause greater than $1.2 million in goat losses in the United States annually. Predation occurs primarily on young livestock but Feral Swine can also kill weakened or injured livestock. Feral Swine can also cause damage to ponds and water sources for livestock. Wallowing and rooting activities in livestock watering areas can lead to a degradation in water quality caused by increased turbidity, induced algal blooms, depletion of dissolved oxygen, and increased erosion (Beach 1993).

Several target species in Puerto Rico can cause damage at poultry farms. Indian Mongooses are a major predator of domestic poultry (Yamada and Sugimura 2004, Holmern and Røskaft 2014). In Puerto Rico, mongoose predation has resulted in some farmers being unable to allow their free-ranging poultry to roam in their yards (Pimentel 1955). Reticulated Pythons and Boa Constrictors have also been documented to predate on poultry (Shine et al. 1998, Shine et al. 1999, Amador-Alcalá et al. 2013). Rodents can predate on poultry eggs and even young chicks (Parshad 1999, Mohan Rao and Sakthivel 2015). Rodents can also consume and contaminate poultry feed, as well as cause damage to egg trays and poultry house structures (Parshad 1999, Mohan Rao and Sakthivel 2015). Given that rodents can occur in large densities, rodents can cause substantial economic losses at poultry facilities (Brooks and Fiedler 1999, Parshad 1999, Mohan Rao and Sakthivel 2015).

Damage to Agricultural Crops

Many of the target species found in Puerto Rico can cause damage to agricultural crops. During 2001, field crop losses caused by wildlife damages totaled $619 million, while losses of vegetables, fruits, and nuts totaled $146 million (NASS 2002). White-tailed Deer and Feral Swine were among the species that caused the most damage. White-tailed Deer accounted for 58% of the total field crop damage and 33% of vegetable, fruit, and nut damage, while Feral Swine accounted for 3% of the total field crop damage (NASS 2002).

White-tailed Deer are commonly reported as the primary source of wildlife damage (Conover and Decker 1991, Conover et al. 2018). Conover (1994) found that 67% of farmers surveyed throughout the United States reported problems with deer. White-tailed Deer damage a broad variety of vegetables, row crops, fruit, nursery stock, stacked hay, and ornamentals.

Feral Swine can cause damage through direct consumption of agricultural crops and from trampling, rooting, and wallowing, which can destroy fields or reduce productivity (Beach 1993, USDA 2015). Field crops commonly damaged by Feral Swine include sugar cane, corn, grain sorghum, wheat, oats, peanuts, and rice, among others. Feral Swine can also damage vegetable and fruit crops, such as lettuce, spinach, melons, and pumpkins (Schley and Roper 2003, Seward et al. 2004). Feral Swine can also consume, contaminate, and damage livestock feed and grains, resulting in costly losses to farmers (Poudyal et al. 2017). Poudyal et al. (2017) estimated that Feral Swine damaged or destroyed more than $2 million worth of feed and grains in Tennessee during 2015.

Rooting is a common activity of Feral Swine during their search for food where they overturn sod and soil (West et al. 2009, Stevens 2010, Hamrick et al. 2011). Feral Swine also wallow in water and mud to regulate body temperature and to ward off skin parasites. Rooting and wallowing activities exhibited by Feral Swine can damage pastures, land used for hay, and sod farms (Beach 1993). Erosion and soil loss can occur from the removal of vegetation that leaves the soil bare along with the overturning of soil caused by rooting activities. Because Feral Swine often travel in family groups, damages from rooting and wallowing can be extensive, often encompassing several acres. Feral Swine also damage farm facilities, such as fences, water supplies, irrigation ditches, and guzzlers (West et al. 2009).

Economic losses caused by Feral Swine can be substantial. For example, Shi et al. (2010) estimated over $74 million in damage to Alabama's agricultural crops. In Louisiana, Tanger et al. (2015) reported $53 million in production losses and an additional $21 million in increased costs to the state's agricultural sector in 2013. Tanger et al. (2015) also noted that the Wild Pig Task Force in South Carolina estimated $45 million in wild pig related damage. Mengak (2016) estimated $150 million in total damage across the entire state of Georgia. In Texas, $52 million in statewide annual damage to agricultural production was estimated (Timmons et al. 2012).

Introduced rodents, such as Black Rats, Norway Rats, and House Mice, can damage corn, orchards, grain, legumes, and sugarcane crops in the field before harvest (Worth 1950, Kami 1966, Timm 1994*a*, Timm 1994*b*, Tobin et al. 1997). Rodents also consume and destroy stored grains (Marsh 1994, Ahmed et al. 1995). Pimentel et al. (2005) estimated that approximately one billion rats on farms throughout the United States could cause damages to stored grains and other materials exceeding $19 billion per year.

Engeman et al. (2010) estimated that Rhesus Macaques and Patas Monkeys caused over $1.4 million in total losses annually to commercial farms in Puerto Rico. These losses included direct damage to crops and land use switches to less profitable alternatives, such as alternative crops, pastureland, and hay fields (Engeman et al. 2010). Engeman et al. (2010) also suggested that actual total losses from monkeys in Puerto Rico is likely much higher because the study did not include small plot farms and gardens. Damages from monkeys primarily occurred to pumpkins, watermelons, corn, cucumbers, bananas, papayas, and plantains (Engeman et al. 2010).

Green Iguanas can damage and destroy crops. Iguanas have been reported to damage yams, yautias, pumpkin, and melons (López-Torres et al. 2011). However, reports of the extent or economic damage to agricultural crops caused by iguanas is scarce. Indian Mongoose can also damage agricultural crops, such as taros, sweet potatoes, melons, watermelons, and loquats (Yamada and Sugimura 2004).

1.2.2 Need to Resolve Threats that Target Species Pose to Human Safety

Many wildlife species listed in Table 1.1 can be closely associated with human habitation. The close association of those species with human activity can pose threats to human safety from disease transmission. In addition, any animals located on airfields can threaten the safety of air passengers if an aircraft strikes those animals. Furthermore, excessive droppings can be esthetically displeasing, accumulations of nesting material can pose a fire risk in buildings, and aggressive behavior can pose risks to human safety.

Threat of Disease Transmission

Zoonoses (*i.e.*, wildlife diseases transmissible to people) can be a concern of cooperators when requesting assistance from WS. Disease transmission could occur from direct interactions between people and wildlife or from interactions with pets and livestock that have direct contact with wild animals. Pets and livestock can encounter and interact with wildlife, which can increase the opportunity of transmission of disease to people. There are several viral, bacterial, mycotic (fungal), protozoal, and rickettsial pathogens that mammals and reptiles can transmit to people (*e.g.*, see Beran 1994, Davidson 2006).

The most common disease concern expressed by individuals requesting assistance is the threat of rabies transmission to people, pets, and companion animals. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal that poses an indirect and direct threat to people. Indirect threats to people occur from exposure from pets or livestock that have been infected from bites of a rabid animal. Direct threats can occur from handling infected wildlife or from aggressive animal behavior caused by rabies. The disease can be effectively prevented in people when exposure is

identified early and treated. In addition, domestic animals and pets can be vaccinated for rabies. However, the abundant and widely distributed reservoir among wild mammals complicates rabies control.

Over the last 100 years, the vector of rabies in the United States has changed dramatically. Over 90% of all animal cases reported annually to the Centers for Disease Control and Prevention (CDC) now occur in wildlife (Ma et al. 2018, CDC 2020*a*, Ma et al. 2020). Before 1960, the majority of cases were reported in domestic animals (CDC 2020*a*). Amongst wild animals in the United States, bats are one of the most common carriers of the rabies virus. In the United States, for every 10 human deaths caused by the rabies virus, seven were associated with infections caused by bats (CDC 2020*b*).

The number of rabies-related human deaths in the United States has declined from more than 100 annually in the early 1900s to an average of one or two people per year in the 1990s (CDC 2020*a*). Modern day prophylaxis, which is the series of vaccine injections given to people who have been potentially or actually exposed, has proven nearly 100% successful in preventing mortality when administered promptly (CDC 2020*a*). In the United States, human fatalities associated with rabies occur in people who fail to seek timely medical assistance, usually because they were unaware of their exposure to rabies. Although human rabies deaths are rare, the estimated public health costs associated with disease detection, prevention, and control have risen to approximately $245 to $510 million annually (CDC 2020*a*). Those costs include the vaccination of companion animals, maintenance of rabies laboratories, medical costs such as those incurred for exposure case investigations, rabies post-exposure prophylaxis (PEP), and animal control programs (CDC 2020*a*).

Accurate estimates of the aforementioned expenditures are not available. An estimated 55,000 people receive PEPs in the United States each year (CDC 2020*a*). When rabies becomes epizootic (*i.e.*, affecting a large number of animals over a large area) or enzootic (*i.e.*, present in an area over time but with a low case frequency) in a region, the number of PEPs in that area increases. Although the cost varies, a course of rabies immunoglobulin and four doses of vaccine given over a two-week period costs between $1,200 and $6,500, with an average of $3,800 per person (CDC 2020*a*). These costs do not include hospital treatment or wound care (CDC 2020*a*). As epizootics spread in wildlife populations, the risk of "*mass*" human exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increases. One case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for 71 persons (CDC 1999). The total cost of this single incident exceeded $160,000 based on a median cost of $2,376 per PEP in Massachusetts. Likely, the most expensive single mass exposure case on record in the United States occurred in 1994 when a kitten from a pet store in Concord, New Hampshire tested positive for rabies after a brief illness. Because of potential exposure to the kitten or to other potentially rabid animals in the store, at least 665 persons received post-exposure rabies vaccinations at a total cost of more than $1 million (Noah et al. 1995*a*).

All mammals can be reservoirs of rabies. However, the mongoose is likely the primary reservoir for the rabies virus in Puerto Rico (Berentsen et al. 2015*a*, Berentsen et al. 2018). Berentsen et al. (2015*a*) found that 33% of the mongooses sampled at the El Yunque National Forest were positive for rabies virus-neutralizing antibodies. In Puerto Rico, mongooses account for > 70% of reported rabies cases (Krebs et al. 1998, Dyer et al. 2014, Berentsen et al. 2015*a*, Johnson et al. 2016) and average 287 bite injuries to humans annually (Irizarry-Pasaarell 2011). Approximately 95% of people who report mongoose bites in Puerto Rico receive PEP (CDC 2017). In 2015, a man died after contracting rabies following a mongoose bite (CDC 2017). This was the first rabies-associated death directly related to a mongoose bite in Puerto Rico and the third overall rabies-associated death in Puerto Rico in the last century (CDC 2017). During 2015, there were 17 cases of rabies reported in Puerto Rico with eight cases involving mongoose and eight cases involving dogs (Birhane et al. 2017). All 17 cases of rabies reported in Puerto Rico were associated with the mongoose variant of the rabies virus during 2015 (Birhane et al. 2017).

There are concerns that interactions between monkeys and mongoose in Puerto Rico could lead to exposure of monkeys to the virus (USDA 2008*b*). If rabies becomes prevalent in the monkey population, human exposure through contact with monkeys could occur. In their native range, Rhesus Macaques often are commensal with humans (Jaman and Huffman 2013). Although Rhesus Macaques have yet to exhibit commensal relationships with humans in Puerto Rico, commensal behavior could increase the risk of humans contracting rabies from monkey bites.

Other zoonotic diseases that threaten human safety from exposure or handling of monkeys include, but are not limited to, Ebola, Marburg, malaria, tuberculosis, salmonella, shigella, campylobacter, giardiasis, monkeypox, and several simian immunodeficiency viruses (Renquist and Whitney 1987, Walter Reed Army Institute 1988, CDC 1989, CDC 1990, Wolfe et al. 1998, Cogswell 2000, Peeters et al. 2002). Most primate disease exposures are to laboratory researchers and Rhesus Monkey pet owners (Holmes et al. 1990, Jensen et al. 2004). However, if the invasive monkey populations expand in Puerto Rico, more people could encounter monkeys, which could lead to the increased possibility of disease transmission. The amount of crop damage occurring by monkeys has also led to an increase in the employment of damage management methods by local agricultural producers to reduce or alleviate monkey damage to crops, which can increase the chance of disease transmission. The illegal trapping of monkeys for sale as exotic pets could also increase the possibility of exposure (Jensen et al. 2004). Trapping and confinement can increase stress in monkeys, leading to the shedding of reactivated latent viruses (Jensen et al. 2004).

During an accident involving an automobile and an adult male Rhesus Monkey in Puerto Rico, 25 emergency personnel were exposed to blood and other bodily fluids of the adult monkey. The adult monkey later tested positive for antibodies to B-virus (*Cercopithecine herpesvirus*) (Jensen et al. 2004). B-virus is an alphaherpesvirus enzootic in the genus *Macaca*, which includes the Rhesus Monkey. B-virus exhibits mild effects in macaque hosts but is nearly 80% fatal in humans when contracted (Huff and Barry 2003, Jensen et al. 2004). The exposed emergency personnel in Puerto Rico were placed on antiviral medication and monitored for indication of possible contraction of the B-virus. After further investigation, no emergency personnel contracted B-virus. However, during follow-up interviews, all emergency personnel indicated they were unaware of the disease risks associated with monkeys, in particular Rhesus Monkeys (Jensen et al. 2004). The primary mode of transmission between infected monkeys and humans are bites and scratches (Jensen et al. 2004).

Most risk assessments and documented transmissions of the B-virus to humans have occurred at research facilities and few studies have been conducted to assess risks associated with wild populations of Rhesus Monkeys (Engel et al. 2002). B-virus, like other herpesviruses, is characterized by latency periods where the virus lies dormant in the trigeminal and lumbosacral ganglia (Jensen et al. 2004). Stressing of the animal can lead to a shedding of the virus, which can occur during illness, transport, breeding, confinement, and from other environmental stressors. Kapsalis (1985) and Laudenslager et al. (1999) found that trapped and/or relocated monkeys can be stressed and act aggressive. Monkeys relocated to other unrelated monkey groups can cause high stress and potential mortality (Kessler et al. 1985).

Of concern is the high incidence of Rhesus Monkeys that are free ranging in Puerto Rico that are seropositive for the B-virus. In 1967, 82% of Rhesus Monkeys sampled on the Islet Santiago were seropositive for the B-virus, which is now considered enzootic on Islet Santiago (Kessler and Hilliard 1990). Of those monkeys tested, 23% of the yearling and two-year-old monkeys, 84% of three- to four year-old monkeys, and 100% of the Rhesus Monkeys > 5 years of age were seropositive for B-virus (Kessler and Hilliard 1990). Other published data also indicates a high rate of B-virus infection in adult Rhesus Monkeys ranging from 74% to 100% (Orcutt et al. 1976, Weigler 1992).

The National Institute for Occupational Safety and Health (2001) recommends that all macaques be treated as potentially infectious. Since the 1930s, 43 human deaths have been reported from exposure to

B-virus (National Institute for Occupational Safety and Health 2001, Engel et al. 2002). Most documented infections have occurred among laboratory researchers and pet owners. There has been one documented case of ocular exposure to B-virus while handling a macaque. The researcher died, even with treatment for B-virus exposure (National Institute for Occupational Safety and Health 2001).

Several known diseases that are transmittable to people, including rabies, can occur in Feral Cats and Feral Dogs (Vaughn 1976, Eng and Fishbein 1990, Beran 1994, Fitzwater 1994, Krebs et al. 1996, Heller et al. 1997, Davidson 2006). Diseases and parasites affecting Feral Cats and Feral Dogs can have particularly serious implications to human health given the close association of those animals with people and companion animals. Of special concern are those cats and dogs considered companion animals that are not confined indoors at all times but are allowed to range outside the home for extended periods. If interactions occur between companion animals and feral animals of the same species, companion animals could become exposed to a wide-range of zoonoses that could be brought back into the home where direct contact between the companion animal and people increases the likelihood of disease transmission. Feral animals that are considered companion animals are also likely to affect multiple people if disease transmission occurs because those animals are likely to come in direct contact with several members of families and friends before diagnosis of a disease occurs.

Most of the zoonoses known to infect cats and dogs that are infectious to people are not life threatening if diagnosed and treated early. However, certain societal segments can be at higher risks if exposed to zoonoses. Women who are pregnant, people receiving chemotherapy for immunologic diseases and organ transplants, and those with weakened immune systems are at increased risk of clinical disease if exposed to toxoplasmosis (Noah et al. 1995*b*). For example, in 1994, five Florida children were hospitalized with encephalitis that was associated with cat scratch fever (Noah et al. 1995*b*). A daycare center at the University of Hawaii in Manoa was closed for two weeks in 2002 because of concerns about potential transmission of murine typhus (*Rickettsia typhi*) and flea (*Ctenocephalides felis*) infestations afflicting 84 children and faculty (Kliks 2003).

The presence of bats inside the living space of residences or in attics can also be a disease concern. In addition to the threat of rabies from direct contact with a bat or a bat entering the living area of a home, there are other threats associated with bat colonies, including histoplasmosis and mites (Greenhall and Frantz 1994). Bat droppings, particularly when they accumulate over many years, are likely to contain the fungus *Histoplasma capsulatum*, or with fungi species, such as molds, especially in warm, moist conditions. When people disturb fecal accumulations containing *H. capsulatum* and inhale spores from the fungus, they may become ill with a disease known as histoplasmosis. Symptoms of histoplasmosis include some combination of mild, flu-like respiratory illness, a general ill feeling, fatigue, chills, fever, cough, headache, chest pain, and body aches (CDC 2020*c*). Although there are other, more rare illnesses associated with exposure, the most likely is histoplasmosis.

Bat bugs (*Cimex* spp.) are free-living ectoparasites of bats that feed on blood from bats. They will bite people in the absence of their primary hosts. The main means of dispersal for bat bugs is by clinging to the fur of bats as bats move between locations. Typically, bat bug infestations originate from bat populations established in attics, wall voids, unused chimneys, or uninhabited portions of a house. Bat bugs typically do not wander far from occupied bat roosting sites where they have easy access to food. However, if their normal hosts leave, bat bugs can seek other sources of food and may crawl about and invade living areas within a house and bite people. Although their bite is not particularly harmful, the person may experience an allergic reaction and develop a skin rash in response (Jones and Jordan 2004).

Feral Swine are potential reservoirs for at least 30 viral and bacterial diseases (Samuel et al. 2001, Williams and Barker 2001, Davidson 2006) and 37 parasites (Forrester 1991) that are transmissible to humans. Brucellosis, salmonellosis, toxoplasmosis, trichinosis, tuberculosis, and tularemia are some of

the common diseases that can be carried by Feral Swine that are also known to infect humans (Hubalek et al. 2002, Seward et al. 2004, Stevens 2010). Feral Swine are a potential vector for new forms of influenza because they have the required receptors for both avian and human strains of the virus, which provides an opportunity for the viruses to combine (Hall et al. 2008).

Green Iguanas can transmit the infectious bacterium *Salmonella* to humans through their feces (Sanyal et al. 1997, Sam and Mackay 2000). Green Iguanas defecating in swimming pools or food contacting fecal material while people are eating outside are two likely avenues Green Iguanas to pass *Salmonella* to humans (Krysko et al. 2007). Rodents, such as Norway Rats, Black Rats, and House Mice, serve as reservoirs of a number of diseases that may affect humans, including salmonellosis, leptospirosis, trichinosis, lymphocytic choriomeningitis, and toxoplasmosis (Meehan 1984, Gratz 1994). Black Rats can also transmit harmful nematodes to humans, including *Capillaria hepatica* (Berentsen et al. 2015*b*) and *Angiostrongylus cantonensis* (Wang et al. 2008).

This discussion on zoonoses is intended to briefly address the more commonly known zoonoses found in the United States for those species specifically addressed in this EA but is not intended to be an exhaustive discussion of all potential zoonoses. The transmission of diseases from wildlife to people is neither well documented nor well understood for most infectious zoonoses. Determining a vector for a human infected with a disease known to occur in wildlife populations is often complicated by the presence of the known agent across a broad range of naturally occurring sources. For example, a person with Salmonellosis may have contracted *Salmonella* bacterium from direct contact with an infected pet but may have also contracted the bacterium from eating undercooked meat or from other sources.

Disease transmission directly from wildlife to people is uncommon. However, the infrequency of such transmission does not diminish the concerns of those individuals requesting assistance that are fearful of exposure to a diseased animal because disease transmissions can occur. WS actively attempts to educate the public about the risks associated with disease transmission from wildlife to humans through technical assistance and by providing technical leaflets on the risks of exposure.

Threat to Human Safety associated with Aircraft Striking Wildlife at Airports and Military Bases

Mammals and reptiles can also pose a threat to human safety when struck by aircraft. Aircraft strikes involving mammals and reptiles could cause catastrophic failure of aircraft systems (*e.g.*, damage to landing gear), which can cause the aircraft to become uncontrollable leading to crashes. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft, causing additional damage to the aircraft and increasing the threat to human safety. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2004, Dolbeer et al. 2019).

Aircraft strikes involving mammals and reptiles that result in human injuries or fatalities is rare. It is more common for wildlife-aircraft strikes to result in expensive repairs, flight delays, or aborted aircraft movements than in injury or loss of human life. However, the potential does exist for injuries and human fatalities to occur when damage to an aircraft from a strike leads to a loss in control of the aircraft. From 1990 through 2018, Dolbeer et al. (2019) reported one human fatality and 28 human injuries at civil airports in the United States from aircraft striking white-tailed deer.

Additional Human Safety Concerns Associated with Target Species

Similar to aircraft strikes, wildlife also present a collision threat with vehicles. Conover et al. (1995) estimated that over one million deer-vehicle collisions occur annually in the United States, resulting in 29,000 human injuries and 211 human fatalities. Feral Swine is another species that can cause human

injuries or fatalities because of vehicle collisions (Inbar et al. 2002). Even in the absence of a direct collision with an animal, wildlife on roadways present a risk to drivers and passengers. For example, a driver may improperly attempt to avoid a collision with an animal, resulting in an indirect crash.

WS also receives requests for assistance from perceived threats of physical harm from wildlife. Human encroachment into wildlife habitat increases the likelihood of human-wildlife interactions. Those species that humans are likely to encounter are those most likely to adapt to and thrive in human altered habitat. Several predatory and omnivorous wildlife species thrive in urban habitat due to the availability of food, water, and shelter. Many people enjoy wildlife to the point of purchasing food specifically for feeding wildlife despite laws prohibiting the act in many areas. The constant presence of human created refuse, readily available water supplies, and abundant rodent populations found in some areas often increases the survival rates and carrying capacity of wildlife species that are adaptable to those habitats. Often the only limiting factor of wildlife species in and around areas inhabited by people is the prevalence of diseases, which can be confounded by the overabundance of wildlife congregated into a small area that can be created by the unlimited amount of food, water, and shelter found within those habitats.

As people are increasingly living with wildlife, the lack of hazing and threatening behavior by people toward many species of wildlife has led to a decline in the fear wildlife have toward people. When wildlife species begin to habituate to the presence of humans and human activity, a loss of apprehension occurs that can lead to threatening behavior toward humans. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. For example, the annual number of reported attacks on people by Feral Swine appears to be increasing (Mayer 2013). Threatening behavior can be in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although attacks on people associated with those species addressed in this EA rarely occurs, requests for assistance to lessen the threat of possible attack do occur from people in Puerto Rico. Often, wildlife exhibiting threatening behavior or a loss of apprehensiveness to the presence of humans is a direct result and indication of an animal inflicted with a disease. Thus, requests for assistance are often in response to both a desire to reduce the threat of disease transmission and from fear of aggressive behavior either from an animal that is less apprehensive of people or induced as a symptom of disease.

1.2.3 Need to Resolve Target Species Damage Occurring to Property

As shown in Table 1.1, all of the target species addressed in this EA can cause damage to property in Puerto Rico. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. For example, collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996, Keirn et al. 2010). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover et al. 1995).

About 26% of mammal strikes in the United States have resulted in damage compared to 7% for birds from 1990 through 2018 (Dolbeer et al. 2019). Nearly 63% of the reported mammal strikes from 1990 through 2018 occurred at night, with 64% occurring during the arrival phase of flight (Dolbeer et al. 2019). Since 1990, there have been nine airstrikes involving Green Iguanas, five strikes involving bats, and one airstrike involving Spectacled Caimans in Puerto Rico (Federal Aviation Administration 2020). Engeman et al. (2005*a*) suggested the number of aircraft strikes involving Green Iguanas in Puerto Rico is likely much higher given the high density of Green Iguanas at San Juan Luis Muñoz Marín International Airport and the low percentage of airstrikes that are reported to the Federal Aviation Administration. Due to the limited history of Green Iguana as an airstrike hazard, information from actual damage to aircraft from Green Iguanas is lacking. However, Engeman et al. (2005*a*) compared Green Iguana body characteristics to other similarly sized animals and determined Green Iguanas presented a serious airstrike

hazard. Engeman et al. (2005*a*) ranked Green Iguanas in the same damaging category as ducks, pelicans, and eagles. In response to threats caused by Green Iguanas, portions of the airfield at San Juan Luis Muñoz Marín International Airport were temporarily shut down six times during a two-month period during the fall of 2001 (Engeman et al. 2005*a*).

Damage associated with aircraft strikes vary but the Federal Aviation Administration data reveals that mammal strikes in the United States cost the civil aviation industry approximately 325,515 hours of down time and $63.8 million in direct monetary losses between 1990 and 2018 (Dolbeer et al. 2019). Because reporting rates of aircraft strikes have been historically low, these figures likely underestimate the total damage caused by wildlife strikes. In fact, civil wildlife strike reporting rates have been estimated to be as low as 21% (Wright and Dolbeer 2005). However, reporting rates are increasing, as Dolbeer (2015) estimated that nearly 91% of civil wildlife strikes are reported. Despite increased reporting rates, not all airstrike reports provide notation as to whether damage occurred from an airstrike. Furthermore, monetary estimates of the damage caused from an airstrike are often not reported. Additionally, most reports indicating damage to aircraft report direct damages and do not include indirect damage, such as lost revenue, cost of putting passengers in hotels, rescheduling aircraft, and flight cancellations. Thus, actual monetary losses from wildlife strikes are likely much higher than estimated losses.

The presence of a mammal or reptile species on airport property can also attract other wildlife species that pose aircraft strike risks. For example, Green Iguana eggs and hatchlings on or near airfields could also attract other wildlife. Cats, dogs, Spectacled Caiman, Smooth-billed Ani (*Crotophaga ani*), and numerous species of raptors, such as American Kestrels (*Falco sparverius*), could predate on Green Iguana eggs or juveniles (Antonio Rivas et al. 1998, Engeman et al. 2005*b*).

Despite airstrikes being relatively low in Puerto Rico, the infrequency of airstrikes does not lessen the need to prevent threats to human safety and the prevention of damage to property given the consequences that could occur from an aircraft strike. Preventing damage and reducing threats to human safety is the goal of those cooperators requesting assistance at airports in Puerto Rico given that a potential strike can lead to the loss of human life and considerable damage to property.

Wildlife also present a collision threat with vehicles. Vehicle collisions with White-tailed Deer are a serious concern nationwide because of losses to property and the potential for human injury and death (Conover et al. 1995, Romin and Bissonette 1996, Conover 1997). The economic costs associated with deer-vehicle collisions include vehicle repairs, human injuries and fatalities, and picking up and disposing of deer (Drake et al. 2005). Conover et al. (1995) estimated that more than one million deer-vehicle collisions occur annually in the United States. Vehicle repairs average over $1,500 per strike, totaling over $1.1 billion in repair costs annually (Conover et al. 1995). Feral Swine are another species that can severely damage vehicles. Mayer and Johns (2007) reported an average damage estimate of $1,173 per collision with Feral Swine in South Carolina. Many of the target species addressed in this EA can damage vehicles through direct impact in a collision or by indirectly resulting in a collision after a driver maneuvers while attempting to avoid colliding with an animal.

In addition to threats to aircraft and vehicles, many of the target animals included in this EA also present other threats to property in Puerto Rico. Green Iguanas can cause considerable damage to residential and commercial landscape vegetation. Green Iguanas will eat most fruits and flowers, tender new growth, and almost anything planted in a vegetable garden (Kern 2004). Property owners or property managers often install wire mesh or electric fences around herbs, shrubs, and trees to protect them from Green Iguana predation (Krysko et al. 2007). The plant nursery at Las Cabezas de San Juan Nature Reserve (CSJNR) in northeastern Puerto Rico may lose over a 1,000 young trees with an approximate cost of $5,000 annually due to iguana herbivory (López-Torres et al. 2011). Green Iguanas can dig burrows under sidewalks, foundations, seawalls, berms, and canal banks, which can undermine the integrity of these structures

(Kern 2004). Green Iguana digging undermines the main road at CSJNR with repairs costing between $4,000 and $5,000 annually (López-Torres et al. 2011). Green Iguanas burrowing has also affected the landscape around the lighthouse at CSJNR, which is the second oldest in Puerto Rico (López-Torres et al. 2011). Green Iguanas often defecate on docks, moored boats, seawalls, porches, decks, pool platforms and inside swimming pools, causing property owners time and money to clean up these structures (Krysko et al. 2007).

Rhesus Macaques and Patas Monkeys are well known to cause damage throughout their native ranges (Weladji and Tchamba 2003, Saraswat et al. 2015). In urban areas in India, Rhesus Macaques damage property and injure people when they raid houses in order to gain access to food and provisions (Saraswat et al. 2015). However, damage to property from invasive monkeys in Puerto Rico is not well documented and is likely limited to isolated incidents where monkeys cause damage while searching for food, or through such means as automobile accidents incurred while avoiding a collision with a monkey (Engeman et al. 2010). If populations of monkeys increase and expand in Puerto Rico, monkeys could become commensal with humans (González-Martínez 1995, González-Martínez 1998). If commensalism occurs, the likelihood of property damage is also likely to increase.

Rodents, such as Black Rats, Norway Rats, and House Mice, can cause damage to property. Because of their burrowing activities and subsequent impacts caused by erosion or flooding, rodents can cause damage to roads, bridges, railroad track beds, and hydraulic structures (Timm 1994*a*). Rodents may also gnaw or chew on doors, windowsills, walls, and pipes resulting in structural damage to buildings (Hygnstrom 1995). Rodents also can damage or remove insulation in the course of nest building activities and damage electric wires through gnawing, which can lead to house fires (Hygnstrom 1995). The buildup of bat droppings and urine in attics and between walls can result in odor problems and discoloration of walls and ceilings.

White-tailed Deer can damage and destroy landscaping and ornamental trees, shrubs, and flowers by browsing on those trees and plants (Sayre et al. 1992, Storm et al. 2007). Fertilized lawns, gardens, and landscape plants in residential areas may serve as high quality sources of food for deer (Swihart et al. 1995). Furthermore, deer are prolific and adaptable, characteristics that allow them to exploit and prosper in most suitable habitat near urban areas, including residential areas (Jones and Witham 1990). The succulent nature of many ornamental landscape plants, coupled with high nutrient contents from fertilizers, offers an attractive food. In addition to browsing pressure, male deer can damage ornamental trees and shrubs from antler rubbing, which can result in broken limbs and bark removal. While large trees may survive antler-rubbing damage, smaller trees often die or they become scarred to the point that they are not aesthetically acceptable for landscaping.

Feral Swine foraging, rooting, and wallowing can damage landscaping, golf courses, recreational fields, cemeteries, parks, and lawns. Feral Swine can also damage sensitive marshes and archaeological sites (Engeman et al. 2003, Engeman et al. 2004, Pimentel et al. 2005, Engeman et al. 2012). Rooting by Feral Swine can also damage roadsides, dikes, and other earthen structures. Although rare, Feral Swine may also attack pets. For example, in two separate reports, Feral Swine attacked Domestic Dogs in Tioga County, New York, killing one dog and injuring another (USDA 2010). Other target species, such as Reticulated Pythons, Boa Constrictors, and Spectacled Caimans could also pose a predatory threat to small pets.

Some wildlife species have the potential to transmit pathogens to pets. For example, pathogens Feral Cats may transmit to companion cats include feline panleukopenia infection, feline calicivirus infection, feline reovirus infection, and feline syncytium-forming virus infection (Gillespie and Scott 1973). Of the four feline diseases, feline panleukopenia is considered the most serious. Reif (1976) found that during the acute stages of feline panleukopenia, fleas were vectors of this disease to other cats. Additionally,

Feral Swine can transmit diseases, including pseudorabies, to pets. Dogs become infected with pseudorabies after coming into contact with infected Feral Swine. Once a dog is infected, there is no treatment, and death often occurs within 36 hours after symptoms appear (de Cardenas 2008). Feline panleukopenia virus is highly contagious, may survive in the environment for up to a year, and may be transmitted to indoor cats through indirect routes, such as on shoes (Berthier et al. 2000, Truyen et al. 2009).

1.2.4 Need to Resolve Target Species Damage Occurring to Natural Resources

Many of the target species found in Puerto Rico can also negatively affect natural resources through habitat degradation, competition with other wildlife, and through direct depredation on natural resources. Habitat degradation can occur when large concentrations of target species in a localized area negatively affect characteristics of the surrounding habitat, which can adversely affect other wildlife species and can be esthetically displeasing. Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food. Direct depredation occurs when predatory target species feed on other wildlife species, which can negatively influence those species' populations, especially when depredation occurs on T&E species.

Monkeys can harm native flora and fauna in Puerto Rico, including species listed as T&E (USDA 2008*b*). On Desecheo, depredation from Rhesus Macaques resulted in the complete loss of seabird breeding colonies on the island, which included Red-footed Boobies (*Sula sula*), Brown Boobies (*Sula leucogaster*), Noddy Terns (*Anous stolidus*), and Bridled Terns (*Sternus anaethetus*) (Evans 1989, Raffaele 1989). In 1969, massive raids by Rhesus Macaques on booby nests were reported, with macaques pushing boobies off their nests and consuming an estimated 200-300 eggs per week (Noble and Meier 1989). In 1987, although nests were built and eggs laid, Brown and Red-footed Booby nesting success was reportedly zero (Noble and Meier 1989). Rhesus Macaques contributed to the extirpation of at least five seabird species and one land bird species, and has caused significant declines in resident land bird populations on Desecheo (Noble and Meier 1989, Island Conservation 2007). Rhesus Macaques on Desecheo have also been implicated in modifying vegetation structure, contributing to the extirpation of several plant species, and preying on native reptiles including three island-endemic lizards (Evans 1989, Breckon 2000, Island Conservation 2007). Engeman et al. (2010) suggested there has been evidence that monkeys have depredated on the federally Endangered Yellow-shouldered Blackbird (*Agelaius xanthomus*). There is also concern that macaques could negatively affect the federally Endangered Puerto Rican Parrot (*Amazona vittata*), should monkeys expand their range expand their range to the forests of northeastern Puerto Rico (USFWS 1999, Engeman et al. 2006, Engeman et al. 2010).

Cats can have an enormous negative impact on wildlife populations in suburban and rural areas, directly by predation and indirectly by competition for food (Coleman and Temple 1989). Cats have contributed to declines and extinctions of birds worldwide, with Feral Cats considered one of the most important drivers of global bird extinctions (Nogales et al. 2004, Dauphine and Cooper 2009). Studies estimate that cats prey on over one billion birds annually in the United States (Stallcup 1991, Gill 1995, Dauphiné and Cooper 2009). In the United Kingdom, one study determined that House Cats might take an annual toll of some 70 million animals and birds (Churcher and Lawton 1987). In Puerto Rico, Feral Cats have been documented as a predator of the Critically Endangered Puerto Rican Parrot (Rodriguez-Vidal 1959, Snyder et al. 1987).

Feral Dogs are documented to predate on a multitude of T&E species, including birds, reptiles, and mammals (Bergman et al. 2009). Dogs may also haze or chase endemic species, which results in increased stress and energetically costly behavior to native wildlife (Lenth et al. 2008). The presence of dogs can also deter the use and habitation of those areas by native wildlife (Lenth et al. 2008).

Feral Swine can consume large quantities of herbaceous vegetation (3-5% of their body weight daily) and have been linked to 95% declines of understory vegetation in some systems (Cole et al. 2012). Understory animal species (from arthropods to mammals) decline with the absence of understory vegetation (Singer et al. 1984). Rooting, soil compaction, and wallowing influence plant community structure, succession patterns, and nutrient cycles. Consumption of seeds, nuts, and seedlings also reduces the potential for forest regeneration (Campbell and Long 2009), and may influence future over-story composition and reduce tree diversity directly through consumption of seeds (Tolson and LaCour 2013). Sites disturbed by rooting and wallowing are often vulnerable to erosion and colonization by non-native invasive plant species which often prefer disturbed sites and become established more quickly than many native plants. In some habitats, Feral Swine may preferentially browse or uproot protected, sensitive, unique, or rare plant species.

Habitat damage by Feral Swine can be most pronounced in wet environments where plant communities and soils may be more sensitive to disturbance (Engeman et al. 2003, Engeman et al. 2004, West et al. 2009). Near waterways, this can result in destabilization of banks. Unfortunately, these types of areas are often preferred by Feral Swine. Wet soils may make it easier for Feral Swine to obtain some of the foods they favor, such as the roots, tubers, and bulbs that are characteristic of many wetland ecosystems.

Feral Swine diets can overlap with native wildlife, including T&E species, which may result in competition for important and limited natural food supplies, although documentation of competition is limited (Mayer 2009, Barrios-Garcia and Ballari 2012). Mast crops, such as acorns, nuts, and berries, are a preferred food of Feral Swine; mast crops are often a critical food source for many native wildlife species. Consumption of seeds, seedlings, and other vegetation reduces availability for native species (Campbell and Long 2009, Mayer 2009). Feral Swine are omnivorous and will prey on many smaller native animals and invertebrates, such as insects, earthworms, turtles, amphibians, and shrub- or ground-nesting birds. Feral Swine will destroy nests and consume eggs of reptiles and ground-nesting birds, such shorebirds (Campbell and Long 2009). In some areas, Feral Swine can have adverse impacts on T&E species and their habitats and are a factor in the continuing endangerment of multiple plant and animal species (Waithman et al. 1999, Gurevitch and Padilla 2004, Engeman et al. 2010).

People began introducing mongoose into Puerto Rico during the 19th century as a way to control non-native rats that were feeding on commercially grown sugar cane (Johnson et al. 2016, Berentsen et al. 2018). However, mongoose also feed on native wildlife. The introduced Indian Mongoose has been implicated in the decline of the Puerto Rican Parrot (Engeman et al. 2006) and Puerto Rican Nightjar (*Antrostomus noctitherus*) in Puerto Rico (Vilella and Zwank 1993). Mongooses are also known to prey upon the Puerto Rican Giant Anole (*Anolis cuvieri*) (Schwartz and Henderson 1991) and coqui frogs (*Eleutherodactylus* spp.) (Wolcott 1953, Pimentel 1955). The mongoose has been documented damaging nests of the federally Endangered Hawksbill Sea Turtle (*Eretmochelys imbricata*), as well as the Green Sea Turtle (*Chelonia mydas*), and Loggerhead Sea Turtle (*Caretta caretta*) (Seaman and Randall 1962, Nellis and Small 1983, Coblentz and Coblentz 1985*a*). On St. Croix in the United States Virgin Islands, populations of the St. Croix Racer (*Alsophis sancticrucis*), the Puerto Rican Ground Lizard (*Amevia exsul*), and the federally Endangered St. Croix Ground Lizard (*Amevia polops*) have declined presumably due to mongoose predation (Nellis 1982). The mongoose is not only a contributing factor to the extirpation of some species, but also potentially influences behavior. For example, the Bridled-quail Dove (*Geotrygon mystacea*), a ground-nesting bird on St. Croix, was thought to be extinct, but Nellis and Everard (1983) suggested it has become an arboreal nester in response to nest predation by mongooses.

Rodents can cause significant damage to natural resources. Because of their arboreal nature, Black Rats can prey on adult birds, nestlings, and eggs. In island natural areas, particularly forests, Black Rats have been identified as the most destructive rodent to native species and ecosystems (Ruffino et al. 2009, Traveset et al. 2009, Banks and Hughes 2012, Shiels et al. 2014). In Puerto Rico, Black Rats threaten the

nesting of the Critically Endangered Puerto Rican Parrot through direct predation of eggs and young or through hazing so that successful nesting cannot take place (Rodriguez-Vidal 1959, Snyder et al. 1987, Lindsey 1992). Black Rats are also well-known predators of seabirds, especially those that are ground- and burrow-nesting and have small eggs (Jones et al. 2008). Furthermore, Black Rats are recognized worldwide as the likely cause of rare bird extinctions in many island areas (Atkinson 1977, Pitt and Witmer 2006). Black Rats also pose substantial threats to native and T&E plants through seed predation (Pender et al. 2013, Shiels and Drake 2015), as well as potentially aiding in the spread of non-native seeds via dispersal (Shiels 2011, Shiels and Drake 2011). Black Rats can also negatively impact ecosystem services such as pollination and decomposition by consuming insects, which often comprise a large portion of Black Rat diets (St. Clair 2011, Shiels et al. 2013). House Mice can also damage natural resources. Cuthbert and Hilton (2004) recorded House Mice depredation on nestling albatross chicks on Gough Island. Additionally, Witmer et al. (2012) documented seedling damage by House Mice in a captive study. House Mice may also negatively affect many plant pollinators, as insects often dominate their diets (Shiels et al. 2013, Shiels and Pitt 2014).

Introduced Feral Goats can affect native plant communities and compete with native wildlife for food resources. Feral Goats on Mona Island forage on many protected plant species, including the fruits of the federally Endangered High Chumbo (*Harrisia portoricensis*) (Meléndez-Ackerman et al. 2008). Meléndez-Ackerman et al. (2008) also suggested that Feral Goats did not pass the seeds of High Chumbo or other cacti plants through their feces, thus limiting seedling recruitment and regeneration potential. Feral Goats are believed to compete with the federally Endangered Mona Ground Iguana (*Cyclura stejnegeri*) for herbaceous forage on Mona Island, and to be to be detrimental to plant populations on other Puerto Rican islands (Wiedwandt 1977).

Green Iguanas are another species that can negatively affect native plants and wildlife species in Puerto Rico. Burgos-Rodríguez et al. (2016) suggested that food competition from invasive Green Iguanas could negatively affect the Puerto Rican Slider (*Trachemys stejnegeri*). The foraging habits of Green Iguanas have been identified as a source of mortality to Black Mangrove (*Laguncularia racemosa*) at the San Juan Bay Estuary (Carlo and García-Quijano 2008). Although Green Iguanas are herbivores, there have been limited reports of iguanas feeding on bird eggs and insects (Hirth 1963, Lazell 1973).

Spectacled Caimans, Reticulated Pythons, and Boa Constrictors are also predatory animals that could negatively affect native wildlife in Puerto Rico. Spectacled Caimans are opportunistic predators that consumes invertebrates, fish, amphibians, reptiles, birds, and mammals (Thorbjarnarson 1993). However, Bontemps et al. (2016) found that Spectacled Caimans in Puerto Rico feed primarily on exotic species. Furthermore, Bontemps et al. (2016) did not document any caiman predation on T&E species. Reticulated Pythons and Boa Constrictors feed primarily on birds and mammals (Shine et al. 1998, Shine et al. 1999, Amador-Alcalá et al. 2013). However, studies investigating their diets in Puerto Rico are lacking. Therefore, it is unknown if, and how, pythons and boas are affecting native wildlife populations in Puerto Rico.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT AND WS' DECISION-MAKING

The National Environmental Policy Act (NEPA) requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes (Public Law 9-190, 42 USC 4321 et seq.). Therefore, if WS provided assistance by conducting activities to manage damage caused by mammals and reptiles, those activities would be a federal action requiring compliance with the NEPA. The NEPA requires federal agencies to have available and fully consider detailed information regarding environmental effects of federal actions and to make information regarding environmental effects available to interested persons and agencies.

As part of the decision-making process associated with the NEPA, WS follows the Council on Environmental Quality regulations implementing the NEPA (40 CFR 1500 et seq.) along with the implementing procedures of the USDA (7 CFR 1b) and the APHIS (7 CFR 372). The NEPA sets forth the requirement that federal agencies evaluate their actions in terms of their potential to significantly affect the quality of the human environment to avoid or, where possible, to mitigate and minimize adverse impacts, making informed decisions, and including agencies and the public in their planning to support informed decision-making.

1.3.1 Complying with the National Environmental Policy Act

To comply with the NEPA and Council on Environmental Quality regulations, WS is preparing this Environmental Assessment (EA) to evaluate alternative approaches of achieving the objectives of WS and to determine whether the potential environmental effects caused by the alternative approaches might be significant, requiring the preparation of an Environmental Impact Statement (EIS). As described by the Council on Environmental Quality (2007), the intent of an EA is to provide brief but sufficient evidence and analysis to determine whether to prepare an EIS, aid in complying with the NEPA when an EIS is not necessary, and to facilitate preparation of an EIS when one is necessary. The Council on Environmental Quality (2007) further states, "*The EA process concludes with either a Finding of No Significant Impact…or a determination to proceed to preparation of an EIS*". WS developed this EA under the 1978 NEPA regulations and existing APHIS NEPA implementing procedures because WS initiated this EA prior to the NEPA revisions that went into effect on September 14, 2020.

1.3.2 Rationale for Preparing an EA Rather Than an EIS

One comment that WS often receives during the public involvement process associated with the development of an EA is that WS should have prepared an EIS instead of an EA or that proposed activities require the development of an EIS. As discussed in Section 1.3.1, the primary purpose for developing an EA is to determine if the alternative approaches developed to meet the need for action could potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS (see 40 CFR 1501.4, 40 CFR 1508.9(a)(3)). WS prepared this EA so that WS can make an informed decision on whether or not an EIS would be necessary if WS implemented the alternative approaches to meeting the need for action.

WS is preparing this EA to facilitate planning, promote interagency coordination, streamline program management, clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities, and to evaluate and determine if there would be any potentially significant or cumulative effects from the alternative approaches developed to meet the need for action. The analyses contained in this EA are based on information derived from WS' Management Information System, available documents (see Appendix A), interagency consultations, and public involvement.

If WS makes a determination that implementation of a selected alternative approach would have a significant impact on the quality of the human environment based on this EA, WS would publish a Notice of Intent to prepare an EIS. This EA would be the foundation for developing that EIS in accordance with the 1978 NEPA implementing regulations of the Council on Environmental Quality (40 CFR 1508.9(a)(3)).

1.3.3 Using this EA to Inform WS' Decisions and the Decisions to be made

Although WS only provides assistance when requested, WS is required to comply with the NEPA before making final decisions about actions that could have environmental effects. WS will use the analyses in this EA to help inform agency decision-makers, including a decision on whether the alternative

approaches of meeting the need for action requires the preparation of an EIS or the EA process concludes with a Finding of No Significant Impact.

Another major purpose of the NEPA is to include other agencies and the public during the planning process to support informed decision-making. Prior to making and publishing the decision[3] to conclude this EA process, WS will make this EA available to the public, agencies, tribes, and other interested or affected entities for review and comment. Making the EA available to the public, agencies, tribes, and other interested or affected entities during the planning process will assist with understanding applicable issues and reasonable alternative means to meeting the need for action (see Section 1.2) and to ensure that the analyses are complete for informed decision-making.

Based on agency relationships, Memorandum of Understandings, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. Section 1.5 discusses the roles and responsibilities of agencies related to activities discussed in this EA. The Puerto Rico Department of Natural and Environmental Resources (DNER) has regulatory authority over wildlife species in Puerto Rico, including non-native species, and WS' activities involving wildlife species would require authorization from the DNER prior to WS conducting activities. In addition, WS would be subject to any conditions associated with the authorizations given by the DNER. Therefore, activities to alleviate damage or reduce threats of damage associated with those mammal and reptile species identified in this EA would only occur at the discretion of the DNER.

Based on the scope of this EA, a decision to be made is should WS conduct activities to alleviate damage and threats of damage associated with mammal and reptile species in Puerto Rico. If so, how can WS best respond to the need to reduce damage and would activities conducted responding to that need result in effects to the human environment requiring the preparation of an EIS.

1.3.4 Public Involvement

Public outreach and notification methods for this EA will include posting a notice on the national WS program webpage and on the www.regulations.gov webpage. In addition, WS will send out direct mailings to local known stakeholders and an electronic notification to stakeholders registered through the APHIS Stakeholder Registry. WS will also publish a notice in the legal section of the *San Juan Daily Star* newspaper. WS will provide for a minimum of a 30-day comment period for the public and interested parties to review the EA and provide their comments. WS will inform the public of the decision using the same venues.

WS will coordinate the preparation of this EA with consulting partner agencies and tribes to facilitate planning, to promote interagency and tribal coordination, and to incorporate agency and tribal expertise, which includes the DNER. WS has asked each consulting agency to review the draft EA and provide input and direction to WS to ensure proposed activities would comply with applicable federal and Commonwealth regulations and policies, federal land management plans, Memorandum of Understandings, and cooperative agreements.

1.3.5 Period for which this EA is Valid

If WS determines that the analyses in this EA indicate that an EIS is not warranted, this EA remains valid until WS determines that new or additional needs for action, changed conditions, new issues, and/or new alternatives having different environmental impacts need to be analyzed to keep the information and

[3]As discussed in Section 1.2.1, the EA process concludes with either a Finding of No Significant Impact or the publication of a Notice of Intent to prepare an EIS.

analyses current. At that time, this analysis and document would be reviewed and, if appropriate, supplemented if the changes would have "*environmental relevance*" (40 CFR 1502.9(c)), or a new EA prepared pursuant to the NEPA.

If WS provides assistance with managing damage caused by mammal and reptile species, WS would monitor activities conducted by its personnel to ensure those activities and their impacts remain consistent with the activities and impacts analyzed in this EA and selected as part of the decision. Monitoring activities would ensure that WS' activities and the effects associated with those activities occurred within the limits of evaluated/anticipated activities. Monitoring involves review of the EA for all of the issues evaluated in Chapter 3 to ensure that the activities and associated impacts have not changed substantially over time.

1.4 SCOPE OF ANALYSIS

WS has decided that one EA analyzing potential effects of implementing the alternatives approaches of meeting the need for action for the entire Commonwealth of Puerto Rico provides a more comprehensive and less redundant analysis than multiple EAs covering smaller regions. This approach also provides a broader scope for the effective analysis of potential cumulative impacts and for using data and reports from wildlife management agencies, which typically report data for the entire Commonwealth.

Many of the target species discussed in Section 1.2 occur throughout Puerto Rico. Damage and threats of damage caused by target species can occur wherever those species occur within the Commonwealth. Target species could occur in and around commercial, industrial, public, and private buildings, facilities, and properties where target species may sleep, loaf, feed, or otherwise occur. Examples of areas where target species occur include, but are not necessarily limited to, residential buildings, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, and schools. Activities could also occur in and around agricultural areas, wetlands, restoration sites, cemeteries, public parks, bridges, industrial sites, urban/suburban woodlots, hydro-electric dam structures, reservoirs and reservoir shore lands, nuclear, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, on ship fleets, military bases, or at any other sites where target species may occur. Target species could occur in and around agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, grain mills, and grain handling areas (*e.g.*, railroad yards) where target species destroy crops, feed on spilled grains, or contaminate food products for human or livestock consumption. Additionally, target species could occur at airports and surrounding properties where those species represent a threat to aviation safety.

Responding to requests for assistance falls within the category of actions in which the exact timing or location of individual requests for assistance can be difficult to predict with sufficient notice to describe accurately the locations or times in which WS could reasonably expect to be acting. Although WS could predict some of the possible locations or types of situations and sites where some requests for assistance could occur, WS cannot predict the specific locations or times at which affected resource owners would determine that damage had become intolerable and they request assistance from WS. WS must be ready to provide assistance on short notice anywhere in Puerto Rico when receiving a request for assistance. Therefore, the geographic scope of the actions and analyses in this EA cover the entire Commonwealth of Puerto Rico and this EA analyzes actions that could occur on federal, Commonwealth, municipality, city, and private lands, when requested. However, WS would only provide assistance when the appropriate property owner or manager requested such assistance and only on properties where WS and the appropriate property owner or manager has signed a work initiation document.

The analyses in this EA would apply to any actions that WS may conduct to alleviate damage caused by target mammal and reptile species in any locale and at any time within Puerto Rico when WS receives a

request for such assistance from the appropriate property owner or property manager. The standard WS Decision Model (see WS Directive 2.201; Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS in Puerto Rico (see Chapter 2 for a description of the WS Decision Model and its application). The WS Decision Model is an analytical thought process used by WS' personnel for evaluating and responding to requests for assistance. If WS determines that the analyses in this EA do not warrant the preparation of an EIS, the decisions made by WS' personnel using the model would be consistent with the alternative approach that WS selects to meet the need for action. In addition, decisions made using the model would be in accordance with WS' directives as well as relevant laws and regulations.

As discussed previously, the property owner or property manager would determine when assistance from WS was appropriate. WS would only conduct activities after receiving a request from the appropriate property owner or property manager. In addition, WS would only conduct activities after the appropriate property owner or manager signed a work initiation document allowing WS to conduct activities on the property they own or manage. Therefore, this EA meets the intent of the NEPA with regard to site-specific analysis, informed decision-making, and providing the necessary timely assistance to those people requesting assistance from WS.

1.5 AGENCIES INVOLVED IN THIS EA AND THEIR ROLES AND AUTHORITIES

If WS provides assistance to meet the need for action, several governmental agencies would have roles and authorities that would relate to WS conducting activities. Below are brief discussions of the roles and authorities of other governmental agencies, as those authorities relate to conducting wildlife damage management.

1.5.1 United States Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources and their habitats. The USFWS shares responsibility with other federal, Commonwealth, tribal, and local entities. However, the USFWS has specific responsibilities for the protection of T&E species under the Endangered Species Act (ESA), migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that the USFWS administers for the management and protection of those resources, such as the National Wildlife Refuge System.

1.5.2 United States Environmental Protection Agency

The United States Environmental Protection Agency (EPA) is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act, which regulates the registration and use of pesticides.

1.5.3 Department of Natural and Environmental Resources of Puerto Rico

The DNER was formed on June 20, 1972 by Law Number 23. The DNER exercises the regulatory and executive powers of the Commonwealth with respect to wild animal life and aquatic life. The authority for management of resident wildlife species is the responsibility of the DNER. The DNER collects and compiles information on wildlife population trends and take, and uses this information to manage wildlife populations.

1.5.4 Puerto Rico Department of Agriculture

The Puerto Rico Department of Agriculture (PRDA) was created by the Law Number 60 of 1940 on April 25, 1940, and later by Article IV of the Constitution of the Commonwealth of Puerto Rico on July 25, 1952. The mission of the PRDA is to establish agricultural policies to ensure a greater food security for Puerto Rico, as well as to develop an advanced agricultural industry in areas such as technology and entrepreneurship that is responsible with the environment and economically sustainable. The authority for management of livestock is the responsibility of the PRDA.

1.5.5 Puerto Rico Department of Health

The Puerto Rico Department of Health was created by Article IV of the Constitution of the Commonwealth of Puerto Rico on July 25, 1952. The Puerto Rico Department of Health can declare public health emergencies in response to threats to human health and safety caused by wildlife.

1.6 DOCUMENTS RELATED TO THIS EA

Additional environmental documents relate to activities that WS could conduct to manage damage or threats of damage associated with mammal and reptile species in Puerto Rico. The relationship of those documents to this EA occurs below for each of those documents.

1.6.1 Final Environmental Impact Statement: Feral Swine Damage Management: A National Approach, 2015

In 2015, WS developed an EIS to review the environmental impacts of alternative approaches to achieve the APHIS' goal of reducing damage caused by Feral Swine to agriculture, natural and cultural resources; property; animal health; and human health and safety (USDA 2015). The EIS analyzed alternative approaches that are programmatic in nature. The EIS guides APHIS cooperation and interactions with program partners and provides a system for allocation of project resources. The Record of Decision selected the preferred alternative in the EIS to implement a nationally coordinated program that integrates methods to address feral swine damage. However, the EIS did not replace the need to develop state, territorial, or local level analyses to address local issues and needs in accordance with the Council on Environmental Quality and APHIS' implementing regulations under the NEPA. Therefore, this EA will evaluate the need for action, issues, and alternative approaches to reducing Feral Swine damage or threats of damage throughout the Commonwealth of Puerto Rico. In accordance with the Record of Decision, WS developed this EA to be consistent with the EIS and the Record of Decision.

1.6.2 Final Environmental Assessment: Managing Damage and Threats Associated With Invasive Patas and Rhesus Monkeys in the Commonwealth of Puerto Rico, 2008

In 2008, WS developed an EA that analyzed the need for action, issues, and alternative approaches to managing damage associated with Patas Monkeys and Rhesus Macaques in Puerto Rico (USDA 2008*b*). In response to the need to address damage or threats of damage associated with several additional species, WS initiated this new EA to address damage or threats of damage caused by mammal and reptile species throughout Puerto Rico. Because activities conducted under the previous EA addressing damage caused by Patas Monkeys and Rhesus Macaques will be re-evaluated under this EA, the previous EA that addressed monkeys will be superseded by this analysis and the outcome of the Decision issued based on the analyses in this EA.

1.6.3 Final Environmental Assessment: Management of Feral and Free-ranging Cat Populations to Reduce Threats to Human Health and Safety and Impacts to Native Wildlife Species in the Commonwealth of Puerto Rico

In 2003, WS developed an EA that analyzed the need for action, issues, and alternative approaches to managing damage associated with Feral and Free-ranging Cats in Puerto Rico (USDA 2003). In response to the need to address damage or threats of damage associated with several additional species, WS initiated this new EA to address damage or threats of damage caused by mammal and reptile species throughout Puerto Rico. Because activities conducted under the previous EA addressing damage caused by Feral and Free-ranging Cats will be re-evaluated under this EA, the previous EA that addressed cats will be superseded by this analysis and the outcome of the Decision issued based on the analyses in this EA.

1.6.4 Comprehensive Wildlife Conservation Strategy of Puerto Rico, 2005

The DNER and their partners developed a Comprehensive Wildlife Conservation Strategy (CWCS) in 2005. The objectives of the CWCS were to (1) identify the status of the species and their habitats, (2) identify conservation priorities for these species and their habitats, and (3) establish a regular monitoring process aimed at updating the previous two objectives. The CWCS considers the broad range of Puerto Rico's wildlife with appropriate emphasis placed on species/habitat with the greatest conservation needs, especially data deficient species. The strategy also contemplated the funding available for the conservation of those species. The CWCS was updated in 2015, and renamed the Puerto Rico State Wildlife Action Plan (SWAP).

1.6.5 Puerto Rico State Wildlife Action Plan, 2015

The SWAP replaces the CWCS from 2005, and represents a comprehensive approach for conserving Puerto Rico's wildlife and natural areas for future generations. The objectives of this document include: (1) identify the status of the species and their habitats, (2) identify and update conservation priorities for these species and their habitats, and (3) establish a regular monitoring process aimed at updating the previous two objectives.

1.6.6 Puerto Rico Gap Analysis Project

The Puerto Rico Gap Analysis Project (PRGAP) is a comprehensive report on land cover, vertebrate occurrences and natural history information, and land stewardship in Puerto Rico. The PRGAP follows methods by the national Gap Analysis Program, which aims to determine the degree to which wildlife species and habitats are represented in the current mix of conservation lands. Wildlife species and habitats that are not well represented are considered conservation "*gaps*." The PRGAP provides geographic and ecological information on the status of not only threatened or rare species, but the common species of Puerto Rico. The PRGAP has four major components: land cover mapping, documentation of vertebrate species distributions, documentation of land stewardship practices with respect to conservation, and an integrated analysis of these three elements.

The PRGAP classified 53% of Puerto Rico as predominantly woody vegetation, 35% as grassland or herbaceous agriculture, 11% as developed land, and approximately 1% each of water and natural barrens. Of the woody habitats, mid-elevation moist forests comprise 26%, upper-elevation wet forests cover 18%, dry forests represent 7%, and flooded mangrove and Pterocarpus forests cover 1% of the Commonwealth.

1.7 REGULATIONS THAT COULD APPLY TO WS' ACTIVITIES

In addition to the NEPA, several regulations and executive orders would be relevant to activities that WS could conduct when providing assistance. This section discusses several regulations and executive orders that would be highly relevant to WS' activities when providing assistance. All management actions conducted and/or recommended by WS would comply with appropriate federal, Commonwealth, and local laws in accordance with WS Directive 2.210.

1.7.1 Federal regulations that could apply to WS' activities

If WS provides assistance to manage damage or threat of damage, several federal regulations could apply to the activities that WS conducts. The following are the primary federal regulations that could apply to WS' activities.

Endangered Species Act

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the ESA (Section 2(c)). Evaluation of the alternatives in regards to the ESA will occur in Section 3.1.2 of this EA.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act and its implementing regulations (Public Law 110-426, 7 USC 136 et. seq.) require the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act. The EPA and the PRDA regulate pesticides that could be available to manage damage associated with mammals in the Commonwealth.

National Historic Preservation Act

The National Historic Preservation Act and its implementing regulations (see 36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Section 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106.

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; PL 92-583, October 27, 1972; 86 Stat. 1280)

This law established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. Funds were authorized for cost-sharing grants to states to develop their programs. Subsequent to federal approval of their plans, grants would be awarded for implementation purposes. In order to be eligible for federal approval, each state's plan was required to define boundaries of the coastal zone, identify uses of the area to be regulated by the state, determine the mechanism (criteria, standards or regulations) for controlling such uses, and develop broad guidelines for priorities of uses within the coastal zone. In addition, this law established a system of criteria and standards for requiring that federal actions be conducted in a manner consistent with the federally approved plan. The standard for determining consistency varied depending on whether the federal action involved a permit, license, financial assistance, or a federally authorized activity. As

appropriate, a consistency determination would be conducted by WS to assure management actions would be consistent with the Commonwealth's Coastal Zone Management Program.

Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act of 1970 and its implementing regulations (29 CFR 1910) on sanitation standards states that, "*Every enclosed workplace shall be so constructed, equipped, and maintained, so far as reasonably practical, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their presence is detected*." This standard includes target species that may cause safety and health concerns at workplaces.

The Native American Graves Protection and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal projects would discontinue work until a reasonable effort has been made to protect the items and the proper authority has been notified.

Federal Food, Drug, and Cosmetic Act (21 USC 360)

This law places administration of pharmaceutical drugs, including those used in wildlife capture and handling, under the United States Food and Drug Administration.

Controlled Substances Act of 1970 (21 USC 821 et seq.)

This law requires an individual or agency to have a special registration number from the United States Drug Enforcement Administration to possess controlled substances, including controlled substances used for animal capture and handling.

Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act and its implementing regulations (21 CFR 530) establish several requirements for the use of animal drugs, including those animal drugs used to capture and handle wildlife in damage management programs. Those requirements are: (1) a valid "*veterinarian-client-patient*" relationship, (2) well defined record keeping, (3) a withdrawal period for animals that have been administered drugs, and (4) identification of animals. A veterinarian, either on staff or on an advisory basis, would be involved in the oversight of the use of animal capture and handling drugs under any alternative where WS could use those immobilizing drugs. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (*i.e.*, a period after a drug was administered that must lapse before an animal may be used for food) for specific drugs. Animals that people might consume within the withdrawal period must be identifiable (*e.g.*, use of ear tags) and labeled with appropriate warnings.

Environmental Justice in Minority and Low Income Populations - Executive Order 12898

Executive Order 12898 promotes the fair treatment of people of all races, income levels, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Executive Order 12898 requires federal agencies to make environmental justice part of their

mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations. This EA will evaluate activities addressed in the alternative approaches for their potential impacts on the human environment and compliance with Executive Order 12898.

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

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. Federal agencies must make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. In addition, federal agencies must ensure agency policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Invasive Species - Executive Order 13112 and Executive Order 13751

Executive Order 13112 establishes guidance to federal agencies to prevent the introduction of invasive species, provide for the control of invasive species, and to minimize the economic, ecological, and human health impacts that invasive species cause. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. Executive Order 13751 amended Executive Order 13112 by clarifying the operations of the National Invasive Species Council and by expanding its membership. In addition, Executive Order 13751 incorporated additional considerations into federal efforts to address invasive species and to strengthen coordinated, cost efficient federal actions.

Airborne Hunting Act

The Airborne Hunting Act, passed in 1971 (Public Law 92-159), and amended in 1972 (Public Law 92-502) added to the Fish and Wildlife Act of 1956 as a new section (16 USC 742j-l) that prohibits shooting or attempting to shoot, harassing, capturing or killing any bird, fish, or other animal from aircraft except for certain specified reasons. Under exception [see 16 USC 742j-l, (b)(1)], state and federal agencies are allowed to protect or aid in the protection of land, water, wildlife, livestock, domesticated animals, human life, or crops using aircraft.

1.7.2 Commonwealth regulations that could apply to WS' activities

If WS provides assistance to manage damage or the threat of damage, regulations of the Commonwealth could also apply to the activities that WS conducts. The following are the primary Commonwealth regulations that could apply to WS' activities.

Commonwealth of Puerto Rico Law Number 23

Passed on June 20, 1972, Law Number 23, also known as the Organic Law of the Department of Natural Resources, established the DNER and tasked the agency to establish programs for the conservation of natural resources in Puerto Rico.

Commonwealth of Puerto Rico Law Number 241

Passed on August 15, 1999, Law Number 241, also known as the New Wildlife Act of Puerto Rico, defines the protection of wildlife in the Commonwealth and places regulatory control of managing those resources to the DNER. The New Wildlife Act states:

"To establish the New Wildlife Act of Puerto Rico for the purpose of protecting, conserving and fostering native and migratory wildlife species; to declare as property of Puerto Rico all wildlife species within its jurisdiction; to define the faculties, powers and duties of the Secretary of the Department of Natural and Environmental Resources; to regulate hunting and the use of hunting weapons and their registration; to issue, renew and revoke hunting licenses, permits for operating game reserves and permits for hunting or collecting game for scientific, educational, recovery and population control purposes; to establish regulations for the introduction of exotic species into Puerto Rico; to fix penalties for violations of the provisions of this Act and of the regulations promulgated by virtue thereof and to repeal Act No. 70 of May 30, 1976, as amended."

Commonwealth of Puerto Rico Law Number 223

Passed on December 22, 2014, Law Number 223 amends parts of Law Number 241. The amendments included expanding the definitions of illegal acts as it pertains to importing exotic wildlife species, creating a list of harmful and poisonous species, and establishing penalties for breaking any of the articles set forth by Law Number 223.

Commonwealth of Puerto Rico Regulation Number 6765

Passed on February 11, 2004, Regulation Number 6765 promotes the protection, conservation, and management of wildlife species. Regulation Number 6765 further defines exotic and invasive species in the Commonwealth of Puerto Rico. The DNER, under Law Number 241 and Regulation Number 6765, is designated as the regulatory authority over wildlife species in Puerto Rico, including invasive species. Regulation Number 6765 defines the authority of the DNER to authorize take of invasive species through permits. It also establishes more rigorous regulations pertaining on hunting licenses, the inscription of hunting weapons, and the renovation and suspension of these weapons for infractions set forth in the law and in this regulation.

Commonwealth of Puerto Rico Regulation Number 6766

The purposes of Regulation Number 6766, passed on February 11, 2004, are to: a) identify, conserve, and preserve Vulnerable and Endangered species, b) stimulate the propagation and survival of these species, c) identify and promote the conservation of the critical natural habitats and essential critical natural habitats, d) regulate the import and export of Vulnerable or Endangered species, and e) adopt the criteria used by the international scientific community to designate species whose population could rapidly become Critically Endangered or extinct within a very short time period.

Although Regulation Number 6766 identified Vulnerable and Endangered species to be listed in the Commonwealth, the regulation requires the Secretary of the DNER to review the Vulnerable and Endangered species list at least every five years. At the time of publishing this EA, the most current list of Vulnerable and Endangered species listed by the Commonwealth of Puerto Rico can be found in the 2015 version of the SWAP (see Appendix C).

Commonwealth of Puerto Rico Regulation Number 7399

Passed on August 7, 2007, Regulation Number 7399 designates Rhesus Macaques, Patas Monkeys, and Squirrel Monkeys as species hurtful to agricultural interests and that pose a threat to human safety in Puerto Rico. The regulation further prohibits the introduction, importation, possession, acquisition, sale, or transfer of these species in Puerto Rico. However, the regulation does not apply to government agencies or other public or private entities, which are required to have monkeys to perform their activities when the Secretary of the PRDA provides the appropriate written authorization.

CHAPTER 2: ISSUES AND ALTERNATIVES

WS has identified a need for action based on requests for assistance that WS receives to manage damage caused by target species in the Commonwealth (see Section 1.2). WS has identified several issues associated with the activities that WS could implement to meet that need for action. Issues are concerns regarding potential effects that might occur from proposed activities. Federal agencies must consider such issues during the decision-making process required by the NEPA. Section 2.1 of this EA discusses the issues that WS identified, which could occur from the implementation of alternative approaches to meet the need for action. Section 3.2 discusses additional issues that WS identified; however, the EA does not analyze those issues in detail for the reasons provided in Section 3.2.

WS developed four alternative approaches to meet the need for action that Section 1.2 of this EA identifies and to address the identified issues discussed in Section 2.1. Section 2.4.1 discusses the four alternative approaches that WS could implement to meet the need for action. Section 2.4.2 discusses alternatives considered but not analyzed in detail and provides the rationale for not considering those alternative approaches in detail within this EA. In addition, WS' directives would provide guidance to WS' personnel conducting official activities (see WS Directive 1.101).

2.1 ISSUES USED TO DEVELOP THE ALTERNATIVE APPROACHES

This section describes the issues that WS identified during the scoping process for this EA. Section 3.1 analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. WS evaluated, in detail, the following four issues.

2.1.1 Issue 1 - Effects of Damage Management Activities on Populations of Target Species

A common issue when addressing damage caused by wildlife is the potential impacts of management actions on the populations of target species. Methods available to alleviate wildlife damage or threats of damage are either nonlethal or lethal methods. Nonlethal methods available can capture, exclude, disperse, or otherwise make an area unattractive to target species causing damage, which can reduce the presence of those species at the site and potentially the immediate area around the site where people use those nonlethal methods. Lethal methods could also be available to remove an individual or individuals of the target species responsible for causing damage or posing threats to human safety. Therefore, if WS' personnel used lethal methods, the removal of an individual or individuals could result in local population reductions in the area where damage or threats were occurring. The number of individuals from a target species that WS could remove from a population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individual animals involved with the associated damage or threat, and the efficacy of methods employed.

The basis for the analysis to determine the magnitude of impacts on the populations of those target species addressed in this EA from the use of lethal methods would be a measure of the number of individuals lethally removed in relation to the abundance of that species. Magnitude may be determined

either quantitatively or qualitatively. Quantitative determinations may rely on population estimates, allowable removal levels, and actual removal data. Qualitative determinations may rely on population trend data, when available. WS would monitor the annual take of target species by comparing the number of individuals from each target species lethally removed with overall populations or trends. WS' personnel would only use lethal methods at the request of a cooperator seeking assistance. All lethal removal of target species by WS would occur at the request of a cooperator seeking assistance and only after authorization has been provided by the DNER and/or the municipality for the lethal take, when required.

Some target wildlife species can be lethally removed without a permit from the DNER. Under Regulation Number 6765, Indian Mongooses, Rhesus Macaques, Patas Monkeys, Black Rats, Norway Rats, House Mice, Spectacled Caimans, Green Iguanas, and Feral Cats (when Feral Cats occur in natural reserves, wildlife refuges, and regulatory forests) can be trapped and lethally removed by any entity at any time, including WS, without the need for a permit from the DNER. In addition, many of the target species addressed in this EA can be harvested during annual hunting seasons. Feral Swine and Feral Goats can be harvested during a regulated hunting season on Mona Island. In addition to the hunting season for Feral Swine and Feral Goats on Mona Island, there are hunting seasons for pigeons/doves and waterfowl throughout all of Puerto Rico. Under Regulation Number 6765, Indian Mongooses, Black Rats, Norway Rats, House Mice, Spectacled Caimans, Green Iguanas, and Feral Cats (when those Feral Cats occur in natural reserves, wildlife refuges, and regulatory forests) can be hunted during any of the legal hunting seasons in Puerto Rico. Therefore, any activities conducted by WS under the alternatives addressed would be occurring along with other natural processes and human-induced events, such as natural mortality, human-induced mortality from private damage management activities, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

2.1.2 Issue 2 - Effects on the Populations of Nontarget Wildlife Species, Including T&E Species

The potential for effects on nontarget species and Threatened or Endangered species arises from the use of nonlethal and lethal methods identified in the alternative approaches. The use of nonlethal and lethal methods has the potential to inadvertently exclude, disperse, capture, or kill nontarget wildlife. Appendix B describes the methods available for use under the alternative approaches. As part of the scoping process for this EA, WS consulted with the USFWS pursuant to Section 7 of the ESA during the development of this EA, which Section 3.1.2 discusses in further detail.

2.1.3 Issue 3 - Effects of Damage Management Methods on Human Health and Safety

An additional issue often raised is the potential risks to human health and safety associated with employing methods to manage damage caused by target species. WS' employees would use and recommend only those methods that were legally available, selective for target species, and were effective at resolving the damage associated with the target species. Still, some concerns exist regarding the safety of methods despite their legality, selectivity, and effectiveness. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public and employees of WS. Section 3.1.3 further evaluates the risks to human safety as this issue relates to the alternative approaches.

2.1.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

Several nonlethal and lethal methods would be available to alleviate damage associated with target species. The use of nonlethal and lethal methods has the potential to disperse, exclude, capture, or kill target species. Section 3.1.4 will discuss concerns regarding the humaneness of available methods and animal welfare concerns.

2.2 COMMON ACTIONS ASSOCIATED WITH DAMAGE MANAGEMENT ACTIVITIES

The following subsections discuss those actions WS identified that would continue to occur if WS implemented any of the alternative approaches identified in Section 2.4 that involve WS providing assistance.

2.2.1 WS' Co-managerial Approach to Making Decisions

Those entities experiencing damage associated with target species could conduct activities on their own, they could contact a private business for assistance, they could seek assistance from another governmental agency, they could seek assistance from WS, if available, or they could take no action. However, in all cases, the person and/or entity experiencing damage or threats of damage would determine the appropriate involvement of other people and/or entities and to what degree those people or other entities were involved in the decision-making process.

If a person and/or entity requested assistance from WS and WS was able to provide assistance, WS would follow the "*co-managerial approach*" to alleviate damage or threats of damage as described by Decker and Chase (1997). Within this management model, WS could provide technical assistance regarding the biology and ecology of target species and effective, practical, and reasonable methods available to a local decision-maker(s) to reduce damage or threats. Generally, a decision-maker seeking assistance would be part of a community, municipality, business, governmental agency, and/or a private property owner.

Under a community based decision-making process, WS would provide information, demonstration, and discussion on all available methods to the appropriate representatives of the community for which services were requested to ensure a community-based decision was made. By involving decision-makers in the process, WS could present damage management recommendations to the appropriate decision-maker(s) to allow decisions on damage management to involve those individuals that the decision maker(s) represents. As addressed in this EA, WS would provide technical assistance to the appropriate decision-maker(s) to allow the decision-maker(s) to present information on damage management activities to those persons represented by the decision-maker(s), including demonstrations and presentations by WS at public meetings to allow for involvement of the community. Requests for assistance to manage damage caused by target species often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives, the decision-maker(s) would be able to provide the information to local interests either through technical assistance provided by WS or through demonstrations and presentations by WS on activities to manage damage. This process would allow WS to recommend and implement activities based on local input.

The decision-maker for the local community would be officials or representatives of the communities that residents of a community have elected to represent them. The elected officials or representatives would be people who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. In the case of private property owners, the decision-maker would be the individual that owns or manages the affected property. The decision-maker for local, Commonwealth, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. If WS implemented Alternative 4, WS would not provide any assistance with managing the damage that target species can cause in the Commonwealth; therefore, the co-managerial approach would not be applicable.

2.2.2 Availability of Methods to Manage Damage Caused by Target Species

Appendix B discusses several methods available to alleviate damage or threats of damage associated with target species. Many of the methods discussed in Appendix B would be available to any entity for use when managing damage or threats of damage caused by target species in the Commonwealth. Therefore, despite the level of involvement by WS in Puerto Rico, many of the methods discussed in Appendix B would be available to other entities to manage damage or threats of damage associated with target species, including the public, private businesses, and other governmental agencies.

2.2.3 Effectiveness of Methods to Address Damage and Threats of Damage

Defining the effectiveness of any damage management activities often occurs in terms of losses or risks potentially reduced or prevented. Effectiveness can be dependent upon how accurately practitioners diagnose the problem, the species responsible for the damage, and how people implement actions to correct or mitigate risks or damages. To determine that effectiveness, WS must be able to complete management actions expeditiously to minimize harm to nontarget animals and the environment, while at the same time, using methods as humanely as possible. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of people using the method and, for WS' personnel, the guidance provided by WS' directives and policies. For any management methods employed, the proper timing is essential in effectively addressing damage. Employing methods soon after damage begins or soon after identifying damage threats increases the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods is necessary to be effective in achieving expedient resolution of animal damage.

WS is considering several methods (see Appendix B) that WS' personnel could incorporate into alternative approaches (see Section 2.4) to meet the need for action. If WS provides assistance and depending on the alternative approach selected to meet the need for action, WS could consider the use of an individual method or consider the use of several methods in combination to address damage and threats of damage. When WS provides assistance, WS' personnel would use the WS Decision Model (see WS Directive 2.201) to identify methods (see WS Directive 2.101) appropriate to reducing damage and reducing the threat of damage. In general, when providing assistance, WS' personnel would consider an adaptive approach that would integrate a combination of methods to resolve damage and reduce threats of damage (see WS Directive 2.105). If WS provides assistance, WS' personnel would evaluate the request for assistance and would consider the effectiveness of the methods available for that request based on how effective a method or methods were during previous requests for assistance and/or how effective methods were when used by those entities experiencing damage or threats of damage. When using methods, WS' personnel would continue to evaluate method effectiveness during the use of those methods. Therefore, WS' personnel would consider method effectiveness as part of the decision making-process during their use of the WS Decision Model for each damage management request based on continual evaluation of methods and results.

In meeting the need for action, the objective would be to reduce damage, risks, and conflicts with target species as requested and not to reduce/eliminate a species population. If WS excludes, removes, and/or disperses target species from an area where they were causing damage or posing a threat of damage, those target species would no longer be present at that location to cause damage or pose a threat. The removal and/or dispersal of target species could be short-term because new individuals may immigrate to an area. Therefore, the return of target species to an area after removal and/or dispersal activities does not mean individual management actions or methods were unsuccessful, but that periodic management may be necessary.

Similar to the effectiveness of methods to reduce damage or reduce threats of damage is the cost effectiveness of methods. The cost of methods and/or the cost of implementing methods may sometimes be a secondary consideration because of overriding environmental, legal, human health and safety, humaneness, animal welfare, or other concerns. Therefore, the cost effectiveness of methods and/or a cost benefit analysis is not essential to making a reasoned choice among the alternative approaches that WS is considering. In addition, the Council on Environmental Quality does not require a formal, monetized cost benefit analysis to comply with the NEPA.

2.2.4 Research Methods and Information on the Life History of Target Species

Under any of the alternatives, WS would continue to research and develop methods to address target species damage through the National Wildlife Research Center. The National Wildlife Research Center functions as the research unit of WS by providing scientific information and developing methods to address damage caused by animals. Research biologists with the National Wildlife Research Center work closely with WS' personnel, wildlife managers, researchers, and others to develop and evaluate methods and techniques. For example, one research area that is a focus of the National Wildlife Research Center is defining economic impacts and developing control strategies for reducing impacts of Feral Swine and other ungulates.

2.2.5 Authorization from the DNER, the PRDA, and the municipalities

The DNER has regulatory authority over wildlife species in Puerto Rico. Under Law Number 241, wildlife species are defined as those resident animals that are found in the wild and whose spread or survival does not depend on the zeal, care, or cultivation of humans. Furthermore, pets that become feral and no longer rely on humans to survive are considered wildlife. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove those target species that are considered wildlife. However, those wildlife species that are considered harmful under Regulation Number 6765 can be trapped and lethally removed without a permit from the DNER. Those target species listed as harmful under Regulation Number 6765 include Indian Mongooses, Rhesus Macaques, Patas Monkeys, Black Rats, Norway Rats, House Mice, Spectacled Caimans, Green Iguanas, and Feral Cats (when those Feral Cats occur in natural reserves, wildlife refuges, and regulatory forests).

The DNER requires a license to hunt and lethally take those target species that can be harvested during a regulated hunting season. Feral Swine and Feral Goats can be legally hunted on Mona Island during a regulated hunting season. In addition to the hunting season for Feral Swine and Feral Goats on Mona Island, there are regulated hunting seasons for pigeons/doves and waterfowl throughout all of Puerto Rico. Under Regulation Number 6765, Indian Mongooses, Black Rats, Norway Rats, House Mice, Spectacled Caimans, Green Iguanas, and Feral Cats (when those Feral Cats occur in natural reserves, wildlife refuges, and regulatory forests) can be hunted during any of the legal hunting seasons in Puerto Rico, provided the hunter obtain a license from the DNER and adhere to all rules and regulations for that hunting season during which the person is hunting.

The PRDA also has some regulatory authority over Rhesus Macaques, Patas Monkeys, and Squirrel Monkeys under Regulation Number 7399, which prohibits the introduction, importation, possession, acquisition, sale, or transfer of those species in Puerto Rico. Regulation Number 7399 is a complement, but not a limitation in any way, to the dispositions of Regulation Number 6765. Thus, an entity may need a permit from the PRDA to capture macaques and monkeys, provided the capture is beyond the scope of Regulation Number 6765.

Some of the target species addressed in this EA may be classified as stray domestic animals instead of wildlife depending on unique circumstances related to an individual animal. Those animals that are not under the control of its owner, or does not have a known owner, but rely on humans to survive are considered stray animals. Each municipality has the general power to order, regulate, and resolve concerns regarding stray domestic animals, including the implementation of precautionary measures that are necessary to protect the public health as it may be affected by domestic stray animals (Puerto Rico Statute Title 21 § 4054). Those precautionary measures could include the lethal removal of stray animals. Thus, an entity may need authorization from the municipality in which the stray animal is located in before capturing and/or lethally removing that animal.

2.2.6 Influence of Global Climate Change on Wildlife Populations

The State of the Climate in 2012 report indicates that every year has been warmer than the long-term average since 1976 (Blunden and Arndt 2013). Impacts of this change will vary throughout the United States, but some areas could experience air and water temperature increases, alterations in precipitation, and increased severe weather events. Temperature and precipitation often influence the distribution and abundance of a plant or animal species. As temperatures continue to increase, the ranges of many species will likely expand into northern latitudes and higher altitudes (Trautmann 2018). Species adapted to cold climates may struggle to adjust to changing climate conditions (*e.g*., less snowfall, range expansions of other species). Sheikh et al. (2007) stated, "*Wildlife species can be affected by several climatic variables such as increasing temperatures, changes in precipitation, and extreme weather events*". Sheikh et al. (2007) further stated that changes in climate could benefit some species of wildlife.

The impact of climate change on wildlife and their habitats is of increasing concern to land managers, biologists, and members of the public. Climate change may alter the frequency and severity of habitat-altering events, such as wildfires, weather extremes, such as drought, presence of invasive species, and wildlife diseases. WS recognizes that climate change is an ongoing concern and may result in changes in species range and abundance. Climate change may also affect other factors, such as agricultural practices and the timing of water freeze up, which can influence the timing and movement pattern of migrations. Over time, climate change would likely lead to changes in the scope and nature of human-wildlife conflicts in the Commonwealth. Because these types of changes are an ongoing process, WS has developed adaptive management strategies that allow WS and other agencies to monitor for and adjust to impacts of ongoing changes in the affected environment.

If WS selected an alternative approach to meeting the need for action that allows WS to provide assistance (see Section 2.4), WS would monitor activities, in context of the issues analyzed in detail, to determine if the need for action and the associated impacts remain within the parameters established and analyzed in this EA. If WS implemented Alternative 1, activities would not exceed the levels authorized by the DNER and/or a municipality. In addition, as required, WS would submit annual reports to the DNER and/or a municipality so those entities had the opportunity to evaluate WS' activities and the cumulative take occurring for target species.

Therefore, coordinating activities between WS with the DNER would ensure the DNER has the opportunity to incorporate any activities WS' conducts into population objectives established for wildlife populations in the Commonwealth. If WS determines that a new need for action, changed conditions, new issues, or new alternatives having different environmental impacts warrant a new or additional analysis, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Through monitoring, WS can evaluate and adjust activities as changes occur over time.

WS' monitoring would also include reviewing the list of species the USFWS considers as Threatened or Endangered within the Commonwealth pursuant to the ESA. As appropriate, WS would consult with the

USFWS pursuant to Section 7 of the ESA to ensure the activities conducted by WS would not jeopardize the continued existence of threatened or Endangered species or result in adverse modification to areas designated as critical habitat for a species within the Commonwealth. Through the review of species listed as threatened or Endangered and the consultation process with the USFWS, WS can evaluate and adjust activities conducted to meet the need for action. Accordingly, WS could supplement this analysis or conduct a separate evaluation pursuant to the NEPA based on the review and consultation process. If deemed necessary through the monitoring process, WS could adjust activities to assure that WS' actions do not significantly contribute to changes in the environmental status quo that occur because of climate change.

2.3 WS' DIRECTIVES AND STANDARD PROCEDURES WHEN PROVIDING ASSISTANCE

WS' directives define program objectives and guide WS' activities when managing wildlife damage (see WS Directive 1.201, WS Directive 1.205, WS Directive 1.210). WS' personnel would adhere to applicable WS' directives when responding to and providing assistance. WS' directives improve the safety, selectivity, and efficacy of activities that WS' personnel could conduct to alleviate or prevent damage. In addition, WS' personnel would follow the conditions and requirements associated with authorizations provided by the DNER, including any requirements to report WS' activities. WS' implementation of the alternative approaches discussed in Section 2.4.1 would adhere to WS Directive 2.320, which provides guidelines for WS' actions when managing damage associated with invasive species.

2.4 ALTERNATIVES THAT WS CONSIDERED

This section discusses those alternative approaches that WS identified during the initial scoping process for this EA and provides a description of how WS would implement those approaches. WS developed the alternative approaches based on the need for action. The need for action identified by WS is associated with requests for assistance that WS receives to manage damage and threats of damage caused by non-native mammal and reptile species in Puerto Rico (see Section 1.2). WS also developed the alternative approaches to address those issues identified in Section 2.1.

2.4.1 Alternatives Considered in Detail within this EA

As discussed in Section 1.2, people experiencing damage or threats of damage associated with wildlife often seek assistance from other entities to alleviate that damage or to prevent damage from occurring. The WS program is the lead federal agency responsible for managing conflicts between people and wildlife (see Section 1.2); therefore, people could request assistance from WS. This EA considers in detail the following four alternative approaches to meeting the need for action identified in Section 1.2 and those issues identified in Section 2.1.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico (Proposed Action/No Action)

If WS implements Alternative 1, WS would be available to provide assistance when people experience damage or threats of damage associated with those target species addressed in this EA and, consequently, request assistance from WS. When responding to a request for assistance, WS' personnel would use the WS Decision Model (Slate et al. 1992; see WS Directive 2.201) to formulate a management strategy to address each request for assistance.

The general thought process and procedures of the WS Decision Model would include the following steps.

1. **Receive Request for Assistance:** WS would only provide assistance after receiving a request for such assistance. WS would not respond to public bid notices.
2. **Assess Problem:** First, WS would make a determination as to whether the assistance request was within the authority of WS. If an assistance request were within the authority of WS, WS' employees would gather and analyze damage information to determine applicable factors, such as what species was responsible for the damage, the type of damage, the extent of damage, and the magnitude of damage. Other factors that WS' employees could gather and analyze would include the current economic loss or current threat (*e.g.*, threat to human safety), the potential for future losses or damage, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.
3. **Evaluate Management Methods:** Once a problem assessment was completed, a WS' employee would conduct an evaluation of available management methods (see Appendix B). The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on biological, environmental, humaneness, social, and cultural factors.
4. **Formulate Management Strategy:** A WS' employee would formulate a management strategy using those methods that the employee determines to be practical for use. The WS employee would also consider factors essential to formulating each management strategy, such as available expertise, legal constraints on available methods, human safety, humaneness, nontarget animal risks, costs, and effectiveness.
5. **Provide Assistance:** After formulating a management strategy, a WS employee could provide technical assistance and/or direct operational assistance to the requester (see WS Directive 2.101). All management actions conducted and/or recommended by WS would comply with appropriate federal, Commonwealth, and local laws in accordance with WS Directive 2.210.
6. **Monitor and Evaluate Results of Management Actions:** When providing direct operational assistance, it is necessary to monitor the results of the management strategy. Monitoring would be important for determining whether further assistance was required or whether the management strategy resolved the request for assistance. Through monitoring, a WS' employee would continually evaluate the management strategy to determine whether additional techniques or modification of the strategy was necessary.
7. **End of Project:** When providing technical assistance, a project would normally end after a WS' employee provided recommendations or advice to the requester. A direct operational assistance project would normally end when WS' personnel stop or reduce the damage or threat to an acceptable level to the requester or to the extent possible. Some damage situations may require continuing or intermittent assistance from WS' personnel and may have no well-defined termination point.

Therefore, if WS implements Alternative 1, WS could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damage caused by target species, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. WS would provide technical assistance to those entities requesting assistance as described for Alternative 3. Direct operational damage management assistance would include damage management activities that WS' personnel would conduct directly or supervise. WS' employees may initiate operational damage management assistance when technical assistance alone would not effectively alleviate the damage or the threat of damage and when WS and the entity requesting assistance have signed a work initiation document. Funding for WS' activities could occur from federal appropriations, funding from the Commonwealth, and/or from cooperative service agreements with an entity requesting WS' assistance.

Appendix B discusses those methods that WS' employees would consider when evaluating management methods to alleviate damage or threats of damage associated with mammals and reptiles in Puerto Rico.

Nonlethal methods from Section I in Appendix B that WS could use and/or recommend include human presence, hand capture, repellents, immobilizing drugs, exclusion methods (*e.g.*, fencing), auditory deterrents (*e.g.*, propane cannons, pyrotechnics), visual deterrents (*e.g.*, lasers, lights), trained dogs, live capture methods (*e.g.*, cage traps, foothold traps), cable devices[4], and nets (*e.g.*, cannon nets, drop nets). WS could also use and/or recommend the use of an unmanned aerial vehicle (UAV). In addition, WS could recommend minor habitat modifications (*e.g.*, planting less palatable vegetation), changes in cultural practices (*e.g.*, removing pet food, using appropriate trash receptacles), and supplemental feeding. WS could also use snagging hooks to capture Spectacled Caiman in Puerto Rico. Lethal methods would include the use of a firearm, body-grip trap, euthanasia after live-capture, and destruction of reptile eggs. Section II in Appendix B describes those lethal methods that would be available to manage damage and threats of damage associated with mammals and reptiles in Puerto Rico. The initial investigation would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to alleviate the problem. When evaluating management methods and formulating a management strategy, WS' personnel would give preference to nonlethal methods when they determine those methods to be practical and effective (see WS Directive 2.101).

In general, the most effective approach to resolving damage would be to integrate the use of several methods simultaneously or sequentially while continuing to evaluate the effectiveness of the method or methods. Alternative 1 would be an adaptive approach to managing damage that would integrate the use of the most practical and effective methods as determined by a site-specific evaluation for each request after applying the WS Decision Model. The philosophy behind an adaptive approach would be to integrate the best combination of methods while minimizing the potentially harmful effects on people, target and nontarget species, and the environment. WS' personnel would not necessarily use every method from Appendix B to address every request for assistance but would use the WS' Decision Model to determine the most appropriate approach to address each request for assistance, which could include using additional methods from Appendix B if initial efforts were unsuccessful at reducing damage or threats of damage adequately.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico using only nonlethal methods

Under this alternative, WS would implement an adaptive integrated methods approach as described under Alternative 1, including the use of the WS' Decision Model; however, WS would only consider nonlethal methods when formulating approaches to resolve damage associated with target species. WS could provide technical assistance and/or direct operational assistance similar to Alternative 1. WS would provide technical assistance to those entities requesting assistance as described for Alternative 3. The only methods that WS could recommend and/or use would be the nonlethal methods. Nonlethal methods that WS could use and/or recommend are detailed in Section I of Appendix B and would be the same nonlethal methods discussed in the description for Alternative 1.

WS would refer requests for information regarding lethal methods to the DNER, the PRDA, municipalities, and/or private entities. Although WS would not recommend or use lethal methods under this alternative, other entities, including private entities, could continue to use many of the lethal methods discussed in Section II of Appendix B to resolve damage or threats of damage. The DNER could continue to authorize the take of those target species addressed in this EA through the issuance of hunting licenses and other authorizations.

[4]When deemed appropriate for use, WS' personnel would only use cable devices to target Feral Swine, Feral Goats, and White-tailed Deer.

Alternative 3 - WS would recommend an integrated methods approach to managing damage caused by target species in Puerto Rico through technical assistance only

If WS implements Alternative 3, WS would continue to use the WS' Decision Model to respond to requests for assistance; however, WS would only provide those cooperators requesting assistance with technical assistance. Technical assistance would provide those cooperators experiencing damage or threats of damage associated with target species with information, demonstrations, and recommendations on available and appropriate methods available. The implementation of methods and techniques to alleviate or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Similar to Alternative 1 and Alternative 2, a key component of assistance provided by WS would be providing information to the requester about the target species and how to manage damage associated with target species.

Education would be an important component of technical assistance because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. When responding to a request for assistance, WS would provide those entities with information regarding the use of appropriate methods. WS would provide property owners or managers requesting assistance with information regarding the use of effective and practical techniques and methods. In addition to the routine dissemination of recommendations and information to individuals or organizations experiencing damage, WS could provide lectures, courses, and demonstrations to agricultural producers, homeowners, governmental entities, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, WS' personnel may present technical papers at professional meetings and conferences so that other wildlife professionals and the public receive updates on recent developments in damage management technology, programs, laws and regulations, and agency policies.

Technical assistance would include collecting information, such as the number of individuals of the target species involved, the extent of the damage, and previous methods that the cooperator had used to alleviate the problem. WS' personnel would then provide information on appropriate methods that the cooperator could consider to alleviate the damage themselves. Types of technical assistance projects may include a site visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues.

Generally, WS' personnel would describe several management strategies to the requester for short and long-term solutions to managing damage based on the level of risk, need, and the practicality of their application. WS' personnel would recommend and loan only those methods legally available for use by the appropriate individual. Many of the methods described in Appendix B would be available to those people experiencing damage or threats associated with target species in the Commonwealth.

Those entities seeking assistance with reducing damage could seek direct operational assistance from other governmental agencies, private entities, or conduct activities on their own. In situations where nonlethal methods were ineffective or impractical, WS could advise the property owner or manager of appropriate lethal methods to supplement nonlethal methods. In order for the property owner or manager to use lethal methods, they would be required to apply for their own permit to take target species from the DNER, when a permit was required.

Alternative 4 - WS would not provide any assistance with managing damage caused by target species in Puerto Rico

This alternative would preclude any activities by WS to alleviate damage or threats of damage associated with those target species addressed in the EA. WS would refer all requests for assistance associated with target species to the DNER, the PRDA, municipalities, and/or to private entities. This alternative would not prevent other governmental agencies and/or private entities from conducting damage management activities directed at alleviating damage and threats associated with target species in the Commonwealth. Therefore, under this alternative, entities seeking assistance with addressing damage caused by those target species addressed in this EA could contact WS but WS would immediately refer the requester to other entities. The requester could then contact other entities for information and assistance, could take actions to alleviate damage without contacting any entity, or could take no further action. Many of the methods listed in Appendix B would be available for use by other government agencies, private entities, or those persons experiencing damage or threats of damage caused by target species in Puerto Rico.

2.4.2 Alternatives and Strategies that WS Did Not Consider In Detail

In addition to those alternatives discussed in Section 2.4.1, WS identified several additional alternative approaches to meeting the need for action. However, those alternatives will not receive detailed analysis in this EA for the reasons provided for each alternative. Those alternatives considered but not analyzed in detail include the following.

Implementation of Alternative 1 but WS must use all of the nonlethal methods identified in Appendix B before using lethal methods

Implementation of this alternative would be an adaptive integrated methods approach similar to Alternative 1. However, this alternative would require that WS apply nonlethal methods or techniques described in Appendix B to all requests for assistance to reduce damage and threats to safety associated with target species in the Commonwealth. If the use of nonlethal methods failed to alleviate the damage situation or reduce threats to human safety at each damage situation, WS' personnel would use lethal methods to alleviate the damage or threat occurring. WS' personnel would apply nonlethal methods to every request for assistance regardless of severity or intensity of the damage or threat until the employee deemed those nonlethal methods inadequate to resolve the damage or threat. This alternative would not prevent the use of lethal methods by other entities to alleviate damage or threats of damage.

WS did not carry this alternative forward for further analysis in Chapter 3 because people experiencing damage often employ nonlethal methods to reduce damage or threats prior to contacting WS. If WS implemented this alternative, WS would be required to implement nonlethal methods the entity requesting assistance had already used or would have to establish criteria to measure the efforts of the requesting entity to determine if the requesting entity applied nonlethal methods appropriately. For example, Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. Therefore, continuing to use methods already proven ineffective at alleviating the damage could prolong the amount of time damage occurs, which could increase the economic losses. Because many people that request assistance use nonlethal methods but continue to experience damage or threats of damage and because there is no standard that exists for the use of nonlethal methods, WS did not carry this alternative forward for further analysis in Chapter 3. In addition, implementation of Alternative 1 would be similar to a nonlethal before lethal alternative because WS' personnel would consider the use of nonlethal methods before considering the use of lethal methods (see WS Directive 2.101). Adding a nonlethal before lethal alternative and the associated analysis would not add additional information to the analyses in this EA.

WS would implement Alternative 1 but would only use lethal methods

This alternative would be similar to Alternative 1 but WS would use only those methods that lethally removed target species. Under WS Directive 2.101, WS must consider the use of nonlethal methods before lethal methods. Nonlethal methods have been effective in alleviating some damage caused by target species. In those situations where damage could be alleviated using nonlethal methods, WS' personnel could use those methods and/or recommend those methods as determined by the WS Decision Model. Therefore, WS did not consider this alternative in detail.

WS would develop a program that compensates people for damage

Establishing a program to compensate people for damage would require WS to establish a system to reimburse persons affected by damages caused by target species. If WS established a program that compensates people for damage, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. A compensation program would require large expenditures of money and labor to investigate and validate damage claims and to determine and administer appropriate compensation. Compensation would most likely be below full market value. Compensation for damages would give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies and would not be practical for reducing threats to human health and safety. For the above listed reasons, WS did not carry this alternative forward for further analysis in Chapter 3.

WS would develop a bounty program

Most wildlife professionals have not supported payment of funds (bounties) for removing animals suspected of causing damage, or posing threats of damage, for many years (Latham 1960). WS concurs because of several inherent drawbacks and inadequacies in the payment of bounties. Bounties are often ineffective at controlling damage over a wide area, such as across the entire State. The circumstances surrounding the removal of animals are typically arbitrary and completely unregulated because it is difficult or impossible to assure animals claimed for bounty were not lethally removed from outside the area where damage was occurring. In addition, WS does not have the authority to establish a bounty program.

WS would implement Alternative 1 but would establish a loss threshold before allowing lethal methods

There is also a concern that damage caused by animals should be a cost of doing business and/or that there should be a threshold of damage before allowing the use of lethal methods to manage damage. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In some cases, any loss in value of a resource caused by target species could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking target species could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of aircraft strikes prior to an actual strike occurring would be appropriate. For those reasons, WS did not carry this alternative forward for further analysis in Chapter 3.

WS would require cooperators completely fund activities (no taxpayer money)

This alternative would be similar to Alternative 1 or Alternative 2 except WS would require the entity requesting assistance to pay for any activities conducted by WS. Therefore, no activities conducted by

WS would occur through federal appropriations or Commonwealth funding (*i.e.*, no taxpayer money). Funding for WS' activities could occur from federal appropriations, through Commonwealth funding, and/or through money received from the entity requesting assistance. In those cases where WS receives federal and/or Commonwealth funding to conduct activities, federal, Commonwealth, and/or local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility. Treves and Naughton-Treves (2005) and the International Association of Fish and Wildlife Agencies (2005) discuss the need for wildlife damage management and that an accountable government agency is best suited to take the lead in such activities because it increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall. Therefore, WS did not carry this alternative forward for further analysis in Chapter 3.

WS would implement Alternative 1 but would require cooperators fund the use of lethal methods

This alternative would be identical to Alternative 1 except WS would require people requesting assistance to pay for all the costs associated with using lethal methods to resolve their request for assistance. If WS used lethal methods to alleviate or prevent damage, the person requesting assistance would be responsible for paying for the costs associated with those activities. WS could then use existing federal and/or Commonwealth funding to pay for the costs associated with using nonlethal methods to manage damage caused by target species. WS did not carry this alternative forward for further analysis because the environmental consequences associated with the use of this method would be identical to Alternative 1.

WS would refer requests for assistance to Private Nuisance Wildlife Control Agents

People experiencing damage or threats of damage associated with target species could contact private wildlife control agents and/or other private entities to reduce damage when they deem appropriate. In addition, WS could refer persons requesting assistance to private wildlife control agents and/or other private entities if WS implemented any of the alternative approaches. WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS only responds after receiving a request for assistance. If WS implemented Alternative 1 or Alternative 2, WS would inform requesters that other service providers, including private entities, might be available to provide assistance. Therefore, WS did not carry this alternative forward for further analysis.

WS would only trap and translocate target species

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods. Target species could be live-captured using hand capture, hand nets, throw nets, drop nets, cannon/rocket nets, catch poles, cage-type traps, cable devices, or with foothold traps. All target species live-captured through direct operational assistance by WS would be translocated. Prior to live-capture, WS' personnel would identify a release site or sites and obtain approval from the appropriate property owner and/or manager to release target species on their property or properties. In addition, the translocation of most target species requires prior authorization from the DNER. Other entities could translocate target species to alleviate damage with proper authorization from the DNER.

Translocation would not be appropriate because most of the target species addressed in this EA are not native to Puerto Rico and can be invasive throughout their introduced ranges. In addition, the translocation of non-native species causing damage or posing a threat of damage to other areas following live-capture generally would not be effective or cost-effective. Translocation is generally ineffective because many of the target species are highly mobile and can easily return to damage sites from long

distances, habitats in other areas are generally already occupied, and translocation would most likely result in damage problems at the new location. In addition, hundreds or thousands of target species (*e.g.*, rodents) would need to be captured and translocated to solve some damage problems; therefore, translocation would be unrealistic in those circumstances. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, the potential for disease transmission, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988, Craven et al. 1998, Massei et al. 2010). Therefore, WS did not consider this alternative in detail.

Reducing damage by managing target species populations using reproductive inhibitors

Under this alternative, the only method available to alleviate requests for assistance would be the recommendation and the use of reproductive inhibitors to reduce or prevent reproduction in target species responsible for causing damage. Reproductive inhibitors can be effective where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). Population dynamic characteristics (*e.g.*, longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity), habitat and environmental factors (*e.g.*, isolation of target population, cover types, and access to target individuals), socioeconomic factors, and other factors can limit the use and effectiveness of reproductive control as a population management tool.

Reproductive control for wildlife could be accomplished through sterilization (permanent) or contraception (reversible). Sterilization could be accomplished through surgical sterilization (vasectomy, castration, and tubal ligation), chemosterilization, or gene therapy. Contraception could be accomplished through hormone implantation (synthetic steroids such as progestins), immunocontraception (contraceptive vaccines), or oral contraception (progestin administered daily).

Population modeling indicates that reproductive control is more effective than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998). Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproductive control technologies as a wildlife management tool for some species. Currently, chemical reproductive inhibitors are not available for use to manage most target species addressed in this EA. Given the costs associated with live-capturing and performing sterilization procedures on target species and the lack of availability of chemical reproductive inhibitors for the management of most target species addressed in this EA, this alternative was not evaluated in detail. If reproductive inhibitors become available to manage a large number of target species and if an inhibitor has proven effective in reducing localized target species populations, WS could evaluate the use of the inhibitor as a method available to manage damage. Currently, the only reproductive inhibitor that the EPA has approved for use is GonaCon™, which is only available to manage localized populations of White-tailed Deer (EPA Reg. No. 56228-40).

CHAPTER 3: ENVIRONMENTAL EFFECTS

Chapter 3 provides information needed for making informed decisions by comparing the environmental consequences of the four alternatives. To determine if the real or potential effects are greater, lesser, or the same as the environmental baseline, Section 3.1 compares the environmental consequences associated with each of the four alternative approaches. A discussion occurs on the cumulative and unavoidable impacts, including direct and indirect effects, in relation to the issues for each of the alternatives. Impacts caused by implementation of an alternative approach and occur at the same time and place are direct effects. In contrast, impacts caused by implementing an alternative approach that occur later in time or further removed in distance, and are still reasonably foreseeable, are indirect effects. The analyses

discuss the cumulative effects in relationship to each of the alternatives analyzed, with emphasis on potential cumulative effects from similar activities, and include summary analyses of potential cumulative impacts to target and nontarget species, including Threatened or Endangered species, threats to human health and safety, and the humaneness of methods.

3.1 ISSUES CONSIDERED IN DETAIL AND THEIR IMPACTS BY ALTERNATIVE

WS developed the alternative approaches (see Section 2.4) to meet the need for action identified in Section 1.2 and to address the issues identified in Section 2.1. This section analyzes the environmental consequences of each alternative approach in comparison to determine the extent of actual or potential impacts on each of the issues. Therefore, Alternative 1 serves as the baseline for the analysis and the comparison of expected impacts among the alternative approaches. The analysis also takes into consideration mandates, directives, and the procedures of WS, the DNER, the PRDA, and municipalities.

3.1.1 Issue 1 - Effects of Damage Management Activities on Populations of Target Species

If WS implemented Alternative 1, Alternative 2, or Alternative 3, WS could conduct and/or recommend activities that could disperse, exclude, capture, or lethally remove target species depending on the alternative approach WS selected and implemented. Appendix B identifies and discusses the methods that WS could consider when formulating strategies to resolve damage caused by target species in Puerto Rico when someone requests such assistance. If WS implemented Alternative 4, WS would not conduct any activities in Puerto Rico involving those target species addressed in this EA. This section evaluates the magnitude of cumulative effects on the populations of target species that could occur if WS implemented one of the four alternative approaches.

- **Population Impact Analyses of the Alternatives - Direct, Indirect, and Cumulative Effects**

Direct effects are impacts the action causes and occur at the same time and place. Indirect effects occur because of the action but are later in time or farther removed in distance. Indirect effects may include impacts related to actions that induced changes in population density, ecosystems, and land use changes. Cumulative impacts, as defined by Council on Environmental Quality (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time. The potential cumulative impacts analyzed below would occur from either WS' activities over time or from the aggregate effects of those activities combined with the activities of other agencies and private entities.

As discussed in Section 1.5, the DNER, the PRDA, and municipalities are the Commonwealth entities responsible for managing those target species addressed in this EA. Through ongoing communication with the DNER, the PRDA, and/or the municipalities, WS can consider the activities of other agencies and private entities to the extent that those agencies know those activities occur. WS does not typically conduct direct damage management activities concurrently with other governmental or private entities at a location, but may conduct damage management activities at adjacent sites within the same period.

WS' actions would be occurring simultaneously over time with other natural processes and human generated changes that are currently taking place. These activities include, but are not limited to

- Natural mortality of target species
- Human-induced mortality through vehicle strikes, aircraft strikes, and illegal take
- Human-induced mortality of target species through private damage management activities

- Human-induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of target species populations. WS' employees use the WS Decision Model to evaluate damage occurring (including other affected elements and the dynamics of the damaging species) and to determine appropriate strategies to minimize effects on environmental elements. After WS' personnel apply damage management actions, they subsequently monitor and adjust/cease damage management actions (Slate et al. 1992). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over target species populations in Puerto Rico, the DNER could adjust take levels, including the take by WS, to achieve population objectives for target species. Consultation and reporting of take by WS would ensure the DNER had the opportunity to consider the activities conducted by WS. As stated previously, WS would not use or recommend those lethal methods available as population management tools over broad areas. WS would use and recommend lethal methods to reduce the number of individuals of target species present at a location where damage was occurring by targeting those target species causing damage or posing threats; therefore, the intent of lethal methods would be to manage those mammals and reptiles causing damage and not to manage entire populations of target species.

Because take of wildlife in Puerto Rico can only legally occur when authorized by the DNER, the DNER can consider take when determining population objectives for target species. Therefore, the DNER could adjust the number of individuals of target species that people harvest during the regulated hunting season and the number of individuals of target species that people can take for damage management purposes to achieve the population objectives. Therefore, for most species, take by WS and the authorized take allowed would occur at the discretion of the DNER. Any target species population declines or increases induced through the regulation of take would be the collective objective for target species populations established by the DNER.

As discussed previously, the analysis for magnitude of impact from lethal take can be determined either quantitatively or qualitatively. Quantitative determinations may rely on population estimates, allowable removal levels, and actual removal data. Qualitative determinations may rely on population trend data, when available. Information on target species populations and trends are often derived from several sources, including published literature and harvest data. The potential impacts of conducting the alternative approaches on the populations of target species occur below for each alternative.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico (Proposed Action/No Action)

If WS implements Alternative 1, WS would be available to provide both technical assistance and direct operational assistance to those persons requesting assistance with managing damage and threats caused by target species in Puerto Rico. The effects on the populations of target species associated with WS providing technical assistance during the implementation of Alternative 1 would be similar to those effects discussed for Alternative 3. Therefore, to reduce redundancy, the effects associated with WS providing technical assistance that would occur if WS implements Alternative 1 occur in the discussion for Alternative 3.

When providing direct operational assistance, WS could employ those methods described in Appendix B in an adaptive approach that would integrate methods to reduce damage and threats associated with target

species effectively. WS' personnel would use the WS Decision Model (see WS Directive 2.201) to identify the most appropriate damage management strategies and their impacts. If WS implemented Alternative 1, WS' personnel could choose to use any of the methods discussed in Appendix B when using the WS Decision Model to formulate strategies. Therefore, implementation of Alternative 1 would allow WS' personnel to consider the widest range of methods available when formulating strategies to resolve requests for assistance associated with target species. WS' personnel would employ methods in an adaptive approach that would integrate methods to reduce damage and threats of damage associated with target species. WS would only use methods after WS and the appropriate entity requesting assistance signed a work initiation document allowing WS to use those methods on property they own or manage. When practical and effective, WS' personnel would give preference to nonlethal methods pursuant to WS Directive 2.101.

A common concern is whether damage management actions would adversely affect the population of a target species, especially when WS and other entities use lethal methods. If WS implemented Alternative 1, the potential effects on the populations of target species associated with WS' use of nonlethal methods would be similar to those potential effects discussed for Alternative 2 because the same nonlethal methods would be available for use by WS' personnel. To limit redundancy, a discussion on the potential effects associated with the use of nonlethal methods does not occur for Alternative 1 because those potential effects would be similar to those discussed for Alternative 2 but those potential effects could possibly occur if WS' implemented Alternative 1. In general, the use of nonlethal methods to disperse, exclude, or capture target species from areas where they are causing damage or posing a threat of damage would have minimal effects on the overall population of a target species because those methods generally do not harm target species (see discussion for Alternative 2).

Therefore, the evaluation of potential effects on the populations of target species for Alternative 1 will primarily focus on WS' use of lethal methods because WS' personnel could use lethal methods to remove an individual of a target species or a group of target species to alleviate damage. WS would only target an individual of a target species or a group of individuals of a target species identified as causing damage or posing a threat to human safety. Therefore, if WS implemented Alternative 1, WS could lethally remove target species, which could potentially have direct, indirect, and cumulative effects on the populations of target species. WS would only take target species when authorized by the DNER and/or the municipality and only at authorized levels.

The use of lethal methods could result in local population reductions in the area where damage or threats were occurring because those methods would remove target species from a population. WS often uses lethal methods to reinforce nonlethal methods and to remove target species that WS' personnel identify as causing damage or posing a threat of damage. The number of target species removed from a population using lethal methods would be dependent on the number of requests for assistance received, the number of target species involved with the associated damage or threat, and the efficacy of methods employed. WS' personnel would only target those individuals or groups of target species that they identify as responsible for causing damage or posing a threat of damage. The potential impacts on the populations of target species from the implementation of Alternative 1 occurs below.

NORWAY RAT POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Norway Rats are native to many parts of Asia, but now occur worldwide with the exception of the polar regions (Long 2003). Norway Rats were most likely introduced to North America via transatlantic shipping beginning in the 1700s (Brooks 1973, Meehan 1984). Norway Rats are among the most successful invasive vertebrates occurring in both rural and urban areas throughout the United States, including Alaska, Hawaii, and all territories.

Although the population of Norway Rats in Puerto Rico is unknown, the species is considered a harmful non-native, invasive species in the Commonwealth under Regulation Number 6765. The DNER has regulatory authority over Norway Rats in Puerto Rico and permit rat damage management activities within the Commonwealth under that authority. Under Regulation Number 6765, an entity may trap and subsequently euthanize Norway Rats in Puerto Rico without a permit from the DNER. In addition, Regulation Number 6765 also authorizes licensed hunters to hunt and lethally remove Norway Rats during the hunting season for Feral Swine and Feral Goats on Mona Island and during the hunting season for waterfowl and doves throughout Puerto Rico. However, outside of the scope of Regulation Number 6765, an entity is required to obtain a permit from the DNER to lethally remove Norway Rats in Puerto Rico under Law Number 241, as amended under Law Number 223. Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law.

When evaluating a request for assistance involving Norway Rats, WS' personnel would ensure WS' actions were consistent with WS Directive 2.345. WS Directive 2.345 outlines WS' policy regarding requests for assistance involving rodent species in urban areas. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Norway Rats would be live-capture methods and body-gripping traps (*i.e.*, snap traps). Norway Rats live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505. From federal fiscal year (FY) 2015 through FY 2020, WS did not receive requests to alleviate damage associated with Norway Rats in Puerto Rico; thus, WS did not use nonlethal or lethal methods to alleviate damage associated with Norway Rats in Puerto Rico during that period. However, WS could receive requests for assistance associated with Norway Rats in the future. WS could lethally remove up to 250 Norway Rats annually in Puerto Rico when requested to alleviate damage and threats of damage.

Although population estimates are not available, Norway Rats are generally prolific breeders and are generally abundant throughout their range. Norway Rats can breed throughout the year. Females produce four to six litters per year, with each litter averaging six to 12 young (Timm 1994*a*). Gestation is about three weeks, and animals reach sexual maturity approximately three weeks after birth (Timm 1994*a*). Given their reproductive potential, populations can expand rapidly when food, water, and habitat are available. Additionally, populations of rats fluctuate greatly over time. Due to the species' relatively high reproductive rates and because management activities would be restricted to specific local sites, WS' activities under the proposed action would have minimal impacts on overall populations of Norway Rats in Puerto Rico. WS' activities would be conducted pursuant to Executive Order 13112 and Executive Order 13751. Any removal of Norway Rats would provide some benefit to the native environment by reducing competition with native wildlife.

BLACK RAT POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Black Rats are native to a large portion of Asia, probably throughout the Indo-Malayan region and throughout southern China (Long 2003). Black Rats are now widespread throughout the world and are the dominant *Rattus* species found on tropical islands, including Puerto Rico (Witmer and Shiels 2018). Black Rats inhabit a variety of habitats, and thrive in human dominated landscapes.

Although the population of Black Rats in Puerto Rico is unknown, the species is considered a harmful non-native, invasive species in the Commonwealth under Regulation Number 6765. The DNER has regulatory authority over Black Rats in Puerto Rico and permit rat damage management activities within the Commonwealth under that authority. Under Regulation Number 6765, an entity may trap and subsequently euthanize Black Rats in Puerto Rico without a permit from the DNER. In addition, Regulation Number 6765 also authorizes licensed hunters to hunt and lethally remove Black Rats during

the hunting season for Feral Swine and Feral Goats on Mona Island and during the hunting season for waterfowl and doves throughout Puerto Rico. However, outside of the scope of Regulation Number 6765, an entity is required to obtain a permit from the DNER to lethally remove Black Rats in Puerto Rico under Law Number 241, as amended under Law Number 223. Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law.

When evaluating a request for assistance involving Norway Rats, WS' personnel would ensure WS' actions were consistent with WS Directive 2.345. WS Directive 2.345 outlines WS' policy regarding requests for assistance involving rodent species in urban areas. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Black Rats would be live-capture methods and body-gripping traps (*i.e.*, snap traps). Black Rats live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505. From FY 2015 through FY 2020, WS lethally removed 85 Black Rats to alleviate damage or threats of damage, which is an average of approximately 14 Black Rats removed annually by WS. The highest level of lethal take by WS occurred during FY 2018 when 49 Black Rats were lethally removed to alleviate damage or threats of damage. Based on previous requests for assistance and in anticipation of additional efforts, WS could lethally remove up to 250 Black Rats annually in Puerto Rico when requested to alleviate damage and threats of damage.

Although population estimates are not available, Black Rats are generally prolific breeders and are generally abundant throughout their range. Black Rats breed throughout the year, and typically bear three or more litters with five to eight young per litter each year (Marsh 1994). While Black Rat population estimates are difficult to determine, the species is abundant and generally considered a pest due to its proclivity to harbor diseases and compete with native species. Additionally, populations of Rats fluctuate greatly over time. Due to the species' relatively high reproductive rates and because management activities would be restricted to specific local sites, WS' activities under the proposed action would have minimal impacts on overall populations of Black Rats in Puerto Rico. WS' activities would be conducted pursuant to Executive Order 13112. Any removal of Black Rats would provide some benefit to the native environment by reducing competition with native wildlife.

HOUSE MOUSE POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

House Mice are small, slender rodents with a pelage that is grayish-brown on the dorsal surface and gray to buff on the ventral area. House Mice are native to southern Europe, northern Africa, and Asia (Long 2003). House Mice now occur worldwide and are probably the most numerous and widespread mammalian species in the world next to humans (Witmer and Jojola 2006).

Although the population of House Mice in Puerto Rico is unknown, the species is considered a harmful non-native, invasive species in the Commonwealth under Regulation Number 6765. The DNER has regulatory authority over House Mice in Puerto Rico and permit mouse damage management activities within the Commonwealth under that authority. Under Regulation Number 6765, an entity may trap and subsequently euthanize House Mice in Puerto Rico without a permit from the DNER. In addition, Regulation Number 6765 also authorizes licensed hunters to hunt and lethally remove House Mice during the hunting season for Feral Swine and Feral Goats on Mona Island and during the hunting season for waterfowl and doves throughout Puerto Rico. However, outside of the scope of Regulation Number 6765, an entity is required to obtain a permit from the DNER to lethally remove House Mice in Puerto Rico under Law Number 241, as amended under Law Number 223. Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to

reduce invasion of those species and the associated damages to the extent practicable and permitted by law.

When evaluating a request for assistance involving Norway Rats, WS' personnel would ensure WS' actions were consistent with WS Directive 2.345. WS Directive 2.345 outlines WS' policy regarding requests for assistance involving rodent species in urban areas. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from House Mice would be live-capture methods and body-gripping traps (*i.e.*, snap traps). House Mice live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505. From FY 2015 through FY 2020, WS did not receive requests to alleviate damage associated with House Mice in Puerto Rico; thus, WS did not use nonlethal or lethal methods to alleviate damage associated with House Mice in Puerto Rico during that period. However, WS could receive requests for assistance associated with House Mice in the future. WS could lethally remove up to 250 House Mice annually in Puerto Rico when requested to alleviate damage and threats of damage.

Although population estimates are not available, House Mice are generally prolific breeders and are generally abundant throughout their range. House Mice are prolific breeders. Females produce five to 10 litters per year, with each litter averaging five to six young (Timm 1994*b*). The young mature within about three weeks and soon become reproductively active. House Mice are short-lived (generally less than one year) and have high population turnover. In one study, 20 House Mice placed in an outdoor enclosure with abundant food, water, and cover became a population of 2000 in eight months (Corrigan 2001). Additionally, populations of mice fluctuate greatly over time. Due to the species' relatively high reproductive rates and because management activities would be restricted to specific local sites, WS' activities under the proposed action would have minimal impacts on overall populations of House Mice in Puerto Rico. WS' activities would be conducted pursuant to Executive Order 13112 and Executive Order 13751. Any removal of House Mice would provide some benefit to the native environment by reducing competition with native wildlife.

RHESUS MACAQUE POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Rhesus Macaques are brown or grey in coloration and have pink, hairless faces. Macaques weigh between 12-17 pounds. The average lifespan of Rhesus Macaques is about 30-36 years in the wild. Females reach sexual maturity at about 4 years of age and produce an average of one offspring per year. Rhesus Macaques have an omnivorous diet that includes roots, seeds, fruit, bark, and insects. Rhesus Macaques have also been observed eating bird eggs. Rhesus Macaques will also raid crops, pick through garbage, and consume food handouts from people (Florida Fish and Wildlife Conservation Commission 2020).

In forested regions of their native range, Rhesus Macaque groups typically contain around 30 individuals with population densities around 35 macaques per km^2 (Anderson et al. 2016). In urban areas, group sizes may increase to 75 individuals with population densities around 200 per km^2 (Anderson et al. 2016). Females remain in their natal groups for life and form dominance hierarchies according to their matrilineal kinship (Melnick et al. 1984). Most males leave their natal group after reaching sexual maturity, after which they remain solitary, join a bachelor group, or join another established macaque group (Anderson et al. 2016).

The native range of Rhesus Macaques is the largest of any non-human primate, and includes Afghanistan, Nepal, Thailand, Pakistan, India, Southeast Asia and China (Anderson et al. 2016, Florida Fish and Wildlife Conservation Commission 2020). Rhesus Macaques were introduced to a number of locations in southwestern Puerto Rico, primarily small islands along the southwest coast, for a variety of purposes. In 1938, 409 Rhesus Macaques from India were introduced to the island of Cayo Santiago to study their

free-ranging ecology (Rawlins and Kessler 1986, Southwick 1989). The La Parguera primate-breeding colony was established in 1961 on the islands of Cueva and Guayacán to produce Rhesus Macaques for research purposes (Kerber et al. 1979). These islands were stocked with macaques from Cayo Santiago and India (González-Martínez 1995). Soon after their release on the islands of Cueva and Guayacán, there was evidence that Rhesus Macaques, along with Patas Monkeys, had escaped to the main island of Puerto Rico (González-Martínez 2004). There was also a population of 57 Rhesus Macaques introduced on the island of Desecheo in 1966; however, this population was eradicated in 2017 (Hanson et al. 2019). The DNER estimates the population of Free-ranging Rhesus Macaques on Puerto Rico; these estimates do not include any macaques found on islands owned or operated by research facilities. The highest population estimate of Free-ranging Rhesus Macaques was 1,359 individuals in August of 2012 (DNER 2019). However, the lethal removal of Rhesus Macaques has since led to population declines. By September of 2019, the population of Free-ranging Rhesus Macaques declined to an estimated 69 individuals (DNER 2019).

Rhesus Macaques are considered a harmful non-native, invasive species under Puerto Rico Regulation Number 6765. In addition, Regulation Number 7399 designates Rhesus Macaques as a species that is hurtful to agricultural interests and that poses a threat to human safety in Puerto Rico. The DNER and the PRDA have regulatory authority over Rhesus Macaques in Puerto Rico and permit macaque damage management activities within the Commonwealth under that authority. Under Regulation Number 6765, an entity may trap and subsequently euthanize Rhesus Macaques in Puerto Rico without a permit from the DNER. However, outside of the scope of Regulation Number 6765, an entity is required to obtain a permit from the DNER to lethally remove Rhesus Macaques in Puerto Rico under Law Number 241, as amended under Law Number 223. Furthermore, under Regulation Number 7399, an entity may need a permit from the PRDA to capture macaques in some instances, provided the capture is beyond the scope of Regulation Number 6765 (see Section 2.2.5).

Under this alternative, activities will occur to manage damage and threats associated with invasive macaques in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Rhesus Macaques would be live-capture methods and the use of firearms. Rhesus Macaques live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS lethally removed 1,057 Rhesus Macaques to alleviate damage or threats of damage in Puerto Rico, which is an average of approximately 176 Rhesus Macaques removed annually by WS. The highest level of lethal take by WS occurred during FY 2015 when 566 Rhesus Macaques were lethally removed to alleviate damage or threats of damage. Based on the number of requests received previously by WS and in anticipation of additional efforts to alleviate damage, WS could lethally remove up to 750 Rhesus Macaques annually under all damage management activities. WS could receive requests for assistance to lethally remove macaques from islands owned or operated by research facilities or any macaques that escape the research facilities. Because population estimates of Free-ranging Rhesus Macaques in Puerto Rico do not include those macaques currently found on islands owned or operated by research facilities, the proposed lethal removal of 750 Rhesus Macaques exceeds population estimates of Free-ranging Rhesus Macaques in Puerto Rico.

Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. Long-term objectives of the DNER could include the suppression or complete removal of macaques from Puerto Rico. Because Rhesus Macaques are considered a harmful non-native, invasive species in Puerto Rico, any reduction of the macaque population could be viewed as beneficial to the native environment in the Commonwealth. Rhesus Macaques located on islands owned

or operated by research facilities will be unaffected unless a request is received for assistance to reduce damages occurring by those macaques.

PATAS MONKEY POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Patas Monkeys are native to Africa. Female Patas Monkeys are sexually mature at four to five years old, typically have a single menstrual cycle, and are seasonal or synchronous breeders with generally a single offspring (Rowell and Hartwell 1978). Heterosexual groups often consist of a single male with multiple females (Rowell and Richards 1979), though breeding by multiple males often takes place if the resident male becomes displaced (Ohsawa et al. 1993). In Puerto Rico, Patas Monkeys primarily feed on the fruits, seeds, or seedpods of both native and introduced trees and shrubs while supplementing their diet with invertebrates (González-Martínez 1998, González-Martínez 2004).

In the early 1970s, Patas Monkeys were released on the islet of Cueva for medical research purposes (Loy 1989). Patas Monkeys were later introduced on the islet of Guayacán. Shortly after the release of Patas Monkeys on the islet of Guayacán, there were reports of monkeys leaving the islet for the Puerto Rico mainland. In the early 1990s, González-Martínez (1995) estimated the size of the Patas Monkey population to be approximately 120 individuals belonging to four heterosexual groups and several all-male groups across a 125 km^2 area in southwestern Puerto Rico. However, by 2006, the Patas Monkey population was estimated to contain 514 to 621 individuals belonging to between nine to 11 heterosexual groups (Massanet 2019). Massanet (2019) also reported that Patas Monkeys expanded their range to encompass 172 km^2 in southwestern Puerto Rico by 2006. The DNER estimates the population of Free-ranging Patas Monkeys on Puerto Rico; these estimates do not include any Patas Monkeys found on islands owned or operated by research facilities. The Patas Monkey population was estimated to be as high as 1,442 individuals by 2010 (DNER 2019). However, the lethal removal of Patas Monkeys has recently led to population declines. In September of 2019, the Patas Monkey population was estimated to contain eight individuals (DNER 2019).

Patas Monkeys are considered a harmful non-native, invasive species under Puerto Rico Regulation Number 6765. In addition, Regulation Number 7399 designates Patas Monkeys as a species that is hurtful to agricultural interests and that poses a threat to human safety in Puerto Rico. The DNER and the PRDA have regulatory authority over Patas Monkeys in Puerto Rico and permit monkey damage management activities within the Commonwealth under that authority. Under Regulation Number 6765, an entity may trap and subsequently euthanize Patas Monkeys in Puerto Rico without a permit from the DNER. However, outside of the scope of Regulation Number 6765, an entity is required to obtain a permit from the DNER to lethally remove Patas Monkeys in Puerto Rico under Law Number 241, as amended under Law Number 223. Furthermore, under Regulation Number 7399, an entity may need a permit from the PRDA to capture monkeys in some instances, provided the capture is beyond the scope of Regulation Number 6765 (see Section 2.2.5).

Under this alternative, activities will occur to manage damage and threats associated with invasive monkeys in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Patas Monkeys would be live-capture methods and the use of firearms. Patas Monkeys live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS lethally removed 123 Patas Monkeys to alleviate damage or threats of damage, which is an average of approximately 21 Patas Monkeys removed annually by WS. The highest level of lethal take by WS occurred during FY 2015 when 56 Patas Monkeys were lethally removed to alleviate damage or threats of damage. Based on previous requests for assistance and in

anticipation of the number of requests received by WS to increase, WS could lethally remove up to 750 Patas Monkeys annually in the Commonwealth to alleviate damage or threats of damage. WS could receive requests for assistance to lethally remove Patas Monkeys from islands owned or operated by research facilities or any monkeys that escape the research facilities. Because population estimates of Free-ranging Patas Monkeys in Puerto Rico do not include those monkeys currently found on islands owned or operated by research facilities, the proposed lethal removal of 750 Patas Monkeys exceeds population estimates of Free-ranging Patas Monkeys in Puerto Rico.

Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. Long-term objectives of the DNER could include the suppression or complete removal of monkeys from Puerto Rico. Because Patas Monkeys are considered a harmful non-native, invasive species in Puerto Rico, any reduction of the monkey population could be viewed as beneficial to the native environment in the Commonwealth. Patas Monkeys located on islands owned or operated by research facilities will be unaffected unless a request is received for assistance to reduce damages occurring by those monkeys.

SQUIRREL MONKEY POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Squirrel Monkeys are up to 12.5 inches long (body length), with a non-prehensile tail of approximately 16 inches. They have a short greyish coat and bright yellow legs. Females reach sexual maturity around 2.5 years of age, while males mature at 4 years of age. Squirrel Monkeys exhibit a polyandrous mating system in which females mate with multiple males within their group, also called a troop. Squirrel Monkeys primarily feed on fruit and insects, but they also consume some leaves and seeds (Rhines 2000).

Squirrel Monkeys are native to the tropical rainforests throughout much of South America (Rhines 2000). In Puerto Rico, there is an introduced population of Free-ranging Squirrel Monkeys near Sabana Seca. In 1970, the Caribbean Primate Research Center of the University of Puerto Rico was established in Sabana Seca. Squirrel Monkeys escaped from the research center and formed a wild population, though it is uncertain when and how many of the monkeys escaped (USDA 2008*b*). By July 2012, the Squirrel Monkey population was estimated to consist of 90 individuals between two colonies (DNER 2019). By March 2016, there were an estimated 154 Squirrel Monkeys in Puerto Rico (DNER 2019). The DNER often receives complaints about Squirrel Monkeys in the neighborhoods of Sabana Seca, suggesting the population is growing and possibly dispersing (DNER 2019).

Squirrel Monkeys are considered an exotic species under Puerto Rico Regulation Number 6765. In addition, Regulation Number 7399 designates Squirrel Monkeys as a species that is hurtful to agricultural interests and that poses a threat to human safety in Puerto Rico. The DNER and the PRDA have regulatory authority over Squirrel Monkeys and permit monkey damage management activities within the Commonwealth under that authority. An entity is required to obtain a permit from the DNER to lethally remove Squirrel Monkeys in Puerto Rico under Law Number 241, as amended under Law Number 223. Furthermore, under Regulation Number 7399, an entity may need a permit from the PRDA to capture monkeys in some instances, provided the capture is beyond the scope of Regulation Number 6765 (see Section 2.2.5).

Under this alternative, activities will occur to manage damage and threats associated with exotic monkeys in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Squirrel Monkeys would be live-capture methods and the use of firearms. Squirrel Monkeys live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS did not receive requests to alleviate damage associated with Squirrel Monkeys in Puerto Rico; thus, WS did not use nonlethal or lethal methods to alleviate damage associated with Squirrel Monkeys in Puerto Rico during that period. However, WS could receive requests for assistance associated with Squirrel Monkeys in the future. WS could lethally remove up to 750 Squirrel Monkeys annually in the Commonwealth to alleviate damage or threats of damage. WS could receive requests for assistance to lethally remove Squirrel Monkeys from islands owned or operated by research facilities or any monkeys that escape the research facilities. Because population estimates of Free-ranging Squirrel Monkeys in Puerto Rico do not include those monkeys currently found on islands owned or operated by research facilities, the proposed lethal removal of 750 Squirrel Monkeys exceeds population estimates of Free-ranging Squirrel Monkeys in Puerto Rico.

Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. Long-term objectives of the DNER could include the suppression or complete removal of monkeys from Puerto Rico. Because Squirrel Monkeys are considered a non-native, invasive species in Puerto Rico, any reduction of the monkey population could be viewed as beneficial to the native environment in the Commonwealth. Squirrel Monkeys located on islands owned or operated by research facilities will be unaffected unless a request is received for assistance to reduce damages occurring by those monkeys.

INDIAN MONGOOSE POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The Indian Mongoose is a diurnal opportunistic omnivore native to parts of the Middle East, India, and Asia (Corbet and Hill 1992, Lekagul and McNeely 1977, Veron et al. 2007). Indian Mongooses were introduced to several regions worldwide, including Puerto Rico, to reduce rodent damage to sugar plantations. Mongooses are slender with short legs, an elongated muzzle, and short ears (Nellis 1989, Pimentel 1955). They are opportunistic generalists and feed on a variety of prey items, including insects, lizards, rats, crustaceans, human refuse, seeds, birds, bird eggs, vegetable matter, and carrion (Wolcott 1953, Kami 1964, Vilella and Zwank 1993, Vilella 1998, Horst et al. 2001, Pitt et al. 2015). Mongooses are largely considered a solitary species but will congregate around locally abundant food resources and discarded animal carcasses (Pitt et al. 2015). Although their preferred habitat is dense grasses, mongoose will also inhabit mature dry forest, montane rain forest, disturbed dry forest-scrub, cattle pastures, cane fields, coastal areas, and urban areas (Pimentel 1955, Coblentz and Coblentz 1985*a*, Vilella and Zwank 1993, Vilella 1998). Mongooses are capable of breeding year round, although two to three birth peaks tend to occur throughout the year in an apparent correlation with day length (Nellis and Everard 1983). Typical litter size is two to four pups (Nellis and Everard 1983, Coblentz and Coblentz 1985*b*).

The number of mongoose present on the main island of Puerto Rico is unknown but mongooses are present nearly island wide. Using different survey techniques, Johnson et al. (2016) estimated the density of mongooses in the El Yunque National Forest could range from 0.33 to 0.94 mongooses per hectare in the fall and from 0.49 to 0.97 mongooses per hectare in the spring. On the Cabo Rojo National Wildlife Refuge, Johnson et al. (2016) estimated the density of mongooses could range from 0.55 to 2.02 mongooses per hectare in the fall and from 0.34 to 0.75 mongooses per hectare in the spring. Pimentel (1955) indicated mongoose densities may reach 2.5 mongoose per hectare in ideal habitat.

Indian Mongooses are considered a harmful non-native, invasive species under Puerto Rico Regulation Number 6765. The DNER has regulatory authority over Indian Mongooses in Puerto Rico and permit mongoose damage management activities within the Commonwealth under that authority. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Indian Mongooses in Puerto Rico. However, under Regulation Number

6765, an entity may trap and subsequently euthanize Indian Mongooses in Puerto Rico without a permit from the DNER. In addition, licensed hunters can lethally remove Indian Mongooses during the hunting season for Feral Swine and Feral Goats on Mona Island and during the hunting season for waterfowl and doves throughout Puerto Rico.

Under this alternative, activities will occur to manage damage and threats associated with invasive mongooses in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document, Memorandum of Understanding, or comparable document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Indian Mongooses would be live-capture methods, body-grip traps, and the use of firearms. Indian Mongooses live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505. From FY 2015 through FY 2020, WS lethally removed 201 Indian Mongooses to alleviate damage or threats of damage, which is an average of 34 Indian Mongooses removed annually by WS. The highest level of lethal take by WS occurred during FY 2020 when 80 Indian Mongooses were lethally removed to alleviate damage or threats of damage.

Based on previous requests for assistance and in anticipation of the number of requests received by WS to increase, WS could lethally remove up to 750 Indian Mongooses annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. Long-term objectives of the DNER could include the suppression or complete removal of mongooses from Puerto Rico. Because Indian Mongooses are considered a harmful non-native, invasive species in Puerto Rico, any reduction of the mongoose population could be viewed as beneficial to the native environment in the Commonwealth.

FERAL AND FREE-RANGING CAT POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Free-ranging Cats are socialized and can be strays, lost or abandoned pets, or pets with homes that are allowed to roam outside. Feral Cats, in contrast, are not socialized to humans and are traditionally not kept as pets. In general, most Feral Cats are small in stature, weighing from 1.4 to 3.6 kilograms (three to eight pounds), standing 20 to 30.5 centimeters (eight to 12 inches) high at the shoulder, and 35.5 to 61 centimeters (14 to 24 inches) long. The tail adds another 20 to 30.5 centimeters (eight to 12 inches) to their length. Colors range from black to white to orange, and a variety of combinations of those colors. Other hair characteristics also vary greatly. Other cats that are not considered feral, but may be considered free-ranging are capable of attaining much higher weights. Feral Cats produce two to 10 kittens during any month of the year. An adult female may produce three litters per year where food and habitat are sufficient. Cats may be active during the day but typically are more active during twilight or night. House Cats have been reported to live up to 27 years, but Feral Cats probably average only three to five years. After several generations, Feral Cats can be considered wild in habits and temperament (Fitzwater 1994).

In some urban and suburban areas, cat populations equal human populations. Furthermore, Feral Cats are the most abundant predators in many suburban and rural areas. They are opportunistic predators and scavengers that feed on rodents, rabbits, shrews, moles, birds, insects, reptiles, amphibians, fish, carrion, garbage, vegetation, and leftover pet food (Fitzwater 1994). The lowest Feral Cat population in the United States has been estimated at 70 million cats with hundreds of cats per square mile in some urban areas (Mott 2004).

The population of Feral Cats in Puerto Rico is unknown. The DNER and/or a municipality has authority over Feral and Free-ranging Cats depending on the specific circumstances related to an individual cat. Municipalities have the authority over those Free-ranging cats that are considered to be stray animals (*i.e.*, those cats not under the control of its owner, or does not have a known owner, but rely on humans to survive). In Puerto Rico, pets, including cats, that become feral and no longer rely on humans to survive are considered wildlife and under the authority of the DNER. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Feral Cats in Puerto Rico. However, under Regulation Number 6765, Feral Cats found on natural reserves, wildlife refuges, and regulatory forests throughout Puerto Rico are considered a harmful non-native, invasive species that can be trapped and subsequently euthanized without a permit from the DNER. In addition, licensed hunters can lethally remove Feral Cats during any of the regulated hunting seasons, provided the hunter obtain a license from the DNER and adhere to all rules and regulations for that hunting season during which the person is hunting. As required by the DNER and/or the municipality, WS would obtain required authorization and/or permits from the regulatory authorities before any capture and/or lethal removal of Feral and Free-ranging Cats.

Under this alternative, activities will occur to manage damage and threats associated with invasive cats in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. In most cases, WS would employ live-capture methods to alleviate damage or threats of damage associated with Feral or Free-ranging Cats. Once live-captured, WS would transfer custody of the cats to a local animal control facility. After relinquishing Feral and Free-ranging Cats to a local animal control facility, the care and the final disposition of the cat would be the responsibility of the animal control facility. WS could also release Free-ranging Cats unharmed at the site of their capture, such as those cats possessing identification collars. In some cases, WS may be requested to lethally remove Feral Cats to alleviate damage or threats.

From FY 2015 through FY 2020, WS used live-capture methods to capture 89 Feral and Free-ranging Cats in Puerto Rico. After capturing these 89 Feral and Free-ranging Cats, WS released the cats unharmed or relinquished custody of the cats to a local animal control facility for care and to determine their adoptability. In addition to using live-capture methods, WS lethally removed five Feral Cats to alleviate damage or threats of damage in Puerto Rico from FY 2015 through FY 2020. Based on previous requests for assistance and in anticipation of the number of requests received by WS to increase, WS could lethally remove up to 150 Feral and Free-ranging Cats annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 directs federal agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health.

Although population estimates are not available, cats are generally prolific breeders and are generally abundant in most habitats where they occur. Because management activities would be restricted to specific local sites, WS' limited removal of Feral Cats would have minimal effects on local populations or the overall population in Puerto Rico. However, some local populations may be temporarily reduced at a site if cats were removed using nonlethal or lethal methods. WS' activities to manage Feral and Free-ranging Cats in Puerto Rico would be conducted pursuant to Executive Order 13112 and at the direction of the DNER and/or the municipality. Because cats are not native to Puerto Rico, any removal of Feral and Free-ranging Cats would provide some benefit to the native environment by reducing predation and/or competition for food resources with native wildlife.

FERAL AND FREE-RANGING DOG POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Free-ranging Dogs are socialized and can be strays, lost or abandoned pets, or pets with homes that are allowed to roam outside. Feral Dogs, in contrast, are not socialized to humans and are traditionally not kept as pets. Feral and Free-ranging Dogs occur in a variety of shapes, sizes, colors, and even breeds. McKnight (1964) noted German shepherds, Doberman pinschers, and collies as breeds that often become feral. Most Feral Dogs today are descendants of Domestic Dogs that appear similar to dog breeds that are locally common (Green and Gipson 1994). The primary feature that distinguishes Feral Dogs from Domestic Dogs is the degree of reliance or dependence on humans, and in some respect, their behavior toward people. Feral Dogs survive and reproduce independently of human intervention or assistance. While it is true that some Feral Dogs use human garbage for food, others acquire their primary subsistence by hunting and scavenging like other wild canids.

Feral and Domestic Dogs often differ markedly in their behavior toward people. Scott and Causey (1973) based their classification of those two types by observing the behavior of dogs while confined in cage-type traps. Domestic Dogs usually wagged their tails or exhibited a calm disposition when a human approached; whereas, most Feral Dogs showed highly aggressive behavior, growling, barking, and attempting to bite. Some dogs were intermediate in their behavior and could not be classified as either feral or domestic based solely on their reaction to humans (Scott and Causey 1973). Feral Dogs may also attack people, especially children. This is especially true where they feed at and live around landfills near human dwellings (Green and Gipson 1994).

Feral Dogs are usually secretive and wary of people. Thus, they are active during dawn, dusk, and at night, much like other wild canids. They often travel in packs or groups and may have rendezvous sites, similar to wolves. Travel routes to and from gathering sites or den sites may be well defined. Food scraps and other evidence of concentrated activity may be observed at gathering sites.

Feral and Free-ranging Dogs may occur where people permit their dogs to roam free or where people abandon unwanted dogs. Feral Dogs probably occur in all of the 50 states, Canada, and Central and South America. They are also common in Europe, Australia, Africa, and on several remote ocean islands, such as the Galapagos. Home ranges of Feral Dogs vary considerably in size, with size likely influenced by the availability of food. Dog packs that are primarily dependent on garbage may remain in the immediate vicinity of a landfill, while other packs that depend on livestock or wild game may forage over an area of 130 km^2 (50 square miles) or more (Green and Gipson 1994).

Feral Dogs are often found in forested areas or scrublands near human habitation. Some people will not tolerate Feral Dogs in close proximity to human activity; thus, they take considerable effort to eliminate them in such areas. Feral Dogs may be found on lands where human access is limited, such as military reservations and large airports. They may also live in remote sites, where they feed on wildlife and native fruits. The only areas that do not appear to be suitable for Feral Dogs are places where food and escape cover are not available, or where large native carnivores, particularly wolves, are common and prey on dogs (Green and Gipson 1994).

Feral Dogs are best described as opportunistic feeders. They can be efficient predators, preying on small and large animals. Feral Dogs can present a serious predatory threat to some wildlife species (Green and Gipson 1994). Feral Dogs can also prey on livestock, poultry, House Cats, or Domestic Dogs. Many rely on carrion, particularly road-killed animals, crippled waterfowl, green vegetation, berries, and other fruits, and refuse at garbage dumps (Green and Gipson 1994).

Feral and Free-ranging Dogs are highly adaptable, social carnivores. Gipson (1983) suggested that family groups of Feral Dogs are more highly organized than previously believed. Pup rearing may be shared by several members of a pack. Survival of pups born during autumn and winter has been documented, even in areas with harsh winter weather. Gipson (1983) found that only one female in a pack of Feral Dogs studied in Alaska gave birth during two years of study, even though other adult females were present in the pack. The breeding female gave birth during late September or early October during both years. Gipson (1983) indicated that all pups from both litters had similar color markings, suggesting that the pups had the same father. Adult males of different colors were present in the pack.

Nesbitt (1975) commented on the rigid social organization of a pack of Feral Dogs where nonresident dogs were excluded, including females in estrus. In one instance, Nesbitt (1975) used three separate female dogs in estrus as bait (dogs were chained in the back of a corral-type trap) over a 59-day period and captured no Feral Dogs. Nesbitt (1975) then baited the same trap with carrion, and a pack of Feral Dogs, including four adult males, entered the trap within one week (Green and Gipson 1994).

Hybridization between Feral Dogs and other wild canids can occur, but non-synchronous estrus periods and pack behavior (that is, excluding non-resident canids from membership in the pack) may preclude much interbreeding. Dens may be burrows dug in the ground or sheltered spots under abandoned buildings or farm machinery.

The population of Feral Dogs in Puerto Rico is unknown. The DNER and/or a municipality has authority over Feral and Free-ranging Dogs depending on the specific circumstances related to an individual dog. Municipalities have the authority over those Free-ranging Dogs that are considered to be stray animals (*i.e.,* those dogs not under the control of its owner, or does not have a known owner, but rely on humans to survive). In Puerto Rico, pets, including dogs, that become feral and no longer rely on humans to survive are considered wildlife and under the authority of the DNER. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Feral Dogs in Puerto Rico. WS would consult with, and obtain authorization and/or permits from, the DNER and/or local municipal authorities with jurisdiction over Feral or Free-ranging Dogs before WS attempted to capture and/or lethal removal of dogs in Puerto Rico (see WS Directive 2.340).

Under this alternative, activities will occur to manage damage and threats associated with invasive dogs in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. In most cases, WS would employ live-capture methods to alleviate damage or threats of damage associated with Feral or Free-ranging Dogs. Once live-captured, WS would transfer custody of the dogs to a local animal control facility. After relinquishing the Feral Dogs to a local animal control facility, the care and the final disposition of the dog would be the responsibility of the animal control facility. WS could also release Free-ranging Dogs unharmed at the site of their capture, if deemed appropriate. If WS' personnel determine that a captured dog is a pet, WS' personnel would inform the pet owner as soon as practicable in accordance with WS Directive 2.340. In some cases, WS may be requested to lethally remove Feral Dogs to alleviate damage or threats.

From FY 2015 through FY 2020, WS did not lethally remove any Feral Dogs to alleviate damage or threats of damage. However, 20 Feral or Free-ranging Dogs were live-captured by WS and released unharmed or were relinquished to a local animal control facility for care and to determine their adoptability. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 50 Feral Dogs annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 and Executive Order 13751 directs federal

agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health.

Because management activities would be restricted to specific local sites, WS' limited removal of Feral Dogs would have minimal effects on local populations or the overall population in Puerto Rico. However, some local populations may be temporarily reduced at a site if dogs were removed using nonlethal or lethal methods. WS' activities to manage Feral and Free-ranging Dogs in Puerto Rico would be conducted pursuant to Executive Order 13112 and at the direction of the DNER and/or the municipality. Because dogs are not native to Puerto Rico, any removal of Feral and Free-ranging Dogs would provide some benefit to the native environment by reducing predation and/or competition for food resources with native wildlife.

FERAL SWINE POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Feral Swine, also known as "*wild pigs*", "*wild boars,*" and "*feral hogs*", are medium-sized hoofed mammals that look like domestic pigs. They usually have coarser and denser coats than their domestic counterparts and exhibit modified canine teeth called "*tusks*" that are usually 7.5 to 12.5 centimeters (3 to 5 inches) long but may be up to 23 centimeters (9 inches) long. These tusks curl out and up along the sides of the mouth. Lower canines are also prominent but smaller. Young Feral Swine have pale longitudinal stripes on the body until they are six weeks of age. Adults of the species average 90 centimeters (3 feet) in height and 1.32 to 1.82 meters (4 feet 6 inches to 6 feet). Males may attain a weight of 165 to 440 pounds (75 to 200 kilograms), while females may weigh 35 to 150 kilograms (77 to 330 pounds). Feral Swine mate any time of year but peak breeding times usually occur from January through February and again in early summer. Litter sizes usually range from one to 13 piglets, with female swine generally producing two litters per year (Barrett and Birmingham 1994, Mayer and Brisbin 2009). Given adequate nutrition, a wild pig population can double in just four months. Feral Swine may begin to breed before six months of age and sows can produce two litters per year (Barrett and Birmingham 1994, Mayer and Brisbin 2009). Feral Swine can be found in variable habitat in much of the southern United States, as well as most of the United States. Populations are usually clustered around areas with ample food and water supplies. Evidence of the presence of Feral Swine may be rooted up earth, tree rubs at ground level to 900 centimeters (36 inches) high, with clinging hair or mud, and muddy wallows.

Feral Swine are known in the United States to be destructive invaders, with quickly growing populations. One of the fastest breeding mammals in North America, a female pig will begin breeding as early as six months of age and breeds twice a year. Litter sizes average between four to six young, but have been observed as high as eight to 12 young. With such reproductive potential, populations of Feral Swine can expand nearly exponentially.

Due to their large and fast growing populations in combination with their proclivity to root up the soil when feeding, these omnivores can be very destructive to the habitats in which they are found. The damage they cause includes the disruption of forest regeneration as they root up and consume seeds and seedlings of native species (Lipscomb 1989), competition with native species for food resources (Henry and Conley 1972), habitat modification effecting niche microhabitats for various species (Singer et al. 1984), accelerated soil erosion (Sierra 2001), and direct predation (Schaefer 2004).

Damage in areas supporting Feral Swine populations is sometimes a serious natural resource management concern for property managers. Substantial damage has occurred to natural resources, including destruction of fragile plant communities, killing tree seedlings, and erosion of soils (Barrett and Birmingham 1994). Food sources for Feral Swine includes acorns, hickory nuts, pecans, beech nuts, and a wide variety of vegetation including roots, tubers, grasses, fruit, and berries. Feral Swine also eat

crayfish, frogs, snakes, salamanders, mice, eggs and young of ground-nesting birds, and any other easy prey or carrion encountered. They have also been reported to kill considerable numbers of domestic livestock, especially young animals, in some areas (Barrett and Birmingham 1994). Several diseases are associated with Feral Swine populations (see Table 1.2).

The population of Feral Swine in Puerto Rico is unknown. However, most reports of Feral Swine on the mainland in Puerto Rico occur on Mona Island or within the central municipalities of Aguas Buenas, Barranquitas, Comerío, Corozal, and Naranjito. On Mona Island, there is an established population of Feral Swine large enough to sustain a regulated hunting season since 1991 (DNER 2018). The Feral Swine population on Mona Island was estimated to have between 400 to 1,300 individuals in 2012 (Olivieri-Cintrón 2011). After Hurricane Maria in 2017, many Vietnamese Potbelly Pigs were displaced or abandoned. As a result, many of the pigs became stray animals, leading to an exponential growth of urban Feral Swine populations (USDA 2019*b*).

The DNER and/or a municipality has authority over Feral Swine depending on the specific circumstances related to an individual swine. Municipalities have the authority over those Free-ranging Swine that are considered to be stray animals (*i.e.*, those swine not under the control of its owner, or does not have a known owner, but rely on humans to survive). In Puerto Rico, pets, including swine, that become feral and no longer rely on humans to survive are considered wildlife and under the authority of the DNER. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Feral Swine in Puerto Rico. In addition, licensed hunters can lethally remove Feral Swine from Mona Island during the regulated hunting season, provided the hunter obtain a license from the DNER and adhere to all rules and regulations for the hunting season. As required by the DNER and/or the municipality, WS would obtain required authorization and/or permits from the regulatory authorities before any capture and/or lethal removal of Feral Swine.

Under this alternative, activities will occur to manage damage and threats associated with Feral Swine in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document, Memorandum of Understanding, or comparable document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Feral Swine would be live-capture methods and the use of firearms. Feral Swine live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS lethally removed 910 Feral Swine to alleviate damage or threats of damage, which is an average of approximately 152 Feral Swine removed annually by WS. The highest level of lethal take by WS occurred during FY 2019 when 594 Feral Swine were lethally removed to alleviate damage or threats of damage. Based on the number of requests received previously by WS and in anticipation of additional efforts to alleviate damage, WS could lethally remove up to 3,000 Feral Swine annually under all damage management activities. Executive Order 13112 and Executive Order 13751 directs federal agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health. With the development of the National Feral Swine Damage Management Program in 2014, a primary objective was to stabilize and eventually reduce the range and size of Feral Swine populations in the United States and territories in accordance with management objectives of states, territories, and tribes.

Long-term objectives of the regulatory agencies could include the suppression or complete removal of Feral Swine from certain areas (*e.g.*, Mona Island, individual municipalities) or throughout all of Puerto Rico. WS' activities to manage Feral Swine in Puerto Rico would be conducted pursuant to Executive Order 13112 and Executive Order 13751 and at the direction of the DNER and/or the municipality. Because Feral Swine are not native to Puerto Rico and can be an invasive species throughout its range,

any removal of Feral Swine would provide some benefit to the native environment by reducing predation and/or competition for food resources with native wildlife.

FERAL GOAT POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Goats are generalists, grazing and browsing in a variety of habitats (Lu 1988, Parkes et al. 1996). Feral Goats eat foliage, twigs, bark, flowers, fruit, roots, plant litter, seeds, and fungi (Parkes et al. 1996). Although they are generalist feeders, goats often preferentially select the highest quality or palatable foods available (Coblentz 1977, Green et al. 1979). Goats may even eradicate plants that are scarce (Coblentz 1977). However, Feral Goats can survive on poor-quality food sources (Coblentz 1977). Goats typically occur in herds (Parkes et al. 1996). Females and their offspring typically form herds with other females and young (Parkes et al. 1996). Young males leave the matriarchal herds and form loose associations with other males (Parkes et al. 1996). Feral Goats have high reproductive potential (Parkes et al. 1996). Female reach sexual maturity within their first year (Parkes et al. 1996). The gestation period is 150 days, allowing females to breed twice within a year (Parkes et al. 1996). Under favorable conditions, twins and triplets are common (Parkes et al. 1996).

In 1592, Spanish explorers introduced goats to Mona Island (Hess et al. 2018). Feral Goats were reportedly abundant enough to sustain hunting by 1632 (Hess et al. 2018). Goats were hunted continuously on Mona Island during part of the nineteenth century to feed guano miners, but hunting was curtailed in the 1970s to allow populations to rebound (Hess et al. 2018). By 1991, goat hunting resumed on Mona Island (DNER 2018). Although the population of Feral Goats on Mona Island sustains a hunting season, population estimates for Mona Island or the rest of Puerto Rico is unknown.

The DNER and/or a municipality has authority over Feral Goats depending on the specific circumstances related to an individual goat. Municipalities have the authority over those Free-ranging Goats that are considered to be stray animals (*i.e.*, those goats not under the control of its owner, or does not have a known owner, but rely on humans to survive). In Puerto Rico, pets, including goats, that become feral and no longer rely on humans to survive are considered wildlife and under the authority of the DNER. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Feral Goats in Puerto Rico. In addition, licensed hunters can lethally remove Feral Goats from Mona Island during the regulated hunting season, provided the hunter obtain a license from the DNER and adhere to all rules and regulations for the hunting season. As required by the DNER and/or the municipality, WS would obtain required authorization and/or permits from the regulatory authorities before any capture and/or lethal removal of Feral Goats.

Under this alternative, activities will occur to manage damage and threats associated with Feral Goats in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Feral Swine would be live-capture methods and the use of firearms. Feral Goats live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS has received inquiries and requests to alleviate damage associated with Feral Goats in Puerto Rico; however, WS did not provide any direct operational assistance involving Feral Goats in Puerto Rico during that period. However, WS could receive requests for assistance associated with Feral Goats in the future. WS could lethally remove up to 1,000 Feral Goats annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 and Executive Order 13751 directs federal agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health. Long-term objectives of the regulatory agencies could include the suppression or complete

removal of Feral Goats from certain areas (*e.g.*, Mona Island, individual municipalities) or throughout all of Puerto Rico. WS' activities to manage Feral Goats in Puerto Rico would be conducted pursuant to Executive Order 13112 and Executive Order 13751 and at the direction of the DNER and/or the municipality. Because Feral Goats are not native to Puerto Rico and can be an invasive species throughout its range, any removal of Feral Goats would provide some benefit to the native environment by reducing predation and/or competition for food resources with native wildlife.

WHITE-TAILED DEER POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

White-tailed Deer feed on a variety of vegetation, allowing them to thrive in a variety of habitats (Dewey 2003). When compared to other land mammals in North America, the White-tailed Deer currently occupies the largest geographic range of any other mammal (Pagel et al. 1991). White-tailed Deer are small to medium-sized mammals with tan or reddish brown pelts above in summer and grayish brown in winter. The belly, throat, noseband, eye-ring, and inside of the ears are white and their tail is brown with white above, often with a dark stripe down the center and white below. Females can reproduce as early as seven months of age and have one to three young per year (Dewey 2003).

White-tailed Deer are not native to Puerto Rico. The DNER has regulatory authority over White-tailed Deer in Puerto Rico and permit deer damage management activities within the Commonwealth under that authority. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove White-tailed Deer in Puerto Rico. Under this alternative, activities will occur to manage damage and threats associated with White-tailed Deer in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from White-tailed Deer would be the use of firearms.

From FY 2015 through FY 2020, WS did not receive requests to alleviate damage associated with White-tailed Deer in Puerto Rico; thus, WS did not use nonlethal or lethal methods to alleviate damage associated with White-tailed Deer in Puerto Rico during that period. However, WS could receive requests for assistance associated with White-tailed Deer in the future. WS could lethally remove up to 200 White-tailed Deer annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 directs federal agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health. Long-term objectives of the DNER could include the suppression or complete removal of deer from Puerto Rico. WS' activities to manage White-tailed Deer in Puerto Rico would be conducted pursuant to Executive Order 13112 and at the direction of the DNER. Because White-tailed Deer are a non-native invasive species in Puerto Rico, any reduction of the deer population could be viewed as beneficial to the native environment in the Commonwealth.

SPECTACLED CAIMAN POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Spectacled Caimans are a medium-sized crocodilian that reaches up to six feet in length (USFWS 2018). Spectacled Caimans are indigenous to southern Mexico, Central America, and northern South America, including Trinidad and Tobago (USFWS 2018). Vagrants occasionally occur in the Grenadines and the Lesser Antilles (USFWS 2018). In the 1960s and 1970s, caimans were introduced in Puerto Rico after pet owners intentionally and accidentally released caimans into the natural environment (Bontemps et al. 2016, USFWS 2018).

Spectacled Caimans inhabit freshwater habitats, including flooded forests, swamps, rivers, lakes and canals (USFWS 2018). Although less common, caimans can inhabit brackish waters (USFWS 2018). In

Puerto Rico, Spectacled Caimans occur in rural, suburban, and urban habitats (USFWS 2018). Spectacled Caimans are opportunistic predators that consumes invertebrates, fish, amphibians, reptiles, birds, and mammals (Thorbjarnarson 1993).

Spectacled Caimans are considered a harmful non-native, invasive species under Puerto Rico Regulation Number 6765. The DNER has regulatory authority over Spectacled Caimans in Puerto Rico and permit caiman damage management activities within the Commonwealth under that authority. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Spectacled Caimans in Puerto Rico. However, under Regulation Number 6765, an entity may trap and subsequently euthanize Spectacled Caimans in Puerto Rico without a permit from the DNER. In addition, licensed hunters can lethally remove Spectacled Caimans during the hunting season for Feral Swine and Feral Goats on Mona Island and during the hunting season for waterfowl and doves throughout Puerto Rico.

Under this alternative, activities will occur to manage damage and threats associated with invasive caimans in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document, Memorandum of Understanding, or comparable document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Spectacled Caimans would be live-capture methods and the use of firearms. Spectacled Caimans live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS lethally removed 51 Spectacled Caimans to alleviate damage or threats of damage, which is an average of approximately nine Spectacled Caimans removed annually by WS. The highest level of lethal take by WS occurred during FY 2019 when 28 Spectacled Caimans were lethally removed to alleviate damage or threats of damage. Based on previous requests for assistance and in anticipation of the number of requests received by WS to increase, WS could lethally remove up to 500 Spectacled Caimans annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. Long-term objectives of the DNER could include the suppression or complete removal of caimans from Puerto Rico. Because Spectacled Caimans are considered a harmful non-native, invasive species in Puerto Rico, any reduction of the caiman population could be viewed as beneficial to the native environment in the Commonwealth.

GREEN IGUANA POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Green Iguanas are native to Mexico, Central America, and South America. Green Iguanas can reach up to 1.75 meters (5.7 feet) in length. It has long spines on its back and tail, a large globular plate under the tympanums, and a double chin skirted with small spines on the front border. Iguanas range from green to reddish or dark grey in color, and sometimes possess dark vertical bands distributed along the body and tail. Green Iguanas are arboreal lizards that live high in the tree canopy, rarely coming down except when females dig burrows to lay eggs. Juveniles establish areas lower in the canopies while older mature iguanas reside higher up. Although preferring an arboreal environment, iguanas can adjust well to a more open area. Green Iguanas prefer habitats near water and will often dive beneath the water to avoid predators. Green Iguanas are generalist herbivorous, foraging on leaves, shoots, flowers and fruits. Females excavate nests in the ground as deep as one meter (3.3 feet) and deposit up to 65 eggs into the nest (Gingell 2005).

The pet trade led to the introduction of iguanas into the wild in Puerto Rico in the 1970s (López-Torres et al. 2011). Currently, Green Iguanas are distributed throughout Puerto Rico, with large colonies occurring

in the coastal regions of the main island and on Culebra Island. Green Iguanas are considered a harmful non-native, invasive species under Puerto Rico Regulation Number 6765. The DNER has regulatory authority over Green Iguanas in Puerto Rico and permit iguana damage management activities within the Commonwealth under that authority. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Green Iguanas in Puerto Rico. However, under Regulation Number 6765, an entity may trap and subsequently euthanize Green Iguanas in Puerto Rico without a permit from the DNER. In addition, licensed hunters can lethally remove Green Iguanas during the hunting season for Feral Swine and Feral Goats on Mona Island and during the hunting season for waterfowl and doves throughout Puerto Rico.

Under this alternative, activities will occur to manage damage and threats associated with invasive iguanas in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document, Memorandum of Understanding, or comparable document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Green Iguanas would be live-capture methods, the use of firearms, and egg destruction. Green Iguanas live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS lethally removed 8,782 Green Iguanas and destroyed 6,240 Green Iguana eggs to alleviate damage or threats of damage, which is an average of 1,464 Green Iguanas and 1,040 Green Iguana eggs removed annually by WS. The highest level of lethal take by WS occurred during FY 2020 when 1,989 Green Iguanas were lethally removed to alleviate damage or threats of damage. Additionally, the highest level of lethal take of Green Iguana eggs occurred during FY 2019 when 3,770 Green Iguana eggs were destroyed. Based on previous requests for assistance and in anticipation of the number of requests received by WS to increase, WS could lethally remove up to 5,000 Green Iguanas and 10,000 Green Iguana eggs annually under all damage management activities. Executive Order 13112 and Executive Order 13751 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. Long-term objectives of the DNER could include the suppression or complete removal of caimans from Puerto Rico. Because Green Iguanas are considered a harmful non-native, invasive species in Puerto Rico, any reduction of the caiman population could be viewed as beneficial to the native environment in the Commonwealth.

BOA CONSTRICTOR POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The Boa Constrictor ranges widely over North, Central, and South America and dozens of marine and lacustrine islands, and has one of the widest latitudinal distributions of any snake in the world. Boas are habitat generalists that can be found in a remarkable range of environments from sea level to 1,000 meters, including wet and dry tropical forest, savanna, very dry thorn scrub, and cultivated fields. Boas prey on birds, mammals, and lizards. The Boa Constrictor has a dorsal that is light tan to brown, and the venter is nearly immaculate and white or off-white in color. The maximum length for boas is around four meters (13.1 feet). Boa Constrictors are viviparous, giving birth to live young (Reed and Rodda 2009).

Boa Constrictors were likely introduced to Puerto Rico through the pet trade, possibly as early as 1992 (Reynolds et al. 2013). Population estimates for the Boa Constrictor in Puerto Rico are not available. However, Boa Constrictors are known to occur in Puerto Rico, primarily on the west side of the island near Mayaguez (USFWS 2010, Mayer 2012, Reynolds et al. 2013). Reynolds et al. (2013) stated that over 150 Boa Constrictors were captured in Puerto Rico since 2011. Reed and Rodda (2009) found that much of Puerto Rico is climatically suitable for the Boa Constrictor.

Boa Constrictors are not native to Puerto Rico. The DNER has regulatory authority over Boa Constrictors in Puerto Rico and permit damage management activities for boas within the Commonwealth under that authority. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Boa Constrictors in Puerto Rico. Under this alternative, activities will occur to manage damage and threats associated with Boa Constrictors in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Boa Constrictors would be live-capture methods. Boa Constrictors live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS did not receive requests to alleviate damage associated with Boa Constrictors in Puerto Rico; thus, WS did not use nonlethal or lethal methods to alleviate damage associated with Boa Constrictors in Puerto Rico during that period. However, WS could receive requests for assistance associated with Boa Constrictors in the future. WS could lethally remove up to 100 Boa Constrictors annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 and Executive Order 13751 directs federal agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health. Long-term objectives of the DNER could include the suppression or complete removal of boas from Puerto Rico. WS' activities to manage Boa Constrictors in Puerto Rico would be conducted pursuant to Executive Order 13112 and Executive Order 13751 and at the direction of the DNER. Because Boa Constrictors are a non-native invasive species in Puerto Rico, any reduction of the boa population could be viewed as beneficial to the native environment in the Commonwealth.

RETICULATED PYTHON POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The Reticulated Python is native to southeastern Asia and on many of the Indo-Pacific islands west of New Guinea. Reticulated Pythons can inhabit a range of habitats, including lowland primary and secondary tropical wet forests, tropical open dry forests, tropical wet montane forests, rocky scrublands, swamps, marshes, plantations and cultivated areas, and suburban and urban areas. Reticulated Pythons need warm temperatures, large amounts of moisture, and an area near a body of water to thrive. Pythons use the water as a protective camouflage to hide before ambushing prey. Reticulated Pythons primarily feeds on birds and small mammals, though pythons will also consume lizards, fish, and frogs. Females may lay one clutch per year, though they may not lay a clutch every year. Each clutch averages of 20-40 eggs per clutch, with the number of eggs per clutch highly dependent on the size of the female (Reed and Rodda 2009). Reticulated Pythons were recently documented to be able to reproduce parthenogenetically, meaning that females do not need males to lay viable eggs (Booth et al. 2014). Thus, even just one female python could potentially create a population.

Reticulated Pythons were likely introduced to Puerto Rico through the pet trade. Population estimates for the Reticulated Python in Puerto Rico are not available. However, Reticulated Pythons have been collected in the western region of the island in Aguadilla and Mayaguez, and the southern region of the island in Guayama, including a 5.5 meters (18 feet) long specimen (USFWS 2010). Furthermore, Reed and Rodda (2009) found that low- and mid-elevations in Puerto Rico offered suitable habitats for the Reticulated Python.

Reticulated Pythons are not native to Puerto Rico. The DNER has regulatory authority over Reticulated Pythons in the wild in Puerto Rico and permit python damage management activities within the Commonwealth under that authority. Under Law Number 241, as amended under Law Number 223, an entity is required to obtain a permit from the DNER to capture and/or lethally remove Reticulated Pythons in Puerto Rico. Under this alternative, activities will occur to manage damage and threats associated with

Reticulated Pythons in Puerto Rico when a request for assistance is received and a cooperating agency or agencies and the property owner or property manager has signed a work initiation document. The primary methods employed by WS under this alternative to address damage or threats of damage occurring from Reticulated Pythons would be live-capture methods. Reticulated Pythons live-captured would be euthanized using methods and procedures in accordance with WS Directive 2.505.

From FY 2015 through FY 2020, WS did not receive requests to alleviate damage associated with Reticulated Pythons in Puerto Rico; thus, WS did not use nonlethal or lethal methods to alleviate damage associated with Reticulated Pythons in Puerto Rico during that period. However, WS could receive requests for assistance associated with Reticulated Pythons in the future. WS could lethally remove up to 100 Reticulated Pythons annually in the Commonwealth to alleviate damage or threats of damage. Executive Order 13112 and Executive Order 13751 directs federal agencies to use their programs and authorities to prevent the spread of and control populations of invasive species that cause economic or environmental harm, or harm to human health. Long-term objectives of the DNER could include the suppression or complete removal of pythons from Puerto Rico. WS' activities to manage Reticulated Pythons in Puerto Rico would be conducted pursuant to Executive Order 13112 and Executive Order 13751 and at the direction of the DNER. Because Reticulated Pythons are a non-native invasive species in Puerto Rico, any reduction of the python population could be viewed as beneficial to the native environment in the Commonwealth.

BAT POPULATION DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

WS could occasionally receive requests for assistance from people experiencing damage or threats of damage associated with bats in Puerto Rico (see Section 1.2). Bat species that occur in Puerto Rico include the Jamaican Fruit-eating Bat, Antillean Fruit-eating Bat, Big Brown Bat, Brown Flower Bat, Eastern Red Bat, Velvety Free-tailed Bat, Greater Antillean Long-tongued Bat, Antillean Ghost-faced Bat, Greater Bulldog Bat, Parnell's Mustached Bat, Sooty Mustached Bat, Red Fig-eating Bat, and Brazilian Free-tailed Bat. None of the bat species that occur in Puerto Rico are considered threatened or Endangered pursuant to the ESA. However, the DNER has classified the Brown Flower Bat and the Red Fig-eating Bat as vulnerable within Puerto Rico, which are species considered at a high risk of extinction in the wild in a foreseeable future. In addition, the DNER is currently conducting a preliminary review to update the protected species list. The DNER has recommended that the Parnell's Mustached Bat, the Sooty Mustached Bat, and the Greater Antillean Long-tongued Bat be classified as Vulnerable and the Eastern Red Bat as Endangered. Furthermore, the SWAP identifies all 13 of the bats as Species of Greatest Conservation Need.

In Puerto Rico, WS has not previously received requests for assistance involving bats; however, WS could receive requests for assistance involving bats in the future. Most requests for WS' assistance would likely occur in relation to bats inhabiting human-occupied buildings or solitary bats found trapped inside a residence or other structure. WS would respond to requests for assistance primarily through various technical assistance projects or referral to other entities. Occasionally, WS could receive requests to provide direct operational assistance. When responding to requests for assistance, WS would recommend and/or use nonlethal methods, such as one-way exclusion devices, structural repairs, hand capture, nets, or repellents. In most cases, a single bat found in a building would be provided an escape route (*e.g.*, opening a door or window) or would be live captured and released outside on site if there was no possibility of an exposure to people or pets. If the bat appeared sick, acted unusually, or if there was a known bite or possible exposure to people or pets, the bat would be euthanized and submitted for rabies testing.

In anticipation of receiving requests for assistance in the future, it is possible that WS could euthanize up to two bats each year in Puerto Rico, in any species combination. Those bats euthanized by WS for

disease testing would likely be euthanized and submitted for testing by other entities in the absence of WS' involvement given the risk to human safety associated with exposure. Therefore, any lethal removal by WS would not be additive to mortality that would likely occur in the absence of involvement by WS.

WS would identify each bat species at a site prior to conducting operational assistance. By identifying each bat species, WS could determine if there were any Brown Flower Bats, Red Fig-eating Bats, Parnell's Mustached Bats, Sooty Mustached Bats, Greater Antillean Long-tongued Bats, and Eastern Red Bats located at the site, which are bat species the DNER has classified, or is considering classifying, as vulnerable or Endangered. WS would only lethally remove Brown Flower Bats, Red Fig-eating Bats, Parnell's Mustached Bats, Sooty Mustached Bats, Greater Antillean Long-tongued Bats, and Eastern Red Bats in extreme cases where human health and safety were at risk, such as when a known bite or possible exposure to people has occurred.

WS would also determine if a site contained a bat maternity colony prior to conducting operational assistance. Because bat maternity colonies are critical to the reproductive cycle of bats, WS would implement and recommend to persons receiving technical assistance that no exclusion be conducted when a maternity colony is present, when practicable. Instead, exclusion should be postponed until after the critical young-rearing periods associated with maternity colonies, unless human health and safety were at risk (*e.g.*, bats leaving the attic and entering the main living area of a house).

Regionally, some bats species are being adversely impacted by the fungal disease white-nose syndrome, which is an emerging disease that is causing unprecedented morbidity and mortality among bats in eastern North America. However, WS' limited lethal removal of bats would not adversely affect overall populations of bat species in Puerto Rico. Impacts to bats would be minimal because any bat removal would be localized and limited in scope. In addition, euthanizing and submitting bats for testing would likely occur in the absence of WS' participation due to the risks to human safety.

ADDITIONAL TARGET SPECIES

WS anticipates addressing a limited number of additional target species if WS implements Alternative 1. Requests for assistance associated with those species would often occur infrequently or would involve only a few individuals. If WS implemented Alternative 1, WS' personnel could choose to use any of the methods discussed in Appendix B when using the WS Decision Model to formulate strategies. If WS implements Alternative 1, WS could receive requests for assistance to use lethal methods to remove some of those target species when nonlethal methods were ineffective or were determined to be inappropriate using the WS Decision model. An example could include target species that pose an immediate strike threat at an airport where attempts to disperse the target species were ineffective. Those species that WS in Puerto Rico could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage are Yellow Anacondas (*Eunectes notaeus*), North African Pythons (*Python sebae*), Dumeril's Boas (*Acrantophis dumerili*), Indian Pythons (*Python molurus*), and Burmese Pythons (*Python bivittatus* [=*Python molurus bivittatus*]). WS would not lethally remove more than 25 individuals annually of any of those species identified above. Currently, no known populations exist in Puerto Rico for any of the species that WS could address in low numbers and/or infrequently. Instead, those species occur in isolated situations as strays likely introduced accidentally or intentionally through the illegal pet trade. Take of those species that WS could address in low numbers and/or infrequently would be limited to those individuals deemed causing damage or posing a threat. Furthermore, any take of those species that WS could address in low numbers and/or infrequently would occur in accordance with applicable Commonwealth and federal laws and regulations authorizing take of target species. Under Law Number 241, as amended by Law Number 223, WS would be required to obtain a permit from the DNER to take those species that WS could address in low numbers and/or infrequently. In addition, WS would report

annually to the DNER any take of all target species in accordance with applicable permits from the DNER.

WILDLIFE DISEASE SURVEILLANCE AND MONITORING

As part of disease monitoring and surveillance, WS could collect samples from mammal and reptile species in Puerto Rico. Examples of strategies for collecting samples that WS could implement include investigating sick/dead animals, conducting surveillance in live animals, conducting surveillance of hunter-harvested animals, and/or conducting environmental sampling. WS would only collect samples from bats in extreme cases where human health and safety were at risk, such as when a known bite or possible exposure to people has occurred. Implementation of those sampling strategies to detect or monitor diseases would not adversely affect populations of mammal and reptile species in Puerto Rico. For example, the sampling (*e.g*., drawing blood, tissue sample, fecal sample) and the subsequent release of live-captured animals would not result in adverse effects because WS' personnel would release those animals unharmed on site. In addition, collecting samples from animals that were sick, dying, or harvested by hunters would not result in the additive lethal take of those animals that would not have already occurred in the absence of sampling. Therefore, sampling mammals and reptiles for pathogens would not adversely affect the populations of any of the mammal and reptile species addressed in this EA nor would sampling result in any take of those species that would not have already occurred in the absence of sampling (*e.g*., hunter harvest).

EFFECTS ON THE PUBLIC'S ESTHETIC ENJOYMENT OF TARGET SPECIES

Public opinion about the best ways to reduce conflicts between people and animals is highly variable, making the implementation and conduct of damage management programs extremely complex. Some people express concerns that proposed activities could interfere with their enjoyment of recreational activities and their esthetic enjoyment of target species. Another concern is WS' activities would result in the loss of esthetic benefits of target species to the public.

People generally regard animals as providing economic, recreational, and esthetic benefits (Decker and Goff 1987), and the mere knowledge that animals exists is a positive benefit to many people. Esthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, esthetics is truly subjective in nature, dependent on what an observer regards as beautiful. The human attraction to animals likely started when people began domesticating animals. The public today share a similar bond with animals and/or wildlife in general and in modern societies, a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing animals. Therefore, the public reaction can be variable and mixed to animal damage management because there are numerous philosophical, esthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between people and animals.

Animal populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those benefits include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing animals exist and contribute to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals and may take the form of direct consumptive use (*e.g.*, using parts of or the entire animal) or non-consumptive use (*e.g.*, viewing the animal in nature or in a zoo, photographing) (Decker and Goff 1987). Animals may provide similar benefits to people that enjoy viewing certain species and knowing they are part of natural ecosystems.

Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and originate from experiences, such as looking at photographs and films of animals, reading about animals, or benefiting from activities or contributions of animals (*e.g.*, their use in research) (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

Public attitudes toward animals vary considerably. Some people believe that WS should capture and translocate all animals to another area to alleviate damage or threats those animals pose. In some cases, people directly affected by animals strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of animals from specific locations or sites. Some people totally opposed to animal damage management want WS to teach tolerance for damage and threats caused by animals, and that people should never kill animals. Some of the people who oppose removal of animals do so because of human-affectionate bonds with individual animals. Those human-affectionate bonds are similar to attitudes of a pet owner and result in esthetic enjoyment.

In some cases, the presence of overabundant non-native species offends people, such as rodents and Green Iguanas, or feral species, such as Feral Swine. To such people, those species represent pests that are nuisances, which upset the natural order in ecosystems, and are carriers of diseases transmissible to people or other animals. In those situations, the presence of overabundant species can diminish their overall enjoyment of other animals by what they view as a destructive presence of such species. They are offended because they feel that those species proliferate in such numbers and appear to remain unbalanced.

In the wild, few animals in the United States have life spans approaching that of people. Mortality is high among wildlife populations and specific individuals among a species may experience death early in life. Mortality in wildlife populations is a natural occurrence and people who form affectionate bonds with animals experience loss of those animals over time in most instances. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls and Labott 1994, Marks et al. 1994, Zasloff 1996, Ross and Baron-Sorensen 1998, Archer 1999, Meyers 2000). Similar observations are probably applicable to close bonds that could exist between people and wild animals. As observed by researchers in human behavior, normal human responses to loss of loved ones proceed through phases of shock or emotional numbness, sense of loss, grief, acceptance of the loss or what cannot be changed, healing, and acceptance and rebuilding, which leads to resumption of normal lives (Lefrancois 1999). Those people who lose companion animals, or animals for which they may have developed a bond and affection, can proceed through the same phases as with the loss of human companions (Gerwolls and Labott 1994, Boyce 1998, Meyers 2000). However, they usually establish a bond with other individual animals after such losses. Although they may lose the sense of enjoyment and meaning from the association with those animals that die or are no longer accessible, they usually find establishing an association with new individual animals or through other relational activities to be similarly meaningful (Weisman 1991). Through this process of coping with the loss and establishing new affectionate bonds, people may avoid compounding emotional effects resulting from such losses (Lefrancois 1999).

WS only conducts activities on properties where the property owner or property manager signs a work initiation document allowing WS' personnel to conduct activities and personnel would only target those species identified as causing damage or posing a threat of damage. In addition, other individuals of the same species would likely continue to be present in the affected area and people would tend to establish new bonds with those remaining target species. In addition, human behavior processes usually result in

individuals ultimately returning to normalcy after experiencing the loss of association with a wild animal that an entity removed from a specific location.

Even in the absence of any involvement by WS, other entities could conduct activities to alleviate damage or threats of damage caused by target species. Because other entities could remove target species causing damage or posing a threat of damage, the involvement of WS in removing those target species would not likely be additive to the number of target species that could be removed in the absence of involvement by WS. In addition, activities that could occur under the alternatives by WS would occur on a relatively limited portion of the total area in Puerto Rico. In localized areas where WS removes an individual of a target species or a group of target species, dispersal of target species from adjacent areas typically contributes to repopulation of the area. The amount of time required to repopulate an area would vary and would depend on the level of removal and target species population levels in nearby areas. Most of the target species addressed in this EA are relatively abundant. As discussed previously, the effects on target species populations from damage management activities would be relatively low if WS implemented Alternative 1, and opportunities to view, hear, or see evidence of many of the target species would still be available over the majority of land area of the Commonwealth.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico using only nonlethal methods

If WS implements Alternative 2, WS would be available to provide both technical assistance and direct operational assistance using only nonlethal methods to those persons requesting assistance with managing damage and threats caused by target species in Puerto Rico. The effects on the populations of target species associated with WS providing technical assistance during the implementation of Alternative 2 would be similar to those effects discussed for Alternative 3. Therefore, to reduce redundancy, the effects associated with WS providing technical assistance that would occur if WS implements Alternative 2 occur in the discussion for Alternative 3.

Under Alternative 2, WS would only use nonlethal methods to resolve damage or threats of damage associated with target species in Puerto Rico. No intentional lethal removal of target species would occur by WS. Nonlethal methods that WS could use and/or recommend are detailed in Appendix B. Nonlethal methods generally disperse, exclude, or live-capture target species. Methods intended to disperse target species from areas where they are causing damage or posing a threat of damage are generally visual or auditory deterrents, such as lights, lasers, pyrotechnics, and propane cannons. Exclusion methods would prevent target species from accessing a resource and could disperse those target species to other areas where resources are unprotected. Exclusion methods could include fencing and netting. WS could also live-capture target species. After a target species has been live-captured, WS could then transfer custody of the animal over to another entity (*e.g.*, a local animal control facility), or attach a radio and/or GPS transmitter and release the target animal at the same site of capture.

DIRECT EFFECTS ON TARGET POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

As discussed for Alternative 1, WS has used nonlethal methods to capture, disperse, or exclude target species. The use of nonlethal methods would generally have minimal effects on the overall population of a target species because those methods would not harm individual animals of a target species. WS' personnel would not employ nonlethal methods over large geographical areas or apply those methods at such an intensity that target species would be unable to access essential resources (*e.g.*, food sources, habitat) for extended durations.

The intent associated with the use of auditory and visual deterrents is to elicit a flight response by scaring target species from an area where damage is occurring or where damage could occur. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of individual target species or the ability of a target animal to survive, especially if the exposure to the stressor was chronic. If stress occurs to a target animal from the scaring associated with hazing, the negative effects associated with causing a flight response could be exacerbated by other deleterious stressors already occurring (*e.g*., disease, food availability). The stress from hazing could negatively affect the health of a target animal, interfere with the raising of young, and/or increase energy needs. A similar concern would occur when using exclusion methods, which could prevent target species from accessing a resource (*e.g*., food source, nesting locations).

WS could also live-capture target animals. When using methods to live-capture a target species, injuries or death could occur during the process of capturing a target animal. Constantly monitoring and addressing captured target animal immediately after capture can reduce the likelihood of injuries and death. In addition, making appropriate modification to live-capture methods can reduce injuries. After a target animal has been live-captured, WS could then relinquish custody of the animal over to another entity (*e.g*., a local animal control facility), or attach a radio and/or GPS transmitter and release the target animal at the same site of capture.

WS could attach identifying markers (*e.g*., ear tags) for identification purposes when attaching a radio and/or GPS transmitter to a target animal. Live-capturing and attaching identifying markers would only occur after WS or another entity received the appropriate permits from the DNER to attach those identifying markers on target species. Because the intent of using identifying markers is to monitor natural movement patterns and to identify individual target species, researchers have designed those methods to allow for natural movements and limit adverse effects on the target species. WS anticipates using identifying markers on a very limited basis because of the time and cost required to live-capture target species.

Overall, the use of nonlethal methods by WS in Puerto Rico to exclude, capture, or haze target species would have no effect on the population of a target species. WS would not employ nonlethal methods over large geographical areas at such intensity levels that resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope. Therefore, direct effects that relate to a target species population would not occur by WS from implementation of Alternative 2. WS does not anticipate any cumulative effects to occur associated with WS' use of nonlethal methods even when considered with the use of nonlethal by other entities. Although nonlethal methods can elicit a flight response or exclude target species, the cumulative use of nonlethal methods by all entities is not likely to rise to a level that would have any effect on the populations of target species.

INDIRECT EFFECTS ON TARGET SPECIES POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

As discussed previously, the use of nonlethal methods by WS in Puerto Rico to exclude, capture, or haze target species would have no effect on the populations of target species. WS would not employ nonlethal methods over large geographical areas at such intensity levels that resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope. Therefore, indirect effects that relate to the population of a target species would not occur by WS from implementation of Alternative 2.

Implementation of Alternative 2 by WS would not prevent other entities from using the lethal methods identified in Appendix B to take target species in Puerto Rico. WS anticipates the lethal take of target species would continue to occur by other entities if WS implements Alternative 2 and would likely occur

at levels similar to the take that would occur if WS implemented Alternative 1. Therefore, WS anticipates the indirect effects associated with implementing Alternative 2 would be similar to those indirect effects discussed for Alternative 1 because the lethal take of target species could continue to occur by other entities.

CUMULATIVE EFFECTS ON TARGET SPECIES POPULATIONS FROM IMPLEMENTING ALTERNATIVE 2

WS does not anticipate any cumulative effects to occur associated with WS' use of nonlethal methods even when other entities utilize nonlethal methods. Although nonlethal methods would likely elicit a flight response, the cumulative use of nonlethal methods by all entities is not likely to rise to a level that would have an effect on the population of a target species. The continued use of many nonlethal methods can often lead to the habituation of target species to those methods (*i.e*., showing no response or limited movements), which can decrease the effectiveness of those methods (*e.g*., see Conover 2002, DeVault et al. 2017, Glow et al. 2020).

Although implementation of this alternative would limit WS to using only nonlethal methods, entities other than WS could continue to use lethal methods. Implementation of Alternative 2 by WS would not prevent the DNER or municipalities from continuing to authorize the lethal take of target species in Puerto Rico. Furthermore, the take of those species listed as harmful in Regulation Number 6765 (*e.g.*, Black Rats, Green Iguanas, Indian Mongooses) could occur by other entities without the need for a permit from the DNER. Take of certain harvestable species would continue to occur during the hunting season for those species (*e.g*., Feral Swine and Feral Goats on Mona Island).

The lethal take of target species could continue to occur by other entities if WS implements Alternative 2 and would likely occur at levels similar to the take that would occur if WS implemented Alternative 1. Therefore, WS anticipates the cumulative effects associated with implementing Alternative 2 would be similar to those cumulative effects discussed for Alternative 1 because the lethal take of target species in the Commonwealth would continue to occur by other entities.

Alternative 3 - WS would recommend an integrated methods approach to managing damage caused by target species in Puerto Rico through technical assistance only

Under a technical assistance only alternative, WS would recommend an integrated methods approach similar to Alternative 1 and Alternative 2; however, WS would not provide direct operational assistance under this alternative. Using information that a requester provides or from a site visit by an employee, WS' personnel would recommend methods and techniques based on their use of the WS Decision Model. In some instances, information provided to the requester by WS could result in tolerance/acceptance of the situation. In other instances, WS would discuss and recommend damage management options. In addition, WS' personnel could assist people with the process for applying for their own permits from the DNER.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON TARGET SPECIES POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 3

If WS implements Alternative 3, WS would not directly affect target species populations in the Puerto Rico. However, persons experiencing damage or threats from target species may implement methods based on WS' recommendations. WS' personnel could recommend and demonstrate the use of both nonlethal and lethal methods that were legally available for use to alleviate damage. Those individuals receiving technical assistance could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from other entities, or take no further action. If

WS implements Alternative 3, WS would have no direct effect on target species populations because WS' personnel would not provide direct operational assistance.

Despite WS not providing direct operational assistance to resolve damage and threats associated with target species, those people experiencing damage caused by target species could alleviate damage by employing those methods legally available or by seeking assistance from other entities. Implementation of Alternative 3 by WS would not prevent other entities from using lethal and nonlethal methods and would not prevent the DNER or municipalities from authorizing the lethal take of target species in the Commonwealth. The take of those species listed as harmful in Regulation Number 6765 (*e.g.*, Black Rats, Green Iguanas, Indian Mongooses) could occur without the need for a permit from the DNER. Take of certain harvestable species would continue to occur during the hunting season for those species (*e.g*., Feral Swine and Feral Goats on Mona Island).

The lethal take of target species could continue to occur by other entities if WS implements Alternative 3 and would likely occur at levels similar to the take that would occur if WS implemented Alternative 1 or Alternative 2. Therefore, WS anticipates the indirect and cumulative effects associated with implementing Alternative 3 would be similar to those indirect and cumulative effects discussed for Alternative 1 and Alternative 2 because the exclusion, dispersal, and lethal take of target species in the Commonwealth would continue to occur by other entities. With the oversight of the DNER and municipalities, it is unlikely that implementation of Alternative 3 by WS would adversely affect the populations of target species, unless those agencies desired to limit or remove those populations. Long-term objectives of the DNER or a municipality could include the suppression or complete removal of those target species from Puerto Rico.

Under this alternative, WS would not provide any assistance with managing damage caused by target species. However, if direct operational assistance is not available from WS or other entities, it is possible that frustration caused by the inability to reduce damage and associated losses could lead to an increase in the illegal use of methods and take. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e.g*., see Allen et al. 1996, United States Department of Justice 2014, United States Department of Justice 2015).

Alternative 4 - WS would not provide any assistance with managing damage caused by target species in Puerto Rico

If WS implements Alternative 4, WS would have no direct involvement with any aspect of addressing damage caused by those target species addressed in this EA and would provide no technical assistance. When contacted about damage or the threat of damage associated with those target species addressed in this EA, WS would refer those people to other entities, such as the DNER, the municipalities, and/or private entities.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON TARGET SPECIES POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 4

If WS implemented Alternative 4, WS would not have direct effects on target species populations because WS would not provide any assistance involving those target species addressed in this EA. However, like the other alternatives, other entities could continue to use nonlethal and lethal methods to address damage caused by target species. Implementation of Alternative 4 by WS would not prevent the DNER or municipalities from continuing to authorize the take of target species in Puerto Rico. The take of those species listed as harmful in Regulation Number 6765 (*e.g.*, Black Rats, Green Iguanas, Indian Mongooses) could occur without the need for a permit from the DNER. Take of certain harvestable species would continue to occur during the hunting season for those species (*e.g*., Feral Swine and Feral

Goats on Mona Island). Therefore, WS anticipates the indirect and cumulative effects associated with implementing Alternative 4 would be similar to those indirect and cumulative effects discussed for the other alternatives because other entities could continue to use nonlethal and lethal methods to alleviate damage caused by target species.

3.1.2 Issue 2 - Effects on the Populations of Nontarget Wildlife Species, Including T&E Species

As discussed previously, a concern would be the potential impacts to nontarget species, including T&E species, from the use of methods to resolve damage caused by target species. When using methods, WS could unintentionally live-capture, disperse, or kill nontarget animals. Discussion on the potential direct, indirect, and cumulative effects of the alternative approaches on the populations of nontarget animal species, including T&E species, occurs below for each of the alternative approaches identified in Section 2.4.1.

Alternative 1 –WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico (Proposed Action/No Action)

If WS implements Alternative 1, WS could provide both technical assistance and direct operational assistance to those persons requesting assistance. When providing direct operational assistance, WS' employees could use lethal and/or nonlethal methods in an integrated methods approach to reduce damage and alleviate risks of damage associated with those target species addressed in this EA.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ANALYSIS ON NONTARGET POPULATIONS

WS' personnel have experience and receive training in wildlife identification, which allows them to identify individual species and to identify damage or recognize damage threats associated with target species. In addition, employees of WS have knowledge in the use patterns of methods available to resolve animal damage, which allows them to select the most appropriate method(s) to address animal damage and minimize impacts on nontarget species.

WS' personnel use a decision making process for evaluating and responding to requests for assistance detailed in the WS Decision Model (see WS Directive 2.201), which Slate et al. (1992) describes in more detail. Using the WS Decision Model, WS' personnel would formulate a management strategy, which would include the method or methods the employee determines to be practical for use to alleviate damage or reduce risks caused by the target species. When determining the appropriate method or methods, WS' personnel would consider risks to nontarget animals from the use of a method or methods. Despite WS' efforts to reduce risks to nontarget animals, the use of a method or methods could exclude, disperse, capture, or kill nontarget animals unintentionally. A discussion of the risks to nontarget animals and the potential effects on the populations of nontarget animals if WS implements Alternative 1 occurs below.

Risks to nontarget animals associated with available methods

The risks to nontarget animals associated with WS providing technical assistance during the implementation of Alternative 1 would be similar to those risks to nontarget animals discussed for Alternative 3. Therefore, to reduce redundancy, the effects associated with WS providing technical assistance that would occur if WS implements Alternative 1 occur in the discussion for Alternative 3. Similarly, the risks to nontarget animals from the use of nonlethal methods during the implementation of Alternative 1 would be similar to those risks to nontarget animals discussed for Alternative 2. To reduce redundancy, the risks to nontarget animals from the use of nonlethal methods if WS implements Alternative 1 occur in the discussion for Alternative 2.

In regards to risks to nontarget animals, the primary risk would be associated with lethal methods because the use of lethal methods could result in the death of a nontarget animal. Lethal methods that WS' employees could use and/or recommend would include the use of a firearm (*i.e.*, shooting and aerial shooting), lethal-capture methods (*e.g.*, body-grip traps, lethal cable devices), egg destruction, euthanasia after live-capture, and sport hunting. WS could also use and/or recommend the use of hooks with the purpose of subsequent lethal removal of Spectacled Caimans.

- *Firearms and Aerial Shooting*

Shooting with firearms, whether from the ground or out of an aircraft, is essentially selective for target species because WS' personnel would identify target species prior to application. There is a slight risk of misidentifying target species, especially when target and nontarget species have a similar appearance. WS' personnel would only employ aerial shooting on those target species that have body sizes sufficiently large enough to ensure positive identification from a moving aircraft (*e.g.*, Feral Swine, Feral Goats). There is also a slight risk of unintentional take of nontarget animals if a projectile strikes a nontarget animal after passing through a target animal, if misses occur, or if a nontarget animal is near a target animal when using a shotgun. WS' personnel can minimize risks by using appropriate firearms, by being aware of what is near or beyond the target animal, and by training to be proficient with the use of a firearm.

Although the use of firearms can reduce the number of target species using a location (similar to dispersing target species), the use of a firearm is most often used to supplement and reinforce the noise associated with nonlethal methods. The noise produced when discharging a firearm could disperse nontarget animals from an area. In those cases, nontarget species nearby could temporarily leave the immediate vicinity, but would most likely return after conclusion of the action. Additionally, when appropriate, WS would use suppressed firearms to minimize noise and the associated dispersal effect that could occur from the discharge of a firearm. WS' personnel would not employ firearms over large geographical areas or use firearms at such an intensity level that WS would cause harm to a nontarget animal by dispersing and preventing them from accessing essential resources (*e.g.*, food sources, habitat).

The risks to nontarget animals associated with WS using an aircraft for aerial shooting during the implementation of Alternative 1 would be similar to those risks to nontarget animals discussed for other aerial operations (*e.g.*, aerial surveying, aerial telemetry) in Alternative 2. Therefore, to reduce redundancy, the effects associated with using an aircraft for aerial shooting that would occur if WS implements Alternative 1 occur in the discussion for other aerial operations (*e.g.*, aerial surveying, aerial telemetry) in Alternative 2.

- *Egg Destruction*

WS' personnel could make Green Iguana eggs unviable by breaking an egg, shaking an egg, or soaking an egg in water for 24 hours. The destruction of eggs would essentially be selective for Green Iguanas because WS' personnel would identify the Green Iguana eggs prior to application. Therefore, WS does not anticipate direct or indirect effects to occur to occur to nontarget species from destroying Green Iguana eggs.

- *Lethal-capture Methods*

WS would strategically place body-grip traps and lethal cable devices at locations likely to capture a target animal and minimize the threat to nontarget species by placement in those areas frequently used by target animals, using baits or lures that are as species specific as possible, and modification of individual

methods to exclude nontarget animals from capture. WS would also use body-grip traps and cable devices in compliance with applicable federal, Commonwealth, and local laws and regulations (WS Directive 2.210), as well as WS' directives to minimize risks to nontarget species.

- *Euthanasia after Live-capture*

Because live-capture of target species using other methods would occur prior to using euthanasia methods, WS' personnel would identify target species prior to using euthanasia methods. WS could euthanize target species using cervical dislocation, carbon dioxide, and firearms. WS' personnel would use euthanasia methods in accordance with WS Directive 2.505. Therefore, WS does not anticipate effects to occur from the use of euthanasia methods following live-capture.

- *Sport Hunting*

WS' personnel could recommend that property owners or managers lethally remove certain species that can be legally harvested during annual hunting seasons. When resorting to sport hunting, a property owner or manager could misidentify a target species. There is also a slight risk of unintentional take of nontarget animals if a projectile strikes a nontarget animal after passing through a target animal, if misses occur, or if a nontarget animal is near a target animal when using a shotgun. However, the recommendation by WS that the public be allowed to harvest target species during the annual hunting seasons would not increase risks to nontarget species above those risks already inherent with hunting target species.

Effects on nontarget animal populations from unintentional take

As discussed previously, the potential effects on nontarget animal populations associated with the use of nonlethal methods would be similar to those potential effects discussed for Alternative 2. Similarly, the potential effects associated with WS providing technical assistance would be similar to those potential effects discussed for Alternative 3. Of primary concern would be WS' use of lethal methods because those methods could result in the unintentional death of a nontarget animal, which could potentially affect the populations of nontarget animals.

However, WS does not anticipate the unintentional lethal removal of nontarget animals to occur at such a frequency or intensity that would affect the population of a nontarget species. From FY 2015 through FY 2020, no lethal removal of nontarget animals occurred by WS in Puerto Rico during prior activities to manage damage caused by target species. If WS' implements Alternative 1, WS' anticipates the unintentional lethal removal of nontarget animals during activities to reduce damage or threats to human safety associated with target species in Puerto Rico to be extremely low to non-existent. WS would continue to monitor the activities conducted to ensure program activities or methodologies used to reduce damage or threats caused by target species do not adversely affect the populations of nontarget animals. Methods available to resolve and prevent damage or threats caused by target species can be selective for target species when employed by trained, knowledgeable personnel. WS would annually report to the DNER any nontarget take to ensure the agency has the opportunity to consider take by WS as part of management objectives.

WS' impact on biodiversity

WS operates in accordance with applicable federal and Commonwealth laws and regulations enacted to ensure species viability. WS' personnel would use or recommend the use of lethal methods that target individuals of target species or groups of individuals of target species identified as causing damage or posing a threat of damage. Any reduction of a local population is frequently temporary because

immigration from adjacent areas or natural reproduction replaces those target species that an entity removes. WS operates on a small percentage of the land area in Puerto Rico and would only target those target species identified as causing damage or posing a threat. However, long-term objectives of the DNER or a municipality could include the suppression or complete removal of certain target species populations from Puerto Rico. Thus, at the request and direction of the DNER, WS could pursue the complete removal of certain target species populations in Puerto Rico, which could result in reduced biodiversity in the Commonwealth. Except for those bat species identified in Section 1.2, the target species addressed in this EA are not native to Puerto Rico. Any removal of non-native species, including complete removal of those populations of non-native target species in Puerto Rico, would provide some benefit to the native environment by reducing predation and/or competition for food resources with native wildlife.

Analysis of risks to T&E species

WS would make special efforts to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures through consultation with the USFWS and/or the National Marine Fisheries Service. The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. WS conducts consultations with the USFWS and/or the National Marine Fisheries Services pursuant to Section 7 of the ESA to ensure compliance. WS also conducts consultations to ensure that *"any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available"* [Sec. 7(a)(2)].

Some of the target species addressed in this EA occur throughout Puerto Rico. If WS implements Alternative 1, WS could conduct activities to manage damage caused by those target species when an entity requests such assistance. Therefore, WS could conduct activities to manage damage in areas where T&E species occur. However, from FY 2015 through FY 2020, no take of T&E species by WS has occurred in the Commonwealth during the implementation of activities and the use of methods to manage the damage that target species cause. During the development of this EA, WS reviewed the current list of species designated as T&E in Puerto Rico as determined by the USFWS and the National Marine Fisheries Service. WS conducted a review of potential impacts of implementing Alternative 1 on each of those species designated as Threatened or Endangered in the Commonwealth by the USFWS and the National Marine Fisheries Service. The evaluation took into consideration the direct and indirect effects of implementing Alternative 1 to alleviate damage caused by target species. WS reviewed the status, critical habitats designations, and current known locations of those species. As part of the review process, WS prepared and submitted a biological evaluation to the USFWS as part of the consultation process pursuant to Section 7 of the ESA.

Based on the use pattern of the methods and the locations where WS could implement damage management activities, the implementation of Alternative 1 would have no effect on those T&E species in Puerto Rico under the jurisdiction of the National Marine Fisheries Service, including any designated critical habitat. In addition, based on the use patterns of methods currently available and based on current life history information for those species under the jurisdiction of the USFWS, WS has made a no effect determination for several species currently listed in Puerto Rico (see Table C.1 in Appendix C). For several species listed within the Commonwealth, WS has determined that the proposed activities "*may affect*" those species but those effects would be solely beneficial, insignificant, or discountable, which would warrant a "*not likely to adversely affect*" determination. Based on those determinations, WS initiated informal consultation with the USFWS for those species that a "*may affect, not likely to adversely affect*" determination was made (see Table C.1 in Appendix C). The USFWS concurred with

WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species (E. Muñiz, USFWS, pers. comm. 2020).

The USFWS has also designated critical habitat in Puerto Rico for some of the species listed as Threatened or Endangered. Table C.2 in Appendix C provides a list of those species with critical habitat designated in Puerto Rico along with WS' effects determination. WS' based the effects determinations on a review of the activities that WS could conduct if WS implemented Alternative 1. The USFWS concurred with WS' effects determination for critical habitats designated in Puerto Rico (E. Muñiz, USFWS, pers. comm. 2020). WS would continue to review the species listed as Threatened or Endangered by the USFWS and the National Marine Fisheries Service and would continue to consult with the USFWS and/or the National Marine Fisheries Service as appropriate.

Table C.3 in Appendix C shows those species designated by the DNER as Critically Endangered, Endangered, or Vulnerable within the Commonwealth. WS has also reviewed the list of species the DNER has designated as Critically Endangered, Endangered, or Vulnerable. Based on the review of species listed in Puerto Rico, WS has determined that the proposed activities would have no effect on those species currently listed as Critically Endangered, Endangered, or Vulnerable by the DNER. WS would continue to review the species listed as Critically Endangered, Endangered, or Vulnerable by the DNER. As appropriate, WS would consult with the DNER when WS determines activities may affect a Critically Endangered, Endangered, or Vulnerable species designated by the DNER.

Alternative 2 – WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico using only nonlethal methods

Implementation of Alternative 2 would require WS to only recommend and use nonlethal methods to manage and prevent damage associated with target species. WS would provide technical assistance and direct operational assistance by recommending and/or using only nonlethal methods. Using the WS Decision Model, WS' personnel would consider the potential effects to nontarget animals from the potential use of nonlethal methods when formulating a management strategy for each request for assistance. Nonlethal methods have the potential to cause adverse effects to nontarget animals primarily through live-capture, exclusion, and dispersal.

If WS implemented Alternative 2, of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of a nontarget animal, or the ability of a nontarget animal to survive, especially if the exposure to the stressor were chronic. The stress caused during the use of nonlethal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON NONTARGET ANIMAL POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

In general, the use of nonlethal methods to disperse, exclude, or capture target species from areas would have no effect on the populations of nontarget animals because those methods generally would not occur with such frequency and would not occur at an intensity level that would cause adverse effects. Therefore, WS does not anticipate direct or indirect effects to occur to any nontarget species. Based on the use pattern of methods and the activities that WS could conduct to manage damage or threats of damage caused by target species, WS does not anticipate cumulative effects to occur to any nontarget species. Activities conducted by WS would not occur with such frequency and would not occur at an intensity level that would cause cumulative adverse effects. WS has received no reports or documented any cumulative effects associated with the use of nonlethal methods from previous activities associated with managing damage caused by target species in the Commonwealth that WS conducted.

Risks to nontarget animals associated with available methods

Appendix B describes the nonlethal methods that would be available for WS' personnel to use if WS implemented Alternative 2. The potential effects associated with specific methods or a category of methods occurs below.

- *Human Presence*

For the effects analysis, human presence will include physical actions that WS could use to haze target species and consideration of WS' employees conducting activities to manage damage in the Commonwealth. Like the intent of many nonlethal methods, the presence of people and/or a vehicle and the physical actions of clapping, waving, or yelling can disperse target species from an area through auditory and visual cues. Like many visual and auditory methods intended to disperse animals from a location, the primary concern would be the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of a nontarget animal or the ability of a nontarget animal to survive, especially if the exposure to the stressor was chronic. Activities conducted by WS can involve repeated visits to the same area until WS and/or another entity reduces damage or threats of damage. In some cases, such as airports, WS' employees may be present in areas multiple times a day and on a regular basis. However, like other visual and auditory stimuli, nontarget animals often habituate to the presence of people, especially in areas where nontarget animals frequently encounter people, such as urban areas. In addition, nontarget animals are likely to return to the area once WS' personnel are no longer present. The presence of WS' personnel would not occur at a magnitude or intensity level that would cause harm to a nontarget animal by preventing them from accessing essential resources (*e.g.*, food sources, habitat).

- *Modifying Cultural Methods*

When providing technical assistance, WS could recommend that people requesting assistance modify behaviors that may be contributing to damage or threats of damage caused by target species. For example, WS could recommend that property owner or managers implement changes to animal husbandry practices, such as employing guard dogs to protect livestock. However, in those cases, the entity experiencing damage or the threat of damage would be responsible for implementing the recommendations made by WS' personnel.

- *Limited Habitat Modification*

WS could also recommend limited modification of habitat in some situations, such as planting a monoculture of a less desirable grass species at airports to reduce the chance of White-tailed Deer occurring near runways. In those cases, the entity experiencing damage or the threat of damage would be responsible for implementing the recommendations made by WS' personnel. WS' employees would recommend habitat modifications in limited circumstances where modifications could result in the dispersal of target species from an area or make an area less attractive to those species. WS' employees would not recommend habitat modifications over large areas and would not recommend modifications to the extent that would result in the removal or modification of large areas of habitat. The use of habitat modifications would generally be restricted to urban areas, airports, industrial parks, office complexes, and other areas where human activities are high. WS' personnel would not recommend habitat modification at a magnitude or intensity level that would cause harm to nontarget animals by reducing available habitat.

- *Supplemental Feeding and Lure Crops*

Providing a supplemental food source and/or planting and maintaining lure crops could be methods that WS recommends to entities experiencing damage or the threat of damage associated with target species. Similar to other recommendations that WS could make when providing technical assistance, the entity requesting assistance would be primarily responsible for providing a supplemental food source and/or planting and maintaining lure crops. WS' employees would not recommend the use of supplemental feeding or the use of lure crops over large areas and would not recommend modifying habitat to plant lure crops to the extent that would result in the removal or modification of large areas of habitat. The use of lure crops are likely to occur in areas already modified for agriculture production.

- *Exclusion Devices*

Exclusionary devices can be effective in preventing access to resources in certain circumstances. Exclusionary methods include the use of nets, window screens, and fences. The use of exclusionary methods is primarily associated with areas modified by people because target species are posing a threat the human health and safety or causing damage to a resource valued by people, such as buildings, infrastructure, turf, and agricultural commodities. Given the expense of excluding target species from large areas, exclusion methods are often restricted to small areas around high value resources (*e.g.*, fencing around a small grain research plot). The most common use of exclusion devices would be to exclude bats from a house or building. The purchase and installation of exclusion devices would primarily occur by the entity experiencing damage or threats of damage. In addition, exclusion methods may also have limited application because their use could restrict people's access to the resource. Any exclusionary device erected to prevent access of target species also potentially excludes other nontarget species. However, WS' personnel and other entities would not employ exclusionary devices over large geographical areas or use those devices at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

- *Visual Deterrents*

Several visual scaring methods would be available for WS' personnel to recommend and/or use to manage damage. Visual methods include electronic guards, effigies, lasers, and lights. The intent associated with the use of visual dispersal methods would be to elicit a flight response by scaring target species from an area where damage was occurring or where damage could occur. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of nontarget animals, or the ability of nontarget animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur a nontarget animal would have to encounter a visual dispersal method and the resulting visual stimuli would have to elicit a negative response. Like other nonlethal methods, WS' personnel would not employ visual dispersal methods over large geographical areas or use those devices at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

- *Auditory Deterrents*

Like the use of visual dispersal methods, the intent with the use of auditory dispersal methods, such as electronic hazing devices, pyrotechnics, and propane cannons, is to illicit a flight response in target species by mimicking distress calls, producing a novel noise, or producing an adverse noise. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which

could reduce the fitness of nontarget animals, or the ability of nontarget animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur, nontarget animals would have to be within hearing distance at the time WS' personnel used an auditory method and the resulting noise stimuli would have to elicit a negative response. Like other nonlethal methods, WS' personnel would not use those methods over large geographical areas or use those methods at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

- *Trained Dogs*

WS could use and/or recommend the use of trained dogs to locate target species, such as Feral Swine, Boa Constrictors, or Reticulated Pythons, in areas where they are causing damage or posing a threat of damage. Only authorized WS' personnel can use trained dogs and personnel can only use trained dogs to conduct specific functions. Pursuant to WS Directive 2.445, "*WS personnel shall control and monitor their trained dogs at all times. A trained dog is considered controlled when the dog responds to the command(s) of WS personnel by exhibiting the desired or intended behavior as directed*." Therefore, WS' personnel would use dogs that are proficient in the skills necessary to locate target animals in a manner that was responsive to its handler's commands. To ensure proper monitoring and control, WS' personnel use various methods and equipment, such as muzzles, electronic training collars, harnesses, leashes, voice commands, global positioning system collars, and telemetry collars. A possibility exists that dogs could switch to a fresher trail of a nontarget species while pursuing the target species. This could occur with any animal that they have been trained to follow, and could occur with an animal that is similar to the target species. With this said, this risk can be minimized greatly by WS' personnel correctly identifying the tracks of target species prior to releasing the dogs and calling them off a track if it is determined that they have switched tracks. Because WS' personnel would only use trained dogs that are responsive to commands, WS' personnel can call back dogs if WS' personnel determine the dogs begin approaching a nontarget species. Therefore, risks to nontarget species from the use of trained dogs would are very low and would not result in adverse impacts on nontarget species' populations.

- *Live Traps*

Live traps include foothold traps, cage-type traps, and nonlethal cable devices. Cage-type traps generally allow a target species to enter inside the trap but prevent the animal from exiting the trap. Foothold traps capture and hold animals by the foot until WS' personnel checks the trap. Similarly, nonlethal cable devices capture and restrain animals until WS' personnel checks the trap. When using live traps, WS' personnel generally use bait and/or a lure to attract target species and to encourage target species to enter the trap. However, live traps have the potential to capture nontarget species. The placement of live traps in areas where target species are active, the use of target-specific attractants, the use of breakaway locks on cable devices, and proper trap pan-tension on foothold traps would likely minimize the capture of nontarget animals when using live traps. WS' personnel would attend to live traps appropriately, which would allow them to release any nontarget animals captured unharmed. There is the remote chance that the use of live traps could result in the death of a nontarget animal. However, given that these devices would be applied with provisions to keep target animals alive, the risks to nontarget species are very low and would not result in adverse impacts on nontarget species' populations.

- *Nets*

Nets are used as a live-capture method and restrain target species after capture. Nets have the potential to capture nontarget species. Net placement in areas where target species are active and the use of target-

specific attractants would likely minimize the capture of nontarget animals. WS' personnel would attend to nets appropriately, which would allow them to release any nontarget animals captured unharmed.

Nets could include the use of net guns, cannon/rocket nets, drop nets, hand nets, and throw nets. Nets are virtually selective for target individuals because application would occur by attending personnel. Furthermore, should any incidental capture of nontarget animals occur using nets, WS' personnel could release the nontarget animals captured on site. WS' personnel would handle any nontarget animals captured in such a manner as to ensure the survivability of the animal if released. Even though nets are intended to capture animals alive, the potential for death of a target or nontarget animal while being restrained or released does exist, primarily from being struck by cannon or rocket assemblies during deployment. The likelihood of cannon or rocket assemblies striking a nontarget animal is extremely low. The risk is likely extremely low because a nontarget animal must be present when WS' personnel activate the net and the nontarget animal must be in a position where the assemblies strike the animal. WS' personnel would position nets so the net envelops target species upon deployment, which would minimize the risk of assemblies striking a nontarget animal. When using nets, WS' personnel would often use a bait to attract target species and to concentrate target species in a specific area to ensure the net completely envelopes targeted individuals. Therefore, WS' personnel could abandon sites if nontarget use of the area was high or could refrain from firing the net at a time when nontarget animals were present.

- *Hand Capture*

WS' personnel would use hand capture methods to selectively capture target animals. WS' personnel would identify a target animal before using their hands to capture the animal. Thus, hand capture methods would not adversely affect any nontarget species.

- *Judas Animals*

Radio and/or GPS transmitters are attached to some target animals for use as Judas animals, which are then released and used to locate other individuals of the same species. For WS to use a target animal as a Judas animal, the target animal would first need to be live-captured using live traps or nets. While trying to capture target species to be used as Judas animals, nontarget animals could be captured in live traps and nets. The use of live traps and nets for the purposes of capturing and using target species as Judas animals would present the same threats to nontarget species as detailed in the live traps and nets sections listed above. WS would not use any nontarget species as Judas animals. Therefore, using target species as Judas animals would not adversely affect any nontarget species.

- *Catch Poles*

WS' personnel could use a catch pole to live-capture or to restrain an animal that has been live-captured using other methods. A catch pole would allow WS' personnel to restrain an animal while keeping them a safe distance away. WS' personnel could use a catch pole to free and release nontarget animals live-captured using other methods (*e.g.*, foothold traps, cage-type traps, nets). Thus, the use of catch poles by WS would not affect any nontarget species.

- *Fishing Hooks for Spectacled Caimans*

Fishing hooks, including large treble hooks and snagging hooks, could be used to capture Spectacled Caimans. When using fishing hooks, WS' personnel generally use bait to attract and encourage caimans to ingest the hook. However, fishing hooks have the potential to capture nontarget species. The placement of fishing hooks in areas where caimans are active, the use of target-specific bait, and the

placement of fishing hooks only over water would likely minimize the capture of nontarget animals when using fishing hooks. WS' personnel would attend to fishing hooks appropriately, which likely would allow them to release any nontarget animals captured unharmed. There is the remote chance that the use of fishing hooks could result in the death of a nontarget animal. However, given that the fishing hooks would be applied with provisions to keep caimans alive, the risks to nontarget species are very low and would not result in adverse impacts on nontarget species' populations.

WS' personnel could also use fishing poles with snagging hooks and/or ropes with snagging hooks to snag a Spectacled Caiman's body. WS' personnel would first identify a Spectacled Caiman before casting a snagging hook. There is a slight risk of unintentional capture of nontarget animals if a snagging hook cast misses the intended target caiman and hooks a nontarget animal. WS' personnel can minimize risks by using snagging hooks by being aware of what is near or beyond the target caiman, and by training to be proficient at casting snagging hooks. Thus, the risks to nontarget species from the use of fishing hooks are very low and would not result in adverse impacts on nontarget species' populations.

- *Unmanned Aerial Vehicles*

WS could use UAVs (*e.g.*, drones) to locate and haze target species, or to elicit a flight response by scaring target species from an area where damage was occurring or where damage could occur. WS could also use UAVs with the intent of locating or monitoring individuals or groups of target species. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of nontarget animals, or the ability of nontarget animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur nontarget animals would have to visually encounter UAVs or their shadows and/or be within hearing distance at the time WS' personnel used UAVs and the resulting visual and/or auditory stimuli would have to elicit a negative response. Like other nonlethal methods, WS' personnel would not employ UAVs over large geographical areas or use UAVs at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

- *Aerial Operations*

An issue that has arisen is the potential for low-level flights to disturb wildlife, including T&E species. Aerial operations could be an important method for surveying, monitoring, and tracking certain target species in Puerto Rico, such as Feral Swine, Feral Goats, Feral Dogs, and White-tailed Deer. Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on low flying aircraft to monitor the status of many animal populations, including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (Bellrose 1976), and colonial waterbirds (Speich 1986). Low-level flights also occur when entities use aircraft to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1996).

A number of studies have looked at responses of various wildlife species to aircraft overflights. The National Park Service (1995) reviewed the effects of aircraft overflights on wildlife and suggested that adverse effects could occur to certain species. Some species will frequently or at least occasionally show an adverse response to even minor overflights. In general though, it appears that the more serious potential adverse effects occur when overflights are chronic (*i.e.*, they occur daily or more often over long periods). Chronic exposures generally involve areas near commercial airports and military flight training facilities. Aerial operations conducted by WS rarely occur in the same areas on a daily basis, and aircraft used by WS actually spend little time flying over those particular areas.

The effects on wildlife from military-type aircraft have been studied extensively (Air National Guard 1997), and were found to have no expected adverse effects on wildlife. Examples of species or species groups that have been studied with regard to the issue of aircraft-generated disturbance are as follows:

Waterbirds and Waterfowl: Low-level overflights of two to three minutes in duration by a fixed-wing airplane and a helicopter produced no "*drastic*" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of Greater Snow Geese (*Anser caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance. Belanger and Bedard (1989, 1990) observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse effects. Conomy et al. (1998) quantified behavioral responses of wintering American Black Ducks (*Anas rubripes*), American Wigeon (*Mareca americana*), Gadwall (*Mareca strepera*), and American Green-winged Teal (*Anas crecca*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the "*time-activity budgets*" of the species. Low-level aerial operations conducted by WS would not be conducted over federal, Commonwealth, or other governmental agency property without the concurrence of the managing entity. Those flights, if requested, would be conducted to reduce threats and damages occurring to natural resources and should not result in impacts to bird species. Thus, there is little to no potential for any adverse effects on waterbirds and waterfowl.

Raptors: The Air National Guard analyzed and summarized the effects of overflight studies conducted by numerous federal and state government agencies and private organizations (Air National Guard 1997). Those studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (see Ellis 1981, Fraser et al. 1985, Lamp 1989, United States Forest Service 1992 as cited in Air National Guard 1997). A study conducted on the impacts of overflights to Bald Eagles (*Haliaeetus leucocephalus*) suggested that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). During the study, observations were made of more than 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10% of the time during aircraft overflights. Evidence also suggested that Golden Eagles (*Aquila chrysaetos*) were not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Finally, one other study found that eagles were particularly resistant to being flushed from their nests (see Awbrey and Bowles 1990 as cited in Air National Guard 1997). Therefore, there is considerable evidence that eagles would not be adversely affected by overflights during aerial operations.

Mexican Spotted Owls (*Strix occidentalis lucida*) did not flush when chain saws and helicopters were greater than 110 yards away; however, owls flushed to these disturbances at closer distances and were more prone to flush from chain saws than helicopters (Delaney et al. 1999). Owls returned to their pre-disturbance behavior 10 to 15 minutes following the event and researchers observed no differences in nest or nestling success (Delaney et al. 1999), which indicates that aircraft flights did not result in adverse effects on owl reproduction or survival.

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 Red-tailed Hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that Red-tailed Hawks habituate to low level flights during the nesting period since results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but found that Ferruginous Hawks (*Buteo regalis*) were

sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco* spp.), and Golden Eagles were "*incredibly tolerant*" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and the overflights never limited productivity.

Grubb et al. (2010) evaluated Golden Eagle response to civilian and military (Apache AH-64) helicopter flights in northern Utah. Study results indicated that Golden Eagles were not adversely affected when exposed to flights ranging from 100 to 800 meters along, towards, and from behind occupied cliff nests. Eagle courtship, nesting, and fledging were not adversely affected, indicating that no special management restrictions were required in the study location.

The above studies indicate raptors were relatively unaffected by aircraft overflights, including those by military aircraft that produce much higher noise levels. Therefore, aerial operations would have little or no potential to affect raptors adversely.

Passerines: Reproductive losses have been reported in one study of small territorial passerines ("*perching*" birds that included sparrows, blackbirds) after exposure to low altitude overflights (see Manci et al. 1988 as cited in Air National Guard 1997), but natural mortality rates of both adults and young are high and variable for most species. The research review indicated passerine birds cannot be driven any great distance from a favored food source by a non-specific disturbance, such as military aircraft noise, which indicated quieter noise would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones, but return rapidly to feed or roost once the disturbance ceases (Gladwin et al. 1988, United States Forest Service 1992). Those studies and reviews indicated there is little or no potential for aerial operations to cause adverse effects on passerine bird species.

Pronghorn (antelope) and Mule Deer: Krausman et al. (2004) found that Sonoran Pronghorn (*Antilocapra americana sonoriensis*) were not adversely affected by military fighter jet training flights and other military activity on an area of frequent and intensive military flight training operations. Krausman et al. (1986) reported that only three of 70 observed responses of Mule Deer (*Odocoileus hemionus*) to small fixed-wing aircraft overflights at 150 to 500 feet above ground level resulted in the deer changing habitats. The authors believed that the deer might have been accustomed to overflights because the study area was near an interstate highway that was followed frequently by aircraft. Krausman et al. (2004) also reported that pronghorn and mule deer do not hear noise from military aircraft as well as people, which potentially indicates why they appeared not to be disturbed as much as previously thought.

Mountain Sheep: Krausman and Hervert (1983) reported that, of 32 observations of the response of Mountain Sheep (*Ovis canadensis mexicana*) to low-level flights by small fixed-wing aircraft, 60% resulted in no disturbance, 81% in no or "*slight*" disturbance, and 19% in "*great*" disturbance. Krausman and Hervert (1983) concluded that flights less than 150 feet above ground level could cause Mountain Sheep to leave an area. When Weisenberger et al. (1996) evaluated the effects of simulated low altitude jet aircraft noise on Desert Mule Deer (*Odocoileus hemionus crooki*) and Mountain Sheep, they found that heart rates of the ungulates increased according to the dB levels, with lower noise levels prompting lesser increases. When they were elevated, heart rates rapidly returned to pre-disturbance levels suggesting that the animals did not perceive the noise as a threat. Responses to the simulated noise levels were found to decrease with increased exposure.

Bison: Fancy (1982) reported that only two of 59 Bison (*Bison bison*) groups showed any visible reaction to small fixed-winged aircraft flying at 200 to 500 feet above ground level. The study suggests that Bison were relatively tolerant of aircraft overflights.

Domestic Animals and Small Mammals: A number of studies with laboratory animals (*e.g.*, rodents [Borg 1979]) and domestic animals (*e.g.*, sheep [Ames and Arehart 1972]) have shown that these animals can become habituated to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "*fight or flight*" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 dbA (United States Forest Service 1992).

Although many of those animal species discussed above are not present in Puerto Rico, the information was provided to demonstrate the relative tolerance most animal species have of overflights, even those that involve noise at high decibels, such as from military aircraft. In general, the greatest potential for impacts to occur would be expected to exist when overflights were frequent, such as hourly and over many days that could represent "*chronic*" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many animal species often become habituated to overflights, which would naturally minimize any potential adverse effects where such flights occur on a regular basis. Therefore, aircraft used by WS should have far less potential to cause any disturbance to animal than military aircraft because the military aircraft produce much louder noise and would be flown over certain training areas many more times per year, and yet were found to have no expected adverse effects on wildlife (Air National Guard 1997).

The fact that WS would only conduct aerial shooting, aerial surveying, and aerial telemetry on a very small percentage of the land area of the Commonwealth indicates that most animals would not even be exposed to aerial overflights in Puerto Rico. Further lessening the potential for any adverse effects is that such flights occur infrequently throughout the year.

- *Repellents*

Similar to their effects on target species, repellents could be distasteful or elicit pain or discomfort when nontarget animals smell, taste, or contact certain repellents. WS would typically use repellents in urban or agricultural areas where most Threatened and Endangered species are unlikely to occur (*e.g.*, residential housing, airports, small agricultural fields). Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of nontarget animals, or the ability of nontarget animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur nontarget animals would have to smell, taste, or contact a repellent and the resulting stimuli would have to elicit a negative response. Like other nonlethal methods, WS' personnel would not employ repellents over large geographical areas or use repellents at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

- *Immobilization Chemicals*

WS could administer chemicals (*e.g.*, Telazol, Ketamine, or a mixture of Ketamine and Xylazine) to immobilize mammals in certain instances (*e.g.*, affixing a radio and/or GPS transmitter on an animal to be used as a Judas animal). WS would only administer immobilization chemicals to mammals. For WS' personnel to administer immobilization chemicals to a target mammal, the target animal would first need

to be captured using live-capture methods (*e.g.*, live-capture traps, nets). WS could also administer immobilization chemicals to target species through injection using a projectile (*e.g.*, dart gun). Nontarget animals could be captured using live-capture methods (*e.g.*, cage-type traps, foothold traps) intended for target species. The use of live-capture methods with the intent of administering immobilization chemicals to target mammals would present the same threats to nontarget species as detailed in the live traps and nets sections listed above. Nontarget animals captured using live-capture methods would be released.

Similar to the use of firearms, using projectiles to administer immobilization chemicals is essentially selective for target mammals because WS' personnel would identify target species prior to application. There is a slight risk of misidentifying target species, especially when target and nontarget species have a similar appearance. There is also a slight risk of unintentionally administering immobilization chemicals to nontarget animals if a projectile strikes a nontarget animal if misses occur. WS' personnel can minimize risks by using appropriate projectiles, by being aware of what is near or beyond the target animal, and by training to be proficient with the use of a projectiles (*e.g.*, dart guns). Therefore, risks to nontarget species from the use of immobilization chemicals are very low and would not result in adverse impacts on nontarget species' populations.

Alternative 3 - WS would recommend an integrated methods approach to managing target species damage in Puerto Rico through technical assistance only

Under a technical assistance alternative, WS would have no direct impact on nontarget species, including T&E species. Those persons requesting assistance could employ methods that WS' personnel recommend or provide through loaning of equipment. Using the WS Decision Model, WS' personnel would base recommendations from information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize impacts on nontarget animals associated with the methods that personnel recommend or loan. Methods recommended could include nonlethal and lethal methods as deemed appropriate by the WS Decision Model and as permitted by laws and regulations.

The potential impacts to nontarget animals under this alternative would be variable and based on several factors. If people employed methods as recommended by WS, the potential impacts to nontarget animals would likely be similar to Alternative 1. If people provided technical assistance did not use the recommended methods and techniques correctly or people used methods that WS did not recommend, the potential impacts on nontarget species, including T&E species, would likely be higher when compared to Alternative 1.

The potential impacts of hazing and exclusion methods on nontarget species would be similar to those described for Alternative 1. Hazing and exclusion methods would be easily obtainable and simple to employ. Because identification of targets would occur when employing shooting as a method, the potential impacts to nontarget species would likely be low under this alternative. However, the knowledge and experience of the person could influence their ability to distinguish between similar target species correctly.

Those people experiencing damage from target species may implement methods and techniques based on the recommendations of WS. The knowledge and skill of those persons implementing recommended methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than Alternative 1. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in nontarget animal removal when compared to the nontarget animal removal that could occur by WS under Alternative 1.

If WS provided technical assistance but none of the recommended actions were implemented and no further action was taken, the potential to remove nontarget animals would be lower when compared to Alternative 1. If those persons requesting assistance implemented recommended methods appropriately and as instructed or demonstrated, the potential impacts to nontarget animals would be similar to Alternative 1. If WS made recommendations on the use of methods to alleviate damage but the methods were not implemented as recommended by WS or if the methods recommended by WS were used inappropriately, the potential for lethal removal of nontarget animals would likely increase under a technical assistance only alternative. Therefore, the potential impacts to nontarget animals, including T&E species, would be variable under a technical assistance only alternative. It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of target species, which could lead to unknown effects on local nontarget species' populations, including some T&E species.

When the damage caused by wildlife reaches a level where assistance does not adequately reduce damage or where no assistance is available, people sometimes resort to using chemical toxicants that are illegal for use on the intended target species and often results in loss of both target and nontarget wildlife (*e.g.*, see Allen et al. 1996, United States Department of Justice 2014, United States Department of Justice 2015). The use of illegal toxicants by individuals frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate take of wildlife species.

The individuals requesting assistance are likely to use lethal methods because a damage threshold has been met that has triggered them to seek assistance to reduce damage. The potential impacts on nontarget animals by those persons experiencing damage would be highly variable. People whose damage problems caused by target species were not effectively resolved by nonlethal control methods would likely resort to other means of legal or illegal lethal control. This could result in less experienced persons implementing control methods and could lead to greater take of nontarget wildlife than the proposed action.

WS' recommendation that target species be harvested during the regulated season by private entities to alleviate damage would not increase risks to nontarget animals. Shooting would essentially be selective for target species and the unintentional lethal removal of nontarget animals would not likely increase based on WS' recommendation of the method.

The ability to reduce negative effects caused by target species to wildlife species and their habitats, including T&E species, would be variable under this alternative. The skills and abilities of the person implementing damage management actions would determine the risks to nontarget animals.

Alternative 4 – WS would not provide any assistance with managing damage caused by target species in Puerto Rico

Under this alternative, WS would not provide any assistance with managing damage associated with target species in the Commonwealth. Therefore, no direct impacts to nontarget animals or T&E species would occur by WS under this alternative. Risks to nontarget animals and T&E species would continue to occur from those people who implement damage management activities on their own or through recommendations by other federal, Commonwealth, and private entities. Although some risks could occur from those people that use methods in the absence of any involvement by WS, those risks would likely be low, and would be similar to those risks under the other alternatives.

The ability to reduce damage and threats of damage caused by target species would be variable based upon the skills and abilities of the person implementing damage management actions under this

alternative. The risks to nontarget animals and T&E species would be similar across the alternatives because most of those methods described in Appendix B would be available to use by people if WS implements this alternative. If people apply those methods available as intended, risks to nontarget animals would be minimal to non-existent. If people apply those methods available incorrectly or apply those methods without knowledge of animal behavior, risks to nontarget animals could be higher if WS implements this alternative. If frustration from the lack of available assistance causes those persons experiencing damage caused by target species to use methods that are not legally available for use, risks to nontarget animals could be higher if WS implements this alternative. People have resorted to the use of illegal methods to resolve wildlife damage that have resulted in the lethal take of nontarget animals (*e.g.*, see Allen et al. 1996, United States Department of Justice 2014, United States Department of Justice 2015).

3.1.3 Issue 3 - Effects of Damage Management Methods on Human Health and Safety

A common concern is the potential adverse effects methods available could have on human health and safety. An evaluation of the threats to human health and safety associated with methods available under the alternatives occurs below for each of the four alternatives carried forward for further analysis.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico (Proposed Action/No Action)

If WS implements Alternative 1, WS' personnel would assess the damage or threat occurring, would evaluate the management methods available, and would formulate a management strategy to alleviate damage or reduce the risk of damage. A WS' employee would formulate a management strategy by selecting from those methods described in Appendix B that the employee determines to be practical for use. WS' employees who conduct activities to alleviate damage caused by target species would be knowledgeable in the use of methods, the wildlife species responsible for causing damage or threats, and WS' directives. WS' personnel would incorporate that knowledge into the decision-making process inherent with the WS' Decision Model, which they would apply when addressing threats and damage caused by target species. Therefore, when evaluating management methods and formulating a management strategy for each request for assistance, WS' employees would consider risks to human health and safety associated with methods.

For example, WS' personnel would consider the location where activities could occur. Risks to human safety from the use of methods would likely be greater in highly populated urban areas in comparison to rural areas that are less densely populated. If WS' personnel conducted activities on rural private property, where the property owner or manager could control and monitor access to the property, the risks to human safety from the use of methods would likely be lower. If damage management activities occurred at or near public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety would increase. In general, WS' personnel would conduct activities when human activity was minimal (*e.g.*, early mornings, at night) or in areas where human activity was minimal (*e.g.*, in areas closed to the public).

WS' personnel receive training in the safe use of methods and would follow the safety and health guidelines required by WS' directives (*e.g.*, see WS Directive 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635). For example, WS' employees would adhere to safety requirements and use appropriate personal protective equipment pursuant to WS Directive 2.601. In addition, WS' personnel would also follow WS Directive 2.635 that establishes guidelines and standard training requirement for health, safety, and personal protection from zoonotic diseases. When using watercraft, WS' employees would follow the

guidelines in WS Directive 2.630. In addition, the WS use of methods would comply with applicable federal, Commonwealth, and local laws and regulations (see WS Directive 2.210).

As allowed by law, WS' personnel would provide information about food safety and the safe handling of carcasses to reduce risks to landowners that prefer to retain feral swine carcasses or other animal carcass killed on their property for personal use (see WS Directive 2.510). Therefore, providing information about food safety and the safe handling of carcasses would minimize risks to human safety by emphasizing precautions for safe handling and preparation/consumption. In addition, WS' personnel would advise landowners to avoid feeding uncooked meat or other carcass products to pets or other animals.

When using immobilizing drugs for the capture and/or restrain target animals, WS would adhere to all established withdrawal times for those species or drugs established through consultation with the DNER and veterinarian authorities. Although unlikely, in the event that WS was requested to immobilize animals during a time when harvest of those mammal species was occurring or during a time where the withdrawal period could overlap with the start of a harvest season, WS would euthanize the animal or mark the animal with a tag. Tags would be labeled with a "*do not eat*" warning and appropriate contact information.

Before providing direct operational assistance, WS and the entity requesting assistance would sign a Memorandum of Understanding, work initiation document, or a similar document that would indicate the methods the cooperating entity agrees to allow WS to use on the property they own or property they manage. Thus, the cooperating entity would be aware of the methods that WS could use on property they own or manage, which would help identify any risks to human safety associated with the use of those methods. WS' personnel would also make the cooperator requesting assistance aware of threats to human safety associated with the use of methods.

Besides direct operational assistance, WS could also recommend methods to people when providing technical assistance. As described previously, technical assistance would consist of WS' personnel providing recommendations on methods the requester could use themselves to resolve damage or threats of damage without any direct involvement by WS. Technical assistance could also consist of occasionally providing methods to a requester that might have limited availability, such as propane cannons. If people receiving technical assistance use methods according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to those risks if WS' personnel were using those methods. If people use methods without guidance from WS or apply those methods inappropriately, the risks to human safety could increase. The extent of the increased risk would be unknown and variable. However, methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods. If WS implements Alternative 1, risks to human health and safety associated with WS' personnel providing technical assistance would be identical to those risks discussed if WS implemented Alternative 3. A discussion of threats to human health and safety for the methods discussed in Appendix B occurs below.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

When using lethal non-chemical methods, WS' personnel would dispose of carcasses in accordance with WS Directive 2.515 and would comply with requirements in depredation permits and/or authorizations issued by the DNER and/or municipalities for activities associated with target species. WS' personnel would also notify the cooperator requesting assistance of threats to human safety associated with the use of methods. Risks to human safety from activities and methods would be similar to the other alternatives because many of the same methods would be available to other entities. If the methods were misused or applied inappropriately, any of the methods available to alleviate damage caused by target species could

threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety.

No adverse effects to human safety have occurred from WS' use of non-chemical methods to alleviate damage or threats of damage caused by target species in Puerto Rico from FY 2015 through FY 2020. The risks to human safety from the use of non-chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by target species, the use of non-chemical would comply with Executive Order 12898 and Executive Order 13045.

- *Human Presence*

As discussed previously, human presence may consist of physical actions of people or the presence of people and/or a vehicle. If WS implements Alternative 1, WS' activities would comply with relevant laws, regulations, policies, orders, and procedures. WS' personnel would follow the safety and health guidelines required by WS' directives (*e.g.*, see WS Directive 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635). Therefore, the physical actions of WS' employees, including the presence of employees and vehicles, would not pose threat to human health and safety.

- *Changes in Cultural and Exclusion Methods*

Based on their use profile for alleviating damage associated with wildlife, WS considers risks to human safety associated with changes in cultural and exclusion methods to be low. The use of fencing, netting, and window screens to exclude target species would not pose risks to human health and safety. WS would not use electrified fencing in areas where risks to human safety would occur. For example, WS could restrict the use of electrified fencing to agricultural areas where target species are feeding on crops or other situations that do not pose a risk to human safety. Altering cultural methods would not pose a threat to human health and safety.

- *Limited Habitat Modification and Supplemental Feeding*

The recommendation by WS that a property owner or manager use habitat manipulation methods and/or a supplemental feeding program to reduce damage or threats of damage caused by target species would not increase risks to human safety above those risks already inherent with a property owner or manager conducting similar work on their property. Recommendations to use habitat manipulation methods and/or supplemental feeding on property owned or managed by a cooperator to reduce localized target species populations that could then reduce target species damage or threats would not increase risks to human safety. Although accidents do occur when using certain equipment required to perform habitat manipulation and/or supplemental feeding (*e.g.*, the use of tractors, chainsaws, or other specialized equipment), the recommendation of using habitat manipulation methods and/or supplemental feeding to reduce localized target species populations would not increase those risks.

- *Visual Deterrents*

Visual deterrents that WS' personnel could use and/or recommend would include electronic guards, effigies, lasers, and lights. Lasers and lights would pose minimal risks to the public because application occurs directly to target species by trained personnel, which limits the exposure of the public to misuse of the method. Similarly, the use of electronic guards and effigies would not pose risks to human safety.

- *Auditory Deterrents*

Auditory deterrents that WS could use and/or recommend would include electronic hazing devices, pyrotechnics, and propane cannons. Risks to human health and safety would primarily occur from the noise produced by those methods, such as hearing loss from repeated and/or prolonged exposure to the noise produced by those methods. Other risks could include fire risks and bodily harm associated with the use of pyrotechnics and propane cannons. Although hazards to human safety from the use of auditory deterrents do occur, those methods are generally safe when used by trained individuals who have experience in their use. For example, although some risk of fire and bodily harm exists from the use of pyrotechnics, when used appropriately and in consideration of those risks, WS' personnel can use those methods with a high degree of safety. WS' employees would adhere to safety requirements and use appropriate personal protective equipment pursuant to WS Directive 2.601. WS' personnel who use pyrotechnics would follow the guidelines for using pyrotechnics in accordance with WS Directive 2.627.

- *Trained Dogs*

WS could use and/or recommend the use of trained dogs to locate target animals, such as Feral Swine, Boa Constrictors, and Reticulated Pythons, in areas where they are causing damage or posing a threat of damage. WS would only use trained dogs that are responsive to their handler, which would minimize risks to the public.

- *Live-capture Methods*

Live-capture methods that would be available for WS' personnel to use and/or recommend would include hand capture, hand nets, throw nets, drop nets, net guns, cannon/rocket nets, cage-type traps, nonlethal cable devices, and foothold traps. Live-capture methods are typically used in situations where human activity would be minimal to ensure public safety. Traps rarely cause serious injury because live-capture traps available for target species are typically walk-in style traps where target species enter but are unable to exit or require a target species to trigger the trap. Therefore, human safety concerns associated with live traps and cable devices used to capture target species require direct contact to cause bodily harm. If left undisturbed, risks to human safety would be minimal. Other live-capture devices, such as cannon/rocket nets, pose minor safety hazards to the public because activation of the device occurs by trained personnel that are present on site and personnel would only activate the method after they observe target species in the capture area of the net. Personnel employing cannon/rocket nets are present at the site during application to ensure the safety of the public and operators.

Although some fire and explosive hazards exist with cannon/rocket nets during ignition and storage of the explosive charges, safety precautions associated with the use of the method, when adhered to, pose minimal risks to human safety and primarily occur to the handler. WS would not use cannon/rocket nets in areas where public activity was high, which further reduces the risks to the public. WS would use nets in areas with restricted public access whenever possible to reduce risks to human safety. WS' personnel employing hand nets, throw nets, drop nets, cannon/rocket nets, and net guns would also be present at the site during application to ensure the safety of the public. Through programmatic risk assessments, WS has determined the use of foothold traps (USDA 2019*c*), cage traps (USDA 2019*d*), cable devices (USDA 2019*e*), and nets (USDA 2020) to manage wildlife damage pose minimal risks to the human health and safety.

- *Lethal-capture Methods*

Lethal-capture methods, such as body-gripping traps and cable devices, are typically used in situations where human activity would be minimal to ensure public safety. Body-gripping traps and cable devices

rarely cause serious injury to humans and are triggered through direct activation of the device. Therefore, human safety concerns associated with body-gripping traps and cable devices used to capture target species require direct contact to cause bodily harm. Again, body-gripping traps and cable devices are not typically used in high-use areas to ensure the safety of the public and pets. Signs warning of the use of those tools in the area are posted for public view at access points to increase awareness that those devices are being used and to avoid the area, especially pet owners. WS would also use body-grip traps and cable devices in compliance with applicable federal, Commonwealth, and local laws and regulations (WS Directive 2.210), as well as WS' directives to minimize risks to human health and safety.

- *Catch Poles*

The proper use of catch poles does not pose a risk to human health and safety. The improper use of catch poles could pose a risk if the captured animal were allowed to get too close to people. Risks would primarily occur to the person handling the animal and primarily from the animal scratching or biting the handler. However, the intended purpose of a catch pole is to allow for control of an animal at a safe distance to the handler and other people. Thus, the proper use of catch poles would not pose a risk to human health and safety.

- *Fishing Hooks for Spectacled Caimans*

Fishing hooks could be used by WS in two ways to capture Spectacled Caimans: baited fishing hooks and snagging hooks. Human safety concerns associated with the use of baited fishing hooks used to capture caimans require direct contact to cause bodily harm. Baited fishing hooks that are set for caimans to ingest would typically be used in situations where human activity would be minimal to ensure public safety. These types of hooks would also be deployed directly over water, further minimizing the chance of direct human contact.

The use of snagging hooks would also occur in areas away from the public. Therefore, any risks from the use of snagging hooks would primarily occur to WS' personnel directly involved with caiman removal operations. WS' personnel would wear gloves and other personal protective equipment when using snagging hooks to minimize risks. Therefore, risks to human health and safety associated with fishing hooks would be minimal.

- *Judas Animals*

After using live-capture methods to capture target species and using immobilization chemicals to sedate target species, WS could attach radio and/or GPS transmitters to those target animals before releasing the animal at the site of capture. The use of Judas animals would not pose a risk to the public. WS' personnel would wear gloves and other personal protective equipment to minimize the risks associated with handling target animals while attaching transmitters. Therefore, the use of Judas animals would not pose a risk to human health and safety.

- *Unmanned Aerial Vehicles*

When using UAVs, WS' personnel would adhere to all federal, Commonwealth, and local laws. All WS' personnel who use UAVs are required to have a commercial Remote Pilot Certificate from the Federal Aviation Administration. To help ensure safe use and awareness, WS' employees who use UAVs receive training from an approved UAV training course and to remain certified to use UAVs, WS' employees must operate an UAV every 90 days to maintain proficiency. WS' personnel who use UAVs are also required to follow the guidelines established in the WS' Small Unmanned Aircraft System Flight Operations Procedures manual. When using UAVs, there would be a minimum of two WS' personnel

present: a Pilot-in-Command, who is remotely controlling the UAV, and a Visual Observer, who alerts the Pilot-in-Command of any dangers while the UAV is being flown. The UAV must always remain in the visual line-of-sight of either the Pilot-in-Command and/or the Visual Observer. Additionally, UAVs are not to be operated over any person that is not directly involved with flight operations. By following the safety precautions outlined by the WS' Small Unmanned Aircraft System Flight Operations Procedures manual, UAVs pose minimal risks to human safety.

- *Firearms*

Certain safety issues can arise related to misusing firearms and the potential human hazards associated with the use of firearms to reduce damage and threats of damage. All WS' personnel who use firearms would follow the guidelines in WS Directive 2.615. To help ensure safe use and awareness, WS' employees who use firearms to conduct official duties receive training from an approved firearm safety-training course, and to remain certified for firearm use, WS' employees must attend a re-certification safety-training course in accordance with WS Directive 2.615. In addition, WS' employees who use firearms from an aircraft must receive training and certification to do so, and to remain certified for firearm use from an aircraft, WS' employees must attend a re-certification safety-training course in accordance with WS Directive 2.615. WS' employees who carry and use firearms as a condition of employment are subject to the Lautenberg Domestic Confiscation Law and are required to inform their supervisor if they can no longer comply with the Lautenberg Domestic Confiscation Law (see WS Directive 2.615). WS would work closely with cooperators requesting assistance to ensure that WS' personnel consider all safety issues before deeming the use of firearms to be appropriate.

The use of firearms to alleviate damage caused by target species would be available if WS implements any of the alternatives unless otherwise prohibited by the DNER and/or a municipality in a depredation permit and/or authorization, or under the Airborne Hunting Act (16 USC 742j-1). The Airborne Hunting Act prohibits using a firearm from an aircraft to lethally shoot wildlife. However, an entity may obtain a license or permit issued by a state agency (*e.g.*, the DNER) to use firearms fired from an aircraft to lethally remove wildlife. Thus, other entities may conduct aerial shooting operations, provided they obtain appropriate licenses or permits. Because the use of firearms to alleviate damage caused by target species would be available under any of the alternatives and the use of firearms by those persons experiencing damage caused by target species could occur whether they contacted or consulted WS, the risks to human safety from the use of firearms would be similar among all the alternatives.

If WS' personnel use firearms from aircraft to remove target species lethally, WS would retrieve the carcasses to the extent possible. WS' personnel would dispose of the carcasses retrieved in accordance with WS Directive 2.515 and would comply with requirements in depredation permits and/or authorizations issued by the DNER and/or municipalities for activities associated with target species. Through programmatic risk assessments, WS has determined the use of firearms (USDA 2019*f*) to manage wildlife damage pose a low risk to human health and safety.

There are also several aviation-related human safety issues that are associated with aerial shooting. The aviation-related safety issues associated with aerial shooting would be the same as those risks associated with conducting other aerial operations (*e.g.*, aerial surveying, aerial telemetry). Therefore, to reduce redundancy, the safety of WS' use of aircraft occurs below in the discussion for aerial operations.

- *Aerial Operations*

Like any other flying, aerial wildlife operations, such as aerial shooting, aerial surveying, and aerial telemetry, may result in an accident. WS' employees participating in any aspect of aerial operations would receive training and certification in their role and responsibilities during the operations. All WS'

personnel involved in aerial operations would follow the policies and directives set forth in WS' Directive 2.620; WS' Aviation Operations Manual; WS' Aviation Safety Manual and its amendments; Title 14 CFR; and Federal Aviation Regulations, Part 43, 61, 91, 119, 133, 135, and 137. Furthermore, WS' pilots and crewmembers would be trained and experienced to recognize the circumstances that lead to accidents. The national WS Aviation Program has increased its emphasis on safety, including funding for additional training, the establishment of a WS Flight Training Center, and annual recurring training for all pilots. Still, accidents may occur and the environmental consequences should be evaluated.

Nationwide, the WS program has been using aircraft during aerial operations for many years. During this time, no incidents of major ground fires associated with WS' aircraft accidents have occurred; thus, the risk of catastrophic ground fires caused by an aircraft accident is exceedingly low. Aviation fuel is generally extremely volatile and will evaporate within a few hours or less. The fuel capacity for aircraft used by WS varies. For fixed-winged aircraft, a 52-gallon capacity would generally be the maximum, while 91 gallons would generally be the maximum fuel capacity for helicopters. In some cases, little or none of the fuel would be spilled if an accident occurs. Thus, there should be little environmental hazard from unignited fuel spills.

With the size of aircraft used by WS, the quantities of oil (*e.g.*, 6 to 8 quarts maximum for reciprocating (piston) engines and 3 to 5 quarts for turbine engines) capable of being spilled in any accident would be small with minimal chance of causing environmental damage. Aircraft used by WS would be single engine models, so the greatest amount of oil that could be spilled in one accident would be about eight quarts. When exposed to oxygen, petroleum products biodegrade through volatilization and bacterial action (EPA 2000). Thus, small quantity oil spills on surface soils can be expected to biodegrade readily. Even in subsurface contamination situations involving underground storage facilities that would generally be expected to involve larger quantities than would ever be involved in a small aircraft accident, the EPA guidelines provide for "*natural attenuation*" or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents were not cleaned up, the oil does not persist in the environment or persists in such small quantities that no adverse effects would be expected. In addition, WS' accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low to nonexistent.

For these reasons, the risk of ground fires or fuel/oil pollution from aviation accidents would be low. In addition, based on the history and experience of the program in aircraft accidents, it appears the risk of significant environmental damage from such accidents is exceedingly low. Through programmatic risk assessments, WS has determined the use of aircraft during activities to manage wildlife damage pose a low risk to human health and safety (USDA 2019*g*).

- *Egg Destruction*

WS' personnel could make Green Iguana eggs unviable by breaking an egg, shaking an egg, or soaking an egg in water for 24 hours. Risks to human health and safety associated with the destruction of Green Iguana eggs would be minimal.

- *Cervical Dislocation for Euthanasia*

After WS live-captured a target species, WS could euthanize the animal by cervical dislocation. The American Veterinary Medical Association (AVMA) guidelines on euthanasia list cervical dislocation as conditionally acceptable methods of euthanasia for free-ranging target species that can lead to a humane death (AVMA 2020). Risks would primarily occur to the person handling the animal and primarily from the animal scratching or biting the handler. In general, WS' personnel would perform cervical dislocation

outside of public view, which would minimize risks to the public. WS would dispose of carcasses euthanized in accordance with WS Directive 2.515 and would comply with requirements in depredation permits and/or authorizations issued by the DNER for activities associated with target species.

- *Sport Hunting*

The recommendation by WS that the public be allowed to harvest target species during the annual hunting seasons would not increase risks to human safety above those risks already inherent with hunting target species. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce a localized target species population that could then reduce damage or threats caused by target species would not increase risks to human safety. Safety requirements established by the DNER for annual hunting seasons would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized populations of target species would not increase those risks.

SAFETY OF CHEMICAL METHODS EMPLOYED

In addition to non-chemical methods, chemical methods could also be available for WS' personnel to use (*e.g.*, carbon dioxide, repellents, immobilization chemicals). Many of the chemical methods would only be available to manage damage or threats of damage in specific situations. The issue of using chemical methods as part of managing damage associated with animals relates to the potential for human exposure either through direct contact with the chemical or through exposure to the chemical from animals that have been exposed. Those chemical methods that WS could use as part of an integrated methods approach include repellents, carbon dioxide, and immobilization chemicals.

WS' personnel would use the WS' Decision Model to determine when chemical methods were appropriate to alleviate damage. WS would not use chemicals on public or private lands without authorization from the land management agency or property owner/manager. In addition, WS' personnel would adhere to WS' directives when using chemical methods, such as WS Directive 2.430. All WS' personnel who handle and administered chemical methods would receive appropriate training to use those methods. WS would dispose of carcasses in accordance with WS Directive 2.515.

All pesticides used by WS are registered under the Federal Insecticide, Fungicide, and Rodenticide Act and administered by the EPA and the PRDA. All WS personnel in Puerto Rico who apply restricted-use pesticides would be certified pesticide applicators by the PRDA and have specific training by WS for pesticide application. The EPA and the PRDA require pesticide applicators to adhere to all certification requirements set forth in the Federal Insecticide, Fungicide, and Rodenticide Act. Pharmaceutical drugs, including those used in wildlife capture and handling, are regulated by the United States Food and Drug Administration and/or the United States Drug Enforcement Administration. WS' personnel that use immobilizing drugs would be certified for their use and would adhere to WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, and WS Directive 2.465.

No adverse effects to human safety have occurred from WS' use of chemical methods to alleviate damage or threats of damage caused by target species in the Commonwealth from FY 2015 through FY 2020. The risks to human safety from the use of chemical methods, when used appropriately and by trained personnel, would be low. Therefore, WS does not expect any direct, indirect, or cumulative effects to occur from WS' use of those chemical methods discussed below and described further in Appendix B. Based on the use patterns of methods available to address damage caused by target species, the use of chemical methods would comply with Executive Order 12898 and Executive Order 13045.

- *Repellents*

WS could recommend and/or use repellents registered for use to disperse target species causing damage or threats of damage. Repellents are typically used in situations where human activity would be minimal to ensure public safety. All WS' personnel who handle and administer repellents would be properly trained in the use of those methods. Training and adherence to WS' directives would ensure the safety of employees applying repellents. WS' involvement, either through recommending the use of repellents or the direct use of repellents, would ensure that label requirements of those repellents are discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using repellents. Repellents, when used according to label directions, are generally regarded as safe, especially when the ingredients are considered naturally occurring. Some risk of exposure to the chemical would occur to the applicator, as well as others, as the product was applied due to the potential for drift. Some repellents also have restrictions on whether application can occur on edible plants with some restricting harvest for a designated period after application. All restrictions on harvest and required personal protective equipment would be included on the label and if followed, would minimize risks to human safety associated with the use of those products. Therefore, the risks to human safety associated with the use of repellents would be extremely low.

- *Carbon Dioxide for Euthanasia*

After target species were live-captured, WS could euthanize those target species by placing the target species into a sealed chamber and releasing compressed carbon dioxide inside the chamber. The AVMA (2020) guidelines on euthanasia list carbon dioxide as conditionally acceptable methods of euthanasia for free-ranging target species that can lead to a humane death. The carbon dioxide released into the sealed chamber would diffuse into the atmosphere once WS' personnel opened the chamber to dispose of the animal. The use of carbon dioxide for euthanasia would occur in ventilated areas where exposure of the applicator or the public to large concentrations of carbon dioxide from the release of carbon dioxide would not occur. Based on the use patterns from the use of carbon dioxide in sealed chamber to euthanize animals, the risks to human safety is extremely low.

- *Immobilization Chemicals*

WS could administer chemicals (*e.g.*, Telazol, Ketamine, or a mixture of Ketamine and Xylazine) to immobilize mammals in certain instances (*e.g.*, affixing a radio and/or GPS transmitter on an animal to be used as a Judas animal). WS would only administer immobilization chemicals to mammals. For WS' personnel to administer immobilization chemicals to a target mammal, the target animal would first need to be captured using live-capture methods (*e.g.*, live-capture traps, nets, hand capture) or through injection using a projectile (*e.g.*, dart gun).

All immobilization chemicals used by WS or recommended by WS would be registered with the United States Drug Enforcement Administration, the United States Food and Drug Administration, and/or the PRDA, as appropriate. WS' personnel would use immobilizing chemicals according to the United States Drug Enforcement Administration, the United States Food and Drug Administration, the PRDA, and WS' directives and procedures. Safety Data Sheets for immobilization chemicals would be provided to all WS' personnel involved with specific damage management activities. All WS' personnel who handle and administer immobilization chemicals would be properly trained in the use of those methods. WS' employees would follow approved procedures outlined in the WS' Field Manual for the Operational Use of Immobilizing and Euthanizing Drugs (Johnson et al. 2001). Training and adherence to agency directives would ensure the safety of employees applying immobilization chemical methods. All chemicals used by WS would be securely stored and properly monitored to ensure the safety of the public. WS Directive 2.401 and WS Directive 2.430 outline WS' use of chemicals and training requirements to

use those chemicals. Although unlikely, it is possible for the unintentional death of a target mammal due to the administration of or the associated process of administering immobilization chemicals to a target animal. If a target animal were to die due to the administration of or the associated process of administering immobilization chemicals, WS' employees would dispose of mammal carcasses in accordance with WS Directive 2.515.

All drugs used in capturing and handling wildlife would be administered under the direction and authority of Commonwealth veterinary authorities, either directly or through procedures agreed upon between those authorities and WS. As determined on a territory-level basis by those veterinary authorities (as allowed by Animal Medicinal Drug Use Clarification Act), animal damage management programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to the hunting season for the target species. This practice would avoid release of animals that may be consumed by hunters prior to the end of established withdrawal periods for the particular drugs used. WS would use ear tagging or other marking of animals drugged and released to alert hunters and trappers that they should contact territory officials before consuming the animal. Most animals administered drugs would be released well before regulated hunting seasons, which would give the drug time to completely metabolize out of the animals' systems before they might be taken and consumed by humans. In some instances, animals collected for control purposes would be euthanized when they are captured within a certain specified time period prior to the legal hunting season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems. Based on the use patterns from the use of immobilization chemicals and those reasons listed above, the risks to human health and safety is extremely low.

Under certain circumstances, personnel of WS could be involved in the capture of animals where the safety of the animal, personnel, or the public could be compromised and chemical immobilization would provide a good solution to reduce those risks. For example, chemical immobilization could be used to capture Feral Swine in urban areas where public safety was at risk. Immobilizing drugs are most often used by WS to remove animals from cage-type traps to be examined (*e.g.*, for disease surveillance) or in areas, such as urban, recreational, and residential areas, where the safe removal of a problem animal is most easily accomplished with a drug delivery system (*e.g.*, darts from rifle). Immobilization is usually followed by release (*e.g.*, after radio collaring a Judas animal for a study).

Immobilizing drugs would be closely monitored and stored in locked boxes or cabinets according to WS' policies and United States Drug Enforcement Administration guidelines. Most drugs fall under restricted-use categories and must be used under the appropriate license from the United States Drug Enforcement Administration.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

Section 1.2.2 discusses the need to resolve threats to human safety associated with the target species addressed in this EA. The primary threats to human safety associated with those target species addressed in this EA include the risks of aircraft or vehicles striking target species, disease transmission between target species and people, and the aggressive behavior of certain target species toward people. If WS implements Alternative 1, those methods identified in Appendix B would be available for WS' personnel to use when formulating a management strategy using the WS Decision Model. WS' personnel would not necessarily use every method from Appendix B to address every request for assistance but would use the WS' Decision Model to determine the most appropriate approach to address each request for assistance, which could include using additional methods from Appendix B if initial efforts did not adequately reduce threats to human safety.

Implementation of Alternative 1 would provide the widest selection of methods to resolve requests for assistance. Restricting methods or limiting the availability of methods could lead to incidents where risks to human safety increase because the only available methods may not be effective enough to reduce risks to human safety adequately. In addition, implementation of Alternative 1 would provide another way for people to resolve threats to human safety because WS would be available to provide direct operational assistance and/or technical assistance. People experiencing threats to human safety could conduct activities themselves to alleviate threats, they could seek assistance from private businesses/entities, they could seek assistance from WS, they could seek assistance from other Commonwealth or federal agencies, and/or they could take no further action. The mission of the national WS program is to provide federal leadership with managing conflicts with wildlife. In some cases, WS may be the only entity available to manage threats to human safety, such as in rural areas or remote air facilities.

Overall, implementation of Alternative 1 would likely result in a higher likelihood of successfully reducing threats to human safety because of the availability of WS and WS' ability to use the widest range of available methods to reduce threats associated with those target species addressed in this EA.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico using only nonlethal methods

Implementation of this alternative would require WS to only recommend and use nonlethal methods to manage and prevent damage caused by target species. WS would provide technical assistance and direct operational assistance under this alternative recommending and using only nonlethal methods. If WS implements Alternative 2, the nonlethal methods that would be available for WS to recommend and/or use would have the potential to threaten human safety.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

Alternative 1 discusses the threats to human safety associated with non-chemical methods that would be available if WS implements Alternative 2. If WS implements Alternative 2, the threats to human safety associated with non-chemical methods would be the same as those threats that would occur if WS implemented Alternative 1 because WS would use the same non-chemical methods that were also nonlethal methods. Non-chemical methods that WS could use and/or recommend if WS implements Alternative 2 include human presence, changes in cultural methods, exclusion methods, habitat management, supplemental feeding, auditory deterrents, visual deterrents, trained dogs, live-capture methods, catch poles, Judas animals, unmanned aerial vehicles, aerial surveying, and aerial telemetry.

No adverse effects to human safety have occurred from WS' use of non-chemical methods to alleviate damage caused by target species in the Commonwealth from FY 2015 through FY 2020. The risks to human safety from the use of non-chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by target species, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Other entities could and would likely continue to use lethal non-chemical methods if WS implements this alternative. All of the lethal non-chemical methods listed in Section II of Appendix B would be available for use by other entities. Those methods include firearms, egg destruction, and cervical dislocation after live-capture. Because other entities could still use lethal non-chemical methods if WS implements Alternative 2, it is possible that less experienced persons could implement those lethal methods, which could lead to greater risks to human safety. Other entities could use lethal methods where WS' personnel may not because WS' personnel would consider threats to human safety when formulating strategies to alleviating damage caused by target species.

SAFETY OF CHEMICAL METHODS EMPLOYED

If WS implements Alternative 2, repellents are a nonlethal chemical method that would be available for WS to use. To reduce redundancy, the safety of WS' use of repellents and immobilization chemicals occurs in the discussion for Alternative 1. WS' use of repellents and immobilization chemicals if WS implemented Alternative 2 would be the same as Alternative 1.

No adverse effects to human safety have occurred from WS' use of nonlethal chemical methods to alleviate damage caused by target species in the Commonwealth from FY 2015 through FY 2020. The risks to human safety from the use of nonlethal chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by target species, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Other entities could and would likely continue to use lethal chemical methods if WS implements this alternative. Carbon dioxide for euthanasia would be available for use by other entities. Because other entities could still use lethal chemical methods if WS implements Alternative 2, it is possible that less experienced persons could implement those lethal methods, which could lead to greater risks to human safety. Other entities could use lethal methods where WS' personnel may not because WS' personnel would consider threats to human safety when formulating strategies to alleviating damage caused by target species.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

As discussed previously, using nonlethal methods can be effective at alleviating damage associated with target species. The use of nonlethal methods in an integrated approach can be effective at dispersing target species (*e.g.*, see DeVault et al. 2017, Glow et al. 2020). Section 1.2.2 discusses the need to resolve threats to human safety associated with the target species. The primary threats to human safety associated with those target species addressed in this EA include the risks of aircraft or vehicles striking target species, disease transmission between target species and people, and the aggressive behavior of certain target species toward people. Limiting the methods available could lead to higher risks to human health and safety. For example, White-tailed Deer have the potential to cause severe damage to aircraft, which can threaten the safety of flight crews and passengers. Risks of aircraft strikes could increase if target species near airports and/or military facilities habituate to the use of nonlethal methods and no longer respond to the use of those methods.

Alternative 3 - WS would recommend an integrated methods approach to managing damage caused by target species in Puerto Rico through technical assistance only

If WS implements this alternative, WS' personnel would only provide recommendations on methods the requester could use to alleviate target species damage themselves with no direct involvement by WS. On occasion, WS' personnel could demonstrate the use of methods but WS' personnel would not conduct any direct operational activities to manage damage caused by target species. WS' personnel would only recommend for use those methods that were legally available to the requester for use. WS would only provide technical assistance to those persons requesting assistance with damage and threats of damage caused by target species.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, those people that request assistance from WS could conduct activities and use methods recommended by WS' personnel, they could implement other methods, they could seek

further assistance from other entities, or they could take no further action. Therefore, the requester and/or other entities would be responsible for using those methods available, including methods recommended by WS. The skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people receiving technical assistance use non-chemical methods according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to those risks if WS' personnel were using those methods. If people implement non-chemical methods inappropriately, without regard for human safety, and/or use methods not recommended by WS, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1. The extent of the increased risk would be unknown and variable. Although some risks to human safety are likely to occur with the use of pyrotechnics, propane cannons, exclusion devices, and firearms, those risks would likely be minimal when people use those methods appropriately and in consideration of human safety. Most non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

SAFETY OF CHEMICAL METHODS EMPLOYED

Carbon dioxide for euthanasia and repellents are chemical methods that would continue to be available to the public for use. Immobilizing chemicals could also be available for use by other entities, provided those entities obtain authorization from appropriate local, territory, and/or federal agencies (*e.g.*, municipalities, PRDA, EPA), when required. Similar to the use of non-chemical methods, the skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people receiving technical assistance from WS implement chemical methods appropriately and in consideration of human safety, the effects of implementing this alternative on human health and safety would be similar to the effects if WS implemented Alternative 1. If the chemical methods were implemented inappropriately, without regard for human safety, and/or methods not recommended by WS were used, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

As discussed previously, if WS implements this alternative, the skill and knowledge of the person using methods would determine how effective those methods were at reducing threats to human health and safety. If methods are implemented as intended at a similar level that would occur if WS' personnel were conducting those activities, the ability to reduce threats to human health and safety would be similar. If the individuals attempting to reduce threats to human health and safety applied methods incorrectly or were not as diligent at employing methods, then the reduction of threats to human health and safety would be lower than Alternative 1. This would likely occur on a case by case basis because one individual may apply methods as intended at a similar intensity level as would occur if WS were conducting the activities while another person may not apply methods as intended or may not apply those methods at a similar intensity level. Therefore, implementing this alternative would likely be effective at reducing threats to human health and safety similar to Alternative 1 in some cases but would not be as effective in other cases. However, implementing this alternative would likely be more effective at reducing threats to human health and safety than the implementation of Alternative 4 because WS would be available to provide technical assistance and demonstration to those persons seeking assistance.

Alternative 4 - WS would not provide any assistance with managing damage caused by target species in Puerto Rico

If WS implements Alternative 4, WS would not provide assistance with any aspect of managing damage or threats of damage caused by those target species addressed in this EA, including providing technical assistance. People could contact WS for assistance but WS would refer those people to other entities,

such as the DNER, the PRDA, a municipality, and/or private entities. Due to the lack of involvement in managing damage or threats of damage caused by those target species addressed in this EA, no impacts to human safety would occur directly by WS. This alternative would not prevent those entities from conducting damage management activities in the absence of WS' assistance. Many of the methods discussed in Appendix B would be available to those persons experiencing damage or threats and, when required, people could continue to take target species lethally when authorized by the DNER and/or a municipality.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, the individuals experiencing damage caused by target species could conduct activities themselves, they could seek assistance from other entities, or they could take no action. The requester and/or other entities would be responsible for using those methods available. Non-chemical methods available to alleviate or prevent damage associated with target species generally do not pose risks to human safety. Most non-chemical methods available to alleviate damage caused by target species involve the live-capture or hazing of target species. The skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people implement non-chemical methods appropriately and in consideration of human safety, then the effects of using non-chemical methods would be similar to those effects if WS implemented Alternative 1. If people implement non-chemical methods inappropriately, without regard for human safety, and/or use illegal methods, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1. Although some risks to human safety are likely to occur with the use of pyrotechnics, propane cannons, exclusion devices, and firearms, those risks would likely be minimal when people use those methods appropriately and in consideration of human safety.

SAFETY OF CHEMICAL METHODS EMPLOYED

Similar to Alternative 3, several chemical methods would continue to be available for use by the public if WS implements Alternative 4. Carbon dioxide for euthanasia and repellents are chemical methods that would continue to be available to the public for use. Immobilizing chemicals could also be available for use by other entities, provided those entities obtain authorization from appropriate local, territory, and/or federal agencies (*e.g.*, municipalities, PRDA, EPA), when required. Similar to the use of non-chemical methods, the skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people use chemical methods appropriately and in consideration of human safety, including follow label requirements, then the effects of implementing this alternative on human health and safety would be similar to those effects if WS implemented Alternative 1. If chemical methods are implemented inappropriately, without regard for human safety, and/or illegal methods are used, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

As discussed previously, if WS implements this alternative, the skill and knowledge of the person using methods would determine how effective those methods were at reducing threats to human health and safety. If people implement methods as intended at a similar level that would occur if WS' personnel were conducting those activities, the ability to reduce threats to human health and safety would be similar. If people attempting to reduce threats to human health and safety applied methods incorrectly or were not as diligent at employing methods, then the ability of those people to reduce threats to human health and safety would be lower than Alternative 1. This would likely occur on a case by case basis because one person may apply methods as intended at a similar intensity level as would occur if WS were conducting the activities while another person may not apply methods as intended or may not apply those methods at

a similar intensity level. Therefore, implementing this alternative would likely be effective at reducing threats to human health and safety similar to Alternative 1 in some cases but would not be as effective in other cases. However, implementing this alternative would likely be less effective at reducing threats to human health and safety than the implementation of Alternative 3 because WS would not be available to provide technical assistance and demonstration to those persons seeking assistance.

3.1.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised is concerns about the humaneness and animal welfare concerns of methods available under the alternatives for resolving damage and threats. Discussion of method humaneness and animal welfare concerns for those methods available under the alternatives occurs below.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico (Proposed Action/No Action)

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that people interpret in a variety of ways. Schmidt (1989) indicated that vertebrate damage management for societal benefits could be compatible with animal welfare concerns, if *"…the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process."* The AVMA has previously described suffering as a *"…highly unpleasant emotional response usually associated with pain and distress"* (AVMA 1987). However, suffering *"…can occur without pain…,"* and *"…pain can occur without suffering…"* (AVMA 1987). Because suffering carries with it the implication of occurring over time, a case could be made for *"…little or no suffering where death comes immediately…"* (California Department of Fish and Game 1991). Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when people do not take action to alleviate conditions that cause pain or distress in animals.

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain. However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991). Research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011). Therefore, the challenge in coping with this issue is how to achieve the least amount of animal suffering.

The AVMA has previously stated "*...euthanasia is the act of inducing humane death in an animal*" and "*... the technique should minimize any stress and anxiety experienced by the animal prior to unconsciousness*" (Beaver et al. 2001). Some people would prefer the use of AVMA accepted methods of euthanasia when killing all animals, including wild animals. However, the AVMA has previously stated, "*For wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress-free death may not be possible*" (Beaver et al. 2001).

Humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most nonlethal methods of capturing wildlife to be humane because the animal is generally unharmed and

alive. Still others believe that any disruption in the behavior of wildlife is inhumane. Given the multitude of attitudes on the meaning of humaneness and the varying perspectives on the most effective way to address damage and threats in a humane manner, the challenge for agencies is to conduct activities and employing methods that people perceive to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of WS would be to use methods as humanely as possible to resolve requests for assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

Some people and groups of people have stereotyped methods as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. Therefore, the goal would be to address requests for assistance effectively using methods in the most humane way possible that minimizes the stress and pain to the animal. When formulating a management strategy using the WS Decision Model, WS' personnel would give preference to the use of nonlethal methods, when practical and effective, pursuant to WS Directive 2.101.

Although some issues of humaneness could occur from the use of nonlethal methods, when used appropriately and by trained personnel, those methods would not result in the inhumane treatment of target species. The nonlethal methods of primary concern would be the use of live-capture methods, such as hooks, nets, cage-type traps, and foothold traps. Concerns from the use of those nonlethal methods would be from injuries to target species while those methods restrain target animals and from the stress of the animal while being restrained or during the application of the method. However, WS' personnel would be present on-site during capture events or WS' personnel would check traps frequently to ensure target species captured are addressed in timely manner to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, WS could also use lethal methods to resolve requests for assistance to resolve or prevent damage and threats caused by target species. Lethal methods would include firearms (*e.g.*, shooting and aerial shooting), egg destruction, euthanasia after target species are live-captured (*e.g.*, cervical dislocation, carbon dioxide), and the recommendation that certain target species be harvested during regulated hunting seasons. WS' use of euthanasia methods under the proposed action would follow those required by WS' directives (see WS Directive 2.505).

The euthanasia methods being considered for use under the proposed action for live-captured target species are cervical dislocation, carbon dioxide, firearms, and egg destruction. The AVMA guideline on euthanasia lists cervical dislocation, carbon dioxide, and gunshot by a firearm as a conditionally acceptable method of euthanasia for free-ranging target species, which can lead to a humane death (AVMA 2020). The use of cervical dislocation or carbon dioxide for euthanasia would occur after the animal has been live-captured and away from public view. Similarly, the use of egg destruction would occur after WS' personnel had gathered Green Iguana eggs by hand. Egg destruction would involve breaking an egg, shaking an egg, or soaking an egg in water for 24 hours. In general, egg destruction would represent a humane method of making a Green Iguana egg unviable.

The use of firearms could occur while the animal was free from capture (*i.e.*, not captured using live-capture methods) or after the animal has been live-captured. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2020). WS' personnel that employ firearms to address target species damage or threats to human safety are trained in the proper placement of shots to ensure a timely and quick death. When WS' personnel deem firearms to be an appropriate method to alleviate damage or threats of damage using the WS Decision Model, WS'

personnel would strive to minimize the distress and pain of target species and to induce death as rapidly as possible.

WS' personnel would be experienced and professional in their use of management methods (see WS Directive 1.301). WS' personnel would receive training for the proper use of the latest and most humane methods to ensure a timely and quick death. Consequently, WS' personnel would implement methods in the most humane manner possible. In accordance with WS Directive 2.505, when taking an animal's life, WS' personnel would exhibit a high level of respect and professionalism toward the animal, regardless of method. People experiencing damage or threats of damage associated with target species could use those methods discussed in Appendix B regardless of the alternative implemented by WS. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives because people could use those methods in the absence of WS' involvement. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by target species in Puerto Rico using only nonlethal methods

If WS implemented this alternative, WS would only use nonlethal methods, which most people would generally regard as humane. WS would use nonlethal methods to live-capture, exclude, or disperse target species. The humaneness and animal welfare concerns of nonlethal methods would be identical to those described for Alternative 1 because those same nonlethal methods would be available for use if WS implemented this alternative. Although some issues of humaneness and animal welfare concerns could occur from the use of nonlethal methods, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of target species.

Alternative 3 - WS would recommend an integrated methods approach to managing damage caused by target species in Puerto Rico through technical assistance only

If WS implemented this alternative, the issue of method humaneness and animal welfare concerns would be similar to the humaneness and animal welfare concerns discussed for Alternative 1 because many of the same methods would be available for people to use. WS would not directly be involved with damage management activities if WS implemented Alternative 3. However, the entity receiving technical assistance from WS could employ those methods that WS recommends. Therefore, by recommending methods and, thus, a requester employing those methods, the issue of humaneness and animal welfare concerns would be similar to Alternative 1.

WS would instruct and demonstrate the proper use of methodologies to increase their effectiveness and to ensure people have the opportunity to use methods to minimize pain and suffering. However, the skill and knowledge of the person applying methods would determine the humane use of the methods the person was using despite WS' demonstration. Therefore, a lack of understanding of the behavior of animals or improperly identifying the damage caused by animals along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of people perceiving those activities as inhumane. In those situations, people are likely to regard the pain and suffering to be greater than discussed for Alternative 1.

Those persons requesting assistance would be directly responsible for the use and placement of methods and if monitoring or checking of those methods does not occur in a timely manner, captured wildlife could experience suffering and if not addressed timely, could experience distress. The amount of time an animal is restrained under the proposed action would be shorter compared to a technical assistance alternative if those requesters implementing methods are not as diligent or timely in checking methods. It

is difficult to evaluate the behavior of individual people. In addition, it is difficult to evaluate how those people will react under given circumstances. Therefore, this alternative can only evaluate the availability of WS' assistance because determining human behavior can be difficult. If those persons seeking assistance from WS apply methods recommended by WS through technical assistance as intended and as described by WS, then those people could apply those methods humanely to minimize pain and distress. If those persons provided technical assistance by WS apply methods not recommended by WS or do not employ methods as intended or without regard for humaneness or animal welfare concerns, then the issue of method humaneness and animal welfare concerns would be of greater concern because the pain and distress of target species would likely be higher.

Alternative 4 – WS would not provide any assistance with managing damage caused by target species in Puerto Rico

WS would not provide any assistance if WS implemented Alternative 4. Those people experiencing damage or threats associated with target species could continue to use those methods legally available. Those persons who consider methods inhumane would likely consider those methods inhumane under any alternative because people often label methods inhumane no matter the entity employing those methods. A lack of understanding regarding the behavior of target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the public to use to resolve damage and threats caused by target species.

3.2 ISSUES NOT CONSIDERED FOR COMPARATIVE ANALYSIS

WS identified additional issues during the scoping process of this EA. WS considered those additional issues but a detailed analysis does not occur in Chapter 3. Discussion of those additional issues and the reasons for not analyzing those issues in detail occur below.

3.2.1 Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 2.4.1 by WS would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the environment, including the Clean Air Act. The actions described in Section 2.4.1 do not involve major ground disturbance, construction, or habitat alteration. Activities that WS could conduct during implementation of those alternative approaches discussed in Section 2.4.1 would not cause changes in the flow, quantity, or storage of water resources. The use and storage of methods by WS' personnel would also follow WS' directives, including WS Directive 2.210, WS Directive 2.430, WS Directive 2.465, WS Directive 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.625, and WS Directive 2.627. Through programmatic risk assessments, WS has determined the use of foothold traps (USDA 2019*c*), cage traps (USDA 2019*d*), cable devices (USDA 2019*e*), firearms (USDA 2019*f*), the use of aircraft (USDA 2019*g*), and nets (USDA 2020) to manage wildlife damage pose minimal risks to the environment.

Most methods available for use to manage damage caused by target species are mechanical methods. Mechanical methods would not cause contaminants to enter water bodies or result in bioaccumulation. For example, firearms are mechanical methods that WS could use to remove target species lethally and to reinforce the noise associated with nonlethal methods, such as pyrotechnics. Firearms would not enter bodies of water and would be securely stored off-site after each use; therefore, the firearm itself would not contaminate water or result in the bioaccumulation of chemicals or other hazardous materials.

There is often concern about the deposition of lead into the environment from ammunition used in firearms used to lethally remove target species. The lethal removal of those target species addressed in this EA by WS using firearms occurs primarily from the use of rifles and handguns. However, the use of shotguns could be employed to lethally remove some species. To reduce risks to human safety and property damage from bullets passing through an individual of a target species, the use of rifles would be applied in such a way (*e.g*., caliber, bullet weight, distance) to reduce the likelihood of the bullet passing through the target species. Target species that were removed using a firearm would often occur within areas where retrieval of all carcasses for proper disposal would be highly likely (*e.g*., at an airport). WS' personnel would retrieve the carcasses of target species to the extent possible and would dispose of the carcasses in accordance with WS Directive 2.515. With risks of lead exposure occurring primarily from ingestion of bullet fragments and lead shot, the retrieval and proper disposal of carcasses would greatly reduce the risk of scavengers ingesting lead contained within the carcass.

However, deposition of lead into soil could occur if, during the use of a firearm, the projectile passed through an individual of a target species, if misses occurred, or if WS' personnel were not able to retrieve the carcass. Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil generally stays within the top 20 centimeters (about 8 inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could lead to contamination of ground water or surface water. Stansley et al. (1992) studied lead levels in water that had high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Lead did not appear to "*transport*" readily in surface water when soils were neutral or slightly alkaline in pH (*i.e*., not acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot was highly accumulated in areas with permanent water bodies present, the lead did not necessarily cause elevated lead levels in water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e*., requiring action to treat the water to remove lead). The study found that the dissolution (*i.e*., capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments, which reduces the transport of lead across the landscape and naturally serves to reduce the potential for ground or surface water contamination (Craig et al. 1999). Those studies suggest that, given the very low amount of lead deposited and the concentrations that would occur from WS' activities to reduce target species damage using firearms, as well as most other forms of hunting in general, lead contamination from such sources would be minimal to nonexistent.

Because the take of target species could occur by other entities during regulated hunting seasons, when permitted by the DNER and/or the municipality, or without the need for a permit under Regulation Number 6765, WS' assistance with removing target species would not be additive to the environmental status quo. WS' assistance would not be additive to the environmental status quo because those target species removed by WS using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of WS' involvement. WS' involvement in activities may result in lower amounts of lead being deposited into the environment due to efforts by WS to ensure projectiles do not pass through, but are contained within the carcass, which would limit the amount of lead potentially

deposited into soil from projectiles passing through the carcass. The proficiency training received by WS' employees in firearm use and accuracy increases the likelihood that WS' personnel lethally remove a target species humanely in situations that ensure accuracy and that misses occur infrequently, which would further reduce the potential for WS' activities to deposit lead in the soil.

In addition, WS' involvement in activities would ensure WS' personnel made efforts to retrieve carcasses lethally removed using firearms to prevent the ingestion of lead in carcasses by scavengers. WS' involvement would also ensure carcasses were disposed of properly to limit the availability of lead. Based on current information, the risks associated with lead ammunition that WS' activities could deposit into the environment due to misses, the bullet passing through the carcass, or from carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination. WS would not use lead ammunition at a magnitude that activities would deposit a large amount of spent bullets or shot in such a limited area that would result in large accumulations of lead in the soil. WS may utilize non-toxic ammunition in rifles and handguns as the technology improves and ammunition becomes more effective and available.

Consequently, WS does not expect that implementing any of the alternative approaches discussed in Section 2.4.1 would significantly change the environmental status quo with respect to soils, geology, minerals, water quality, water quantity, floodplains, wetlands, other aquatic resources, air quality, prime and unique farmlands, timber, and range. WS has received no reports or documented any effects associated with soil, water, or air quality from previous activities associated with managing damage caused by target species in the Commonwealth that WS conducted. Therefore, the EA will not analyze those elements further.

3.2.2 Greenhouse Gas Emissions by WS

Under the alternative approaches intended to meet the need for action discussed in Section 2.4.1, WS could potentially produce criteria pollutants (*i.e.*, pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies). Those activities could include working in the office, travel from office to field locations, travel at field locations (vehicles or all-terrain vehicles), and from other work-related travel (*e.g.*, attending meetings). During evaluations of the national program to manage Feral Swine (*Sus scrofa*), the WS program reviewed greenhouse gas emissions for the entire national WS program (see pages 266 and 267 in USDA 2015). The analysis estimated effects of vehicle, aircraft, office, and all-terrain vehicle use by WS for FY 2013 and included the potential new vehicle purchases that could be associated with a national program to manage damaged caused by Feral Swine. The review concluded that the range of Carbon Dioxide Equivalents (includes CO_2, NO_x CO, and SO_x) for the entire national WS program would be below the reference point of 25,000 metric tons per year recommended by Council on Environmental Quality for actions requiring detailed review of impacts on greenhouse gas emissions. The activities that WS could conduct under the alternative approaches discussed in Section 2.4.1 would have negligible cumulative effects on atmospheric conditions, including the global climate.

3.2.3 WS' Actions Would Result in Irreversible and Irretrievable Commitments of Resources

Other than relatively minor uses of fuels for vehicles, electricity for office operations, carbon dioxide for euthanasia, and some components associated with ammunition (*e.g.*, black powder, shot) and pyrotechnics (*e.g.*, black powder, cardboard), no irreversible or irretrievable commitments of resources result from WS' activities.

3.2.4 Impacts on Cultural, Archaeological, Historic, and Tribal Resources and Unique Characteristics of Geographic Areas

A number of different types of federal and Commonwealth lands occur within the analysis area, such as national wildlife refuges and national forests. WS recognizes that some persons interested in those areas may feel that any activities that could occur in those areas would adversely affect the esthetic value and natural qualities of the area. Similarly, WS' activities could occur within areas with cultural, archaeological, historic, and/or tribal resources. WS would only provide direct operational assistance if WS implements Alternative 1 or Alternative 2 (see Section 2.4.1). WS would provide no assistance with managing damage caused by target species if WS implements Alternative 4 and WS would only provide technical assistance if WS implements Alternative 3.

If WS implements Alternative 1 or Alternative 2, the methods that WS could employ would not cause major ground disturbance and would not cause any physical destruction or damage to property. In addition, the methods available would not cause any alterations of property, wildlife habitat, or landscapes, and would not involve the sale, lease, or transfer of ownership of any property. In general, implementation of Alternative 1 or Alternative 2 would not have the potential to introduce visual, atmospheric, or audible elements to areas that could result in effects on the character or use of properties. Therefore, if WS implemented Alternative 1 or Alternative 2, the methods would not have the potential to affect the unique characteristics of geographic areas or any cultural, archeological, historic, and tribal resources. If WS implements Alternative 1 or Alternative 2 and WS planned an individual activity with the potential to affect historic resources, WS and/or the entity requesting assistance would conduct the site-specific consultation, as required by Section 106 of the National Historic Preservation Act, as necessary.

If WS' personnel were directly involved with carcass burial (*i.e.*, WS' personnel physically or mechanically digging a hole in the ground to bury carcasses), siting decisions would occur after WS consulted with the State Historic Preservation Office in Puerto Rico or the affected tribal authorities to avoid adverse effects on cultural/historic resources. If WS' personnel discovered cultural resources or artifacts during the burial of carcasses, WS would cease operations and contact the State Historic Preservation Office or appropriate tribal authorities. However, WS' personnel rarely, if ever, are directly involved with the burial of carcasses in Puerto Rico.

Conducting activities at or in close proximity to historic or cultural sites for the purposes of alleviating damage caused by target species, such as firearms, would have the potential for audible effects on the use and enjoyment of the historic property. However, WS would only use such methods at a historic site after the property owner or manager signed a Memorandum of Understanding, work initiation document, or a similar document allowing WS to conduct activities on their property. A built-in minimization factor for this issue is that nearly all the methods involved would only have temporary effects on the audible nature of a site and could be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects.

In addition, WS would only conduct activities on tribal lands at the request of the Tribe and only after signing appropriate authorizing documents. Therefore, the Tribe would determine what activities they would allow and when WS' assistance was required. Because Tribal officials would be responsible for requesting assistance and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would likely occur. WS would also adhere to the Native American Graves Protection and Repatriation Act. If WS' personnel located Native American cultural items while conducting activities on federal or tribal lands, WS would notify the property manager and would discontinue work at the site until authorized by the managing entity.

WS would abide by federal and Commonwealth laws, regulations, work plans, Memorandum of Understandings, and policies to minimize any effects and would abide by any restrictions imposed by the land management agency on activities conducted by WS. The implementation of those alternative approaches discussed in Section 2.4.1 by WS would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the unique characteristics of geographic areas or any cultural, archeological, historic, and tribal resources.

3.3 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Based on the best available information and the analyses in Section 3.1.1, the direct, indirect, and cumulative effects on populations of target species associated with implementing Alternative 1 would be of low magnitude. The cumulative lethal removal of target species from all known sources of mortality would not reach a threshold that would cause a decline in their respective populations. The implementation of Alternative 2, Alternative 3, or Alternative 4 would likely have similar effects on target species populations to implementing Alternative 1 because the same or similar activities would occur by other entities. The DNER, the PRDA, and municipalities could issue permits and/or authorizations to lethally remove target species to entities experiencing damage or threats of damage caused by target species in the Commonwealth despite WS only providing technical assistance if WS implemented Alternative 3 or provided no assistance if WS implemented Alternative 4.

If WS implemented Alternative 1, those methods that WS could use to alleviate damage would essentially be selective for target species because WS' personnel would consider the methods available and their potential to disperse, capture, or kill nontarget animals based on the use pattern of the method. WS' personnel would have experience with managing animal damage and would receive training in the use of methods, which would allow WS' employees to use the WS Decision Model to select the most appropriate methods to address damage caused by target species and to reduce the risks to nontarget animals. From FY 2015 through FY 2020, no lethal removal of nontarget animals occurred by WS in Puerto Rico during prior activities to manage damage caused by target species.

If WS implemented Alternative 3, the knowledge and skill of those persons implementing the recommended methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than Alternative 1. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in nontarget animal removal when compared to the nontarget animal removal that could occur by WS under Alternative 1. Similarly, if WS implemented Alternative 4, the knowledge and skill of those persons implementing methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from implementing Alternative 4 could be greater than Alternative 1.

The risks to human health and safety from the use of available methods, when used appropriately and by trained personnel, would be low. No adverse effects to human safety have occurred from WS' use of methods to alleviate damage caused by target species in Puerto Rico from FY 2015 through FY 2020. Based on the use patterns of methods available to address damage caused by target species, implementation of Alternative 1 would comply with Executive Order 12898 and Executive Order 13045. Other entities could conduct activities to manage damage caused by target species in the Commonwealth. If people implemented methods appropriately and in consideration of human safety, threats to human health and safety would be minimal. If people implemented methods inappropriately, without regard for human safety, and/or used illegal methods, risks to human health and safety would increase.

People experiencing damage or threats of damage associated with target species could use those methods discussed in Appendix B regardless of the alternative implemented by WS. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives because people could use those methods in the absence of WS' involvement. Those people who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. In addition, many "*humane*" methods can be inhumane if not used appropriately. For example, people may view a live trap as a humane method because the trap captures an animal alive. Yet, without proper care, people can treat an animal captured in a live trap inhumanely if they do not attend to the animal appropriately.

CHAPTER 4: LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

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APPENDIX A
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APPENDIX B
METHODS AVAILABLE FOR RESOLVING OR PREVENTING DAMAGE CAUSED BY TARGET SPECIES IN PUERTO RICO

WS is evaluating the use of an adaptive approach to managing damage associated with target species, when requested, through the implementation and integration of safe and practical methods based on local problem analyses and the informed decisions of trained WS' personnel. WS' personnel would formulate integrated method approaches using the WS Decision Model (Slate et al. 1992; see WS Directive 2.201). An integrated approach to resolving requests for assistance using the Decision Model would allow WS' personnel greater flexibility and more opportunity to develop an effective damage management strategy for each request for assistance, such as considerations for Threatened, Endangered, or candidate species, that could be present in an area.

When selecting damage management techniques for specific damage situations, WS' personnel would consider the species involved along with the magnitude, geographic extent, duration, frequency, and likelihood of further damage. WS' personnel would also consider the status of target and potential nontarget species, local environmental conditions and impacts, social and legal aspects, humaneness of methods, animal welfare concerns, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. WS' personnel would evaluate those factors when formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to WS relative to the management or reduction of damage from target species. Section E in USDA (2015) discusses many of the methods that WS could use to manage damage caused by feral swine in Puerto Rico[1]. Various federal, Commonwealth, and local statutes and regulations, as well as WS' directives, would govern WS' use of damage management methods. WS would develop and recommend or implement strategies based on resource management, physical exclusion, and wildlife management approaches. Within each approach, there may be available a number of specific methods or techniques. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

I. NONLETHAL METHODS

Nonlethal methods consist primarily of tools or devices used to disperse, exclude, or capture a particular animal or a ground of animals to alleviate damage and conflicts. When evaluating management methods and formulating a management strategy, WS' personnel would give preference to nonlethal methods when they determine those methods to be practical and effective (see WS Directive 2.101). Most of the nonlethal methods available to WS would also be available to other entities within the Commonwealth and other entities could employ those methods to alleviate damage caused by mammal and reptile species in Puerto Rico.

Human presence: Human presence may consist of physical actions of people, such as clapping, waving, or shouting, or the presence of people and/or a vehicle at a location where damage or threats of damage are occurring. For example, animals may associate a vehicle with previous hazing activities and approaching an area in that vehicle or a similar vehicle may disperse target species from an area. Similarly, making a person's presence known to target species by clapping, waving, or shouting can often disperse animals from an area. When animals begin to associate people with hazing and/or shooting activities, the presence of people can disperse those target species when they see people approach.

[1]Section E in USDA (2015) discusses many methods available to manage feral swine damage; however, WS would only use those methods discussed in this EA to manage feral swine damage in Puerto Rico.

Human activities can also enhance the effectiveness of effigies, such as human effigies, because they associate people with hazing or shooting activities.

Modifying cultural methods: WS' personnel could make recommendations to people related to changing cultural methods. Recommendations could include modifying the behavior of people that may be attracting or contributing to the damage caused by mammal and reptile species. For example, artificial feeding of animals by people can attract and sustain more animals in an area than could normally be supported by natural food supplies. Similarly, WS could recommend people feed pets indoors or remove pet food from outside that may be attracting animals. WS could recommend securing garbage cans to prevent animals from accessing them.

Limited habitat modification: In most cases, the resource or property owner would be responsible for implementing habitat modifications, and WS would only provide recommendations on the type of modifications that would provide the best chance of achieving the desired effect. People can manage habitat to make it less attractive to certain wildlife species. For example, WS' personnel could recommend limited habitat management in urban and suburban areas, such as at golf courses, residential homes, and business, where requesters can plant vegetation that is less palatable to a species. Limitations of habitat management as a method of reducing animal damage are determined by the characteristics of the species involved, the nature of the damage, economic feasibility, and other factors.

Supplemental feeding and lure crops: Supplemental feeding and lure crops are food resources planted or provided to attract wildlife away from more valuable resources (*e.g.*, crops). The intent is to provide a more attractive food source so that the animals causing damage would consume it rather than a more valuable resource. The resource owner would be limited in implementing this method contingent upon ownership of or ability to manage the property.

Exclusion: Exclusion pertains to preventing access to resources through fencing, netting, or other barriers. Fencing of small critical areas can sometimes prevent animals that cannot climb from entering areas of protected resources. Fencing installed with an underground skirt can prevent access to areas for many target species that dig, such as Feral Dogs. Areas such as airports, yards, or gardens may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent the entry of smaller target species, such as bats, into buildings through existing holes or gaps. In many cases, WS could recommend the use of exclusion but the implementation of specific methods could be the responsibility of the property owner or manager.

Visual deterrents: Visual scaring techniques use visual stimuli that deter or scare target animals from an area, such as electronic guards (siren strobe-light devices), propane cannons, pyrotechnics, lasers, lights, scarecrows, human effigies, effigies of predators, and the noise associated with the discharge of a firearm. Unfortunately, many of these techniques are only effective for a short time before animals habituate to them (*e.g.*, see Belant et al. 1996). The success of frightening methods depends on an animal's fear of, and subsequent aversion to, offensive stimuli (Shivik and Martin 2001, Shivik et al. 2003, Mettler and Shivik 2007). A persistent effort is usually required to effectively apply frightening techniques and the techniques must be sufficiently varied to prolong their effectiveness. Over time, animals often habituate to commonly used scare tactics and ignore them (*e.g.*, see Conover 2002, Shivik et al. 2003, Mitchell et al. 2004, Shivik 2006, DeVault et al. 2017, Glow et al. 2020).

Auditory deterrents: Similar to visual deterrents, auditory deterrents use auditory stimuli that deter or scare target animals from an area, such as electronic guards, distress calls, propane cannons, and pyrotechnics. Some methods, such as the electronic guard, use a combination of stimuli (siren and strobe light) or people can use auditory deterrents in combination with other auditory and visual deterrents.

Similar to visual deterrents, animals often habituate to auditory deterrents, especially when used singularly or constantly.

Trained dogs: WS' personnel could use specially trained dogs to locate target species, such as Feral Swine, Boa Constrictors, or Reticulated Pythons. The dogs would receive training to follow the scent of a target species and to avoid following the scent of non-target species. WS' personnel typically find the track of the target species in areas with recent damage or at a location where recent sightings of target animals have occurred. Personnel would then put their dogs on the tracks of the target animal or guide the dogs in an area until the dogs locate the scent of a target animal. Typically, if the scent is not too old, the dogs can follow the trail. Once a target animal is located, WS' personnel can capture the target animal or lethally remove the animal. People commonly use different breeds of hounds, such as blue tick, red-bone, and Walker to track and "*bay*" Feral Swine. For more information on WS' use of trained dogs to track Feral Swine, see Section E(5) in Chapter 2 of USDA (2015).

Foothold traps: Foothold traps are mechanical devices designed to capture animals by gripping an animal's foot. A foothold trap consists of a pair of metal jaws, springs, a base to attach the springs and jaws, and a pan triggering mechanism. The springs hold the metal jaws of the trap closed while the pan triggering mechanism, when set, holds the jaws open until an animal steps on the pan, which allows the springs to close the jaws. WS can use foothold traps with rubber pads on the jaws or foothold traps with laminated jaws to reduce injury. WS places foothold traps beside, or in some situations, in travel ways that target species actively use. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of nontarget animals. Effective trap placement and adjustment and the use and placement of appropriate baits and lures by trained WS' personnel also contribute to the selectivity of foothold traps. An additional advantage is that foothold traps can allow for the on-site release of nontarget animals because foothold traps capture animals alive. The use of foothold traps requires more skill than some methods, but they are indispensable in resolving many damage problems. For more information on foothold traps and WS' use of foothold traps, see USDA (2019*c*).

Cage-type traps: Cage traps come in a variety of styles to live-capture animals. The most commonly known cage-type traps are box traps and corral traps. Box traps (*e.g.*, Sherman box traps) are usually rectangular and are made from various materials, including metal, wire mesh, plastic, and wood. These traps are well suited for use in residential areas and work best when baited with foods attractive to the target animal. Box traps are generally portable and easy to set-up. For more information on cage traps and WS' use of cage traps, see USDA (2019*d*).

Corral traps for Feral Swine are generally large circular traps consisting of panels anchored to the ground using steel posts with a door allowing entrance. Side panels are typically woven metal fencing referred to as hog panels or cow panels. The entrances into the traps generally consist of a door that allow entry into the trap but prevents exit. The doors are often designed to allow swine to continually enter the trap that allows for the possibility of capturing multiple swine. For more information on cage traps and corral traps that WS could use to capture Feral Swine, see Section E(6)(a) in Chapter 2 of USDA (2015).

The disadvantages of using cage-type traps are: 1) some individual target animals may avoid cage-type traps; 2) some nontarget animals may associate the traps with available food and purposely get captured to eat the bait, making the trap unavailable to catch target animals; 3) cage-type traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions; and 4) some animals will fight to escape and may become injured; 5) expense of purchasing traps. Disadvantages associated with corral traps include: 1) the expense of purchasing the materials to construct trap, 2) once constructed, corral traps are not moveable until disassembled and transported, and 3) in remote areas, getting all the required equipment to the location can be difficult.

Trap monitors are devices that send a radio signal to a receiver if a set trap is disturbed and alerts field personnel that an animal may be captured. Trap monitors can be attached directly to the trap or attached to a string or wire and then placed away from the trap in a tree or shrub. When the monitor is hung above the ground, it can be detected from several miles away, depending on the terrain in the area. There are many benefits to using trap monitors, such as saving considerable time when checking traps, decreasing fuel usage, prioritizing trap checks, and decreasing the need for human presence in the area. Trap monitors could be used when using cage-type traps.

Trap monitoring devices would be employed, when applicable, that indicate when a trap has been activated. Trap monitoring devices would allow personnel to prioritize trap checks and decrease the amount of time required to check traps, which decreases the amount of time captured target or nontargets would be restrained. By reducing the amount of time targets and nontargets are restrained, pain and stress can be minimized and captured wildlife can be addressed in a timely manner, which could allow nontargets to be released unharmed. Trap monitoring devices could be employed where applicable to facilitate monitoring of the status of traps in remote locations to ensure any captured wildlife was removed promptly to minimize distress and to increase the likelihood nontargets could be released unharmed.

Drop nets: WS does not use drop nets frequently in Puerto Rico; however, WS could use drop nets when WS' personnel deem them appropriate. Drop nets are nylon or cloth nets that would be suspended above an area actively used by an animal or group of animals where target individuals have been conditioned to feed (Ramsey 1968). The area would be baited and once feeding occurs under the net, the net would be released. Drop nets require constant supervision by personnel to drop the net when target individuals are present and when animals are underneath the net. This method has limited use due to the time and effort required to condition animals to feed in a location and the required monitoring of the site to drop the net when target wildlife are present. Nets are used to live-capture target individuals and if any nontargets are present, they can be released on site unharmed. Drop nets allow for the capture of several animals during a single application. Injuries to animals do occur from the use of nets. Injuries to deer occurred when using drop nets with the rate of injury being correlated with the number of deer captured during a single application of the net (Haulton et al. 2001). For more information on nets and WS' use of nets, see USDA (2020). Section E(6)(b) in Chapter 2 of USDA (2015) provides additional information on the use of drop nets for Feral Swine.

Cannon/rocket nets: Similar to drop nets, cannon/rocket nets use nylon or cloth nets to capture wildlife that have been conditioned to feed in a given area through baiting (Hawkins et al. 1968). When using cannon/rocket nets, the net is fully deployed to determine the capture area when fired. Once the capture zone has been established, the net is rolled up upon itself and bait is placed inside the zone to ensure feeding wildlife are captured. When target animals are feeding at the site and within the capture zone of the net, the launcher is activated by personnel near the site, which launches the net over the target wildlife. The net is launched using small explosive charges and weights. Only personnel trained in the safe handling of explosive charges will be allowed to employ rocket nets when explosive charges were used. Pneumatic cannon nets could also be used, which propels the net using compressed air instead of small explosive charges. Cannon/rocket nets require personnel to be present at the site continually to monitor for feeding. Cannon/rocket nets can be used to capture multiple animals during a single application. Similar to drop nets, injury rates for cannons/rocket nets appear to be correlated with the number of animals captured during a single application of the net (Haulton et al 2001). Nontargets incidentally captured can be released on site unharmed. A permit may be required from the DNER and/or a municipality to use cannon/rocket nets. For more information on nets and WS' use of nets, see USDA (2020).

Net guns: Net guns are similar to cannon/rocket nets except the nets are smaller and the nets are propelled from a hand-held launcher similar to a gun. The hand-held gun launches a weighted net over a target species using a firearm blank or compressed air. Similar to the use of cannon/rocket nets and drop nets, the use of net guns is often associated with the use of an attractant. WS may use net guns to capture individual animals or a small number of animals that WS is unable to capture using other methods. For more information on nets and WS' use of nets, see USDA (2020).

Hand nets and throw nets: Hand nets and throw nets are used to catch some target animals. Hand nets resemble fishing dip nets with the exception that they are larger and have long handles. Throw nets, also known as cast nets, are small, weighted nets that are thrown over a target animal to capture and temporarily restrain the animal. Hand nets and throw nets could be employed when it is impractical to use other capture methods (*e.g.*, target animals located in urban areas or confined areas, such as homes and businesses). For more information on nets and WS' use of nets, see USDA (2020).

Hand capture: In certain situations, WS' personnel could use hand capture methods when other live-capture methods are impossible or impractical. For example, WS' personnel may use hand capture methods to capture large, non-native snakes, such as Boa Constrictors and Reticulated Pythons.

Catch poles: A catch pole is a pole with a tightening grip cable and release with a cable loop that tightens around an animal's neck or body and holds the animal away from the captor. Catch poles allow WS' personnel to restrain animals while keeping them a safe distance away. The device consists of a noose that is usually plastic coated cable at the end of a long pole. The operator of the pole can place the noose over the head and around the neck of an animal and tighten the noose to prevent the animal's escape.

Fishing hooks (Spectacled Caiman only): WS would only use fishing hooks to capture Spectacled Caiman in Puerto Rico. WS would use large fishing hooks, including large treble hooks used for fishing. WS could attached a fishing hook to one end of fishing line or rope and attached the other end to a pole or tree. WS' personnel would then bait the hook to attract Spectacled Caiman. After ingesting the bait with the hook, the hook would capture the caiman, similar to fishing. WS could then use a firearm to remove the caiman. In addition, WS' personnel could use fishing poles with snagging hooks and/or ropes with snagging hooks from shore or from a boat to snag and pull Spectacled Caiman to the shore or to a boat. Using a fishing pole or rope and a snagging hook, people can snag caiman by casting the hook over a caiman that is at the surface and dragging the hook across the surface of the water. If caiman submerge under the water, people often cast the hook out near where the caiman submerged and drag the hook along the bottom of the water back to the person who cast the hook. Once pulled to the shore or to a boat, WS' personnel can remove the caiman using a firearm.

Judas animals: Judas animals involves attaching a radio and/or GPS transmitter to an animal that has been captured and then releasing it at the site of capture. The animal would be monitored using signals emitted from the transmitter. Once this animal or "Judas animal" has joined other animals of the same species, those animals may be lethally removed or captured to become additional Judas animals. The original animal with the transmitter may be lethally removed or released to join additional animals of the same species and the process repeated. WS would only capture, collar, and use animals as Judas animals on species that usually congregate in large groups, such as Feral Swine or Feral Goats. If a Judas animal sustains injuries and it is determined that they would not survive during application of this method by WS, they will be euthanized in accordance with WS Directive 5.505. WS would handle Judas animals in compliance with all WS' Standard Operating Procedures and WS' directives. Section E(2)(a) in Chapter 2 of USDA (2015) provides additional information on the use of Feral Swine as Judas animals.

Unmanned Aerial Vehicles: UAVs have several applications to prevent or reduce damage caused by target species. UAVs are receiving increasing attention as a wildlife management tool (Watts et al. 2010, Koh and Wich 2012, Martin et al. 2012, Lyons et al. 2017, Wang et al. 2019). WS' personnel could use UAVs to inspect new areas where target species are causing damage. The information obtained during these flights could help WS make decisions on where to concentrate removal efforts. WS could also collect images or videos to compare before and after removal efforts have been conducted. WS could also use UAVs to locate target species. For example, WS could use thermal cameras attached to UAVs to locate specific animals, such as Feral Swine, Feral Goats, and monkeys. Unmanned aircraft generally produce less noise, use less fuel, and are generally less expensive to operate than manned aircraft (Watts et al. 2010). When using UAVs, WS would adhere to all federal, Commonwealth, and local laws. WS would also follow the guidelines established in the WS' Small Unmanned Aircraft System Flight Operations Procedures manual.

Aerial Surveying: Aircraft are a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of animals. WS uses aerial surveying throughout the United States to monitor damages and/or populations of large-bodied animals, including Feral Swine, Feral Goats, Feral Dogs, and White-tailed Deer. Any animal species large enough to see from a moving aircraft could be surveyed using this method. As with aerial shooting, the WS program aircraft-use policy helps ensure that aerial surveys are conducted in a safe and environmentally sound manner, in accordance with federal and Commonwealth laws. Pilots and aircraft must also be certified under established WS program procedures and policies. Section E(2)(d) in Chapter 2 of USDA (2015) provides additional information on the use of aircraft including unmanned aircraft for Feral Swine.

Aerial Telemetry: Telemetry is used in research projects studying the movements of various animal species. WS' personnel may place radio-transmitting collars on selected individuals of a species and then monitor their movements over a specified period. Whenever possible, WS' personnel typically attempt to locate the research subject using a hand-held antennae and radio receiver. However, occasionally animals will make large movements that prevent biologists from locating the animal from the ground. In these situations, WS can utilize either fixed wing aircraft or helicopters and elevation to conduct aerial telemetry and locate the specific animal wherever it has moved to. As with any aerial operations, the WS program aircraft-use policy helps ensure that aerial surveys would be conducted in a safe and environmentally sound manner, in accordance with federal and Commonwealth laws. Pilots and aircraft must also be certified under established WS program procedures and policies.

Ketamine: Ketamine is a dissociative anesthetic that is used to capture wildlife, primarily mammals, birds, and reptiles. It is used to eliminate pain, calms fear, and allay anxiety. Ketamine is possibly the most versatile drug for chemical capture, and it has a wide safety margin (Johnson et al. 2001). When used alone, this drug may produce muscle tension, resulting in shaking, staring, increased body heat, and, on occasion, seizures. Usually, ketamine is combined with other drugs such as xylazine. The combination of such drugs is used to control an animal, maximize the reduction of stress and pain, and increase human and animal safety.

Xylazine: Xylazine is a sedative (analgesic) that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia. It can also be used alone to facilitate physical restraint. Because xylazine is not an anesthetic, sedated animals are usually responsive to stimuli. Therefore, personnel should be even more attentive to minimizing sight, sound, and touch. When using ketamine/xylazine combinations, xylazine will usually overcome the tension produced by ketamine, resulting in a relaxed, anesthetized animal (Fowler and Miller 1999). This reduces heat production from muscle tension, but can lead to lower body temperatures when working in cold conditions.

Telazol: Telazol is a more powerful anesthetic and usually used for larger animals. Telazol is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride (a tranquilizer). The product is generally supplied sterile in vials, each containing 500 mg of active drug, and when dissolved in sterile water has a pH of 2.2 to 2.8. Telazol produces a state of unconsciousness in which protective reflexes, such as coughing and swallowing, are maintained during anesthesia. Schobert (1987) listed the dosage rates for many wild and exotic animals. Before using Telazol, the size, age, temperament, and health of the animal are considered. Following a deep intramuscular injection of Telazol, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after the administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol administered, but usually requires several hours.

Repellents: Repellents are usually naturally occurring substances, such as coyote urine, capsaicin, or putrescent whole egg solids, that the United States Environmental Protection Agency has classified as general use pesticides, which means the public can purchase and use those products without the need for a pesticide applicators license. By definition, general use pesticides are those products the United States Environmental Protection Agency has determined would not generally cause unreasonable adverse effects on the environment when applicators use those products pursuant to the label. People generally apply taste repellents directly to affected resources, which elicits an adverse taste or texture response when the target animal ingests the treated resource or the ingestion of the repellent causes temporary sickness (*e.g.*, nausea). Products containing coyote urine or other odors associated with predatory wildlife are intended to elicit a fright response in target wildlife by imitating the presence of a predatory animal (*i.e.*, wildlife tend to avoid areas where predators are known to be present). If repellents are available for use in the Commonwealth to reduce damage caused by reptiles and mammals, WS could employ or recommend for use those repellents that were available. Based on the general use repellents that could be available for use in Puerto Rico, WS could use repellents in urban areas (*e.g.*, residential housing, airports) and agricultural areas (*e.g.*, small agricultural fields). WS anticipates using repellents infrequently. WS anticipates primarily using repellents to disperse bats where WS would use a registered repellent in conjunction with exclusion methods to deter bats from the inside of buildings.

II. LETHAL METHODS

In addition to the use of nonlethal methods, WS' personnel could also use lethal methods. When required, the lethal removal of mammals and reptiles by WS would only occur when authorized by the DNER and/or the PRDA and only at levels authorized. In addition, WS would only use those lethal methods authorized by the DNER and/or the PRDA.

Body-grip traps: Body-grip traps are designed to cause the quick death of the animal that activates the trap. Body-grip traps may include snap traps and conibear traps. The conibear trap consists of a pair of rectangular wire frames that close like scissors when triggered, killing the captured animal with a quick body blow. For conibear traps, the traps should be placed so ensure the rotating jaws close on either side of the neck of the animal to ensure a quick death. Conibear traps are lightweight and easily set. Snap traps are common household rat or mouse traps. These traps are often used to collect and identify rodent species that cause damage so that species-specific control tools can be applied, such as identifying the prey base at airports. Safety hazards and risks to humans are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to nontarget animals. Selectivity of body-grip traps can be enhanced by placement, trap size, trigger configurations, and baits. When using body-grip traps, risks of nontarget capture can be minimized by using recessed sets (placing trap inside a cubby, cage, or burrow), restricting openings, or by elevating traps. For example, conibear traps set to capture Indian Mongoose can be placed at den entrances to minimize risks to nontargets. Choosing appropriately sized traps for the target species can also exclude nontargets by preventing larger nontargets from entering and triggering the trap. The trigger configurations of traps can be modified to minimize

nontarget capture. For example, offsetting the trigger can allow nontargets to pass through conibear traps without capture.

Cable devices: Cable devices consist of a cable or wire that a manufacturer or WS' personnel have fabricated with a cable or wire loop at one end of the device. WS' personnel or the manufacturer often fabricates the end of the cable opposite of the loop to work as an anchor to hold the cable device. WS' personnel would position the loop to close around the neck, torso, leg, or foot of a target animal as the animal moves through the loop. USDA (2019*e*) provides more information on cable devices and WS' use of cable devices to capture target animals. Section E(6)(c) in Chapter 2 of USDA (2015) provides additional information on the use of drop nets for Feral Swine. When deemed appropriate for use, WS' personnel would only use cable devices to target Feral Swine, Feral Goats, and White-tailed Deer.

Hunting/trapping: Hunting and/or trapping is sometimes recommended by WS to property owners and managers that can pursue legal hunting and trapping options for reducing damages or threats of damage caused by target species. Although legal hunting/trapping is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some populations of target species.

Firearms: Firearms are very selective for the target species and would be conducted with rifles, handguns, and shotguns. Methods and approaches used by WS may include use of vehicles, illuminating devices, bait, firearm suppressors, night vision/thermal equipment, and elevated platforms. Shooting is an effective method in some circumstances, and can often provide immediate relief from the problem. Shooting may at times be one of the only methods available to effectively and efficiently resolve a wildlife problem.

Ground shooting is sometimes used as the primary method to alleviate damage or threats of damage. Shooting would be limited to locations where it is legal and safe to discharge a weapon. A shooting program, especially conducted alone, can be expensive because it often requires many staff hours to complete.

Shooting can also be used in conjunction with an illumination device at night, which is especially useful for target species that are active at night, such as deer or Feral Swine. Spotlights may or may not be covered with a colored lens, which nocturnal animals may not be able to see, making it easier to locate them undisturbed. 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 Forward Looking Infrared devices can also be used to detect and shoot target species at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and Forward Looking Infrared equipment aid in locating wildlife at night when wildlife may be more active. Night vision and Forward Looking Infrared equipment could be used during surveys and in combination with shooting to remove target species at night. WS' personnel most often use this technology to target animals in the act of causing damage or likely responsible for causing damage. Those methods aid in the use of other methods or allow other methods to be applied more selectively and efficiently. Night vision and Forward Looking Infrared equipment allow for the identification of target species during night activities, which reduces the risks to nontargets and reduces human safety risks. Night vision equipment and Forward Looking Infrared devices only aid in the identification of wildlife and are not actual methods of take. The use of Forward Looking Infrared and night vision equipment to remove target species would increase the selectivity of direct management activities by targeting those animals most likely responsible for causing damage or posing threats.

Aerial Shooting (*i.e.*, shooting from an aircraft) is a damage management method that WS could use for certain large mammals, such as Feral Swine and Feral Goats. WS would only conduct aerial shooting operations from a helicopter in Puerto Rico. Aerial shooting is one of the preferred damage management

methods for reducing Feral Swine damage because local swine populations can quickly be removed when weather and habitat conditions are favorable. Aerial shooting consists of visually sighting target animals in the problem area and personnel shooting the animal from the aircraft. Local depredation problems (*e.g.*, Feral Swine causing damage to crops) can often be resolved quickly through aerial shooting. Aerial shooting is mostly species-selective (there is a slight potential for misidentification) and can be used for immediate control to reduce livestock and natural resource losses if weather, terrain, and cover conditions are favorable. WS could also use aerial shooting for disease surveillance.

Cain et al. (1972) rated aerial shooting as "*very good*" in effectiveness for problem solving, safety, and lack of adverse environmental impacts. Wagner (1997) and Wagner and Conover (1999) found that aerial shooting might be an especially appropriate tool as it reduces risks to nontarget animals and minimizes contact between damage management operations and recreationists.

Good visibility and relatively clear and stable weather conditions are required for effective and safe aerial shooting. Air temperature (high temperatures), which influences air density, affects low-level flight safety and may restrict aerial shooting activities. Tree cover can limit visibility from the aircraft, thus making it difficult for aerial shooting to be effective. However, aerial shooting can be extremely effective in habitats that are open or have broken timber. The WS program aircraft-use policy helps ensure that aerial shooting is conducted in a safe and environmentally sound manner, in accordance with federal and Commonwealth laws. Pilots and aircraft must be certified under established WS program procedures and only properly trained WS' employees are approved as gunners. Ground crews are often used with aerial operations for safety reasons. Ground crews can also assist with locating and recovering target animals, as necessary.

Aircraft overflights have created concerns about disturbing wildlife. The National Park Service (1995) reviewed studies on the effects of aircraft overflights on wildlife. Their report revealed that a number of studies documented responses by certain wildlife species that could suggest adverse impacts may occur. Few, if any studies, have proven that aircraft overflights cause adverse impacts to wildlife populations, although the report stated it is possible to draw the conclusion that affects to populations could occur. It appears that some species will frequently, or at least occasionally, show adverse responses to even minor overflight occurrences. In general, it appears that the more serious potential impacts occur when overflights are frequent, such as hourly, and over long periods of time, which represents chronic exposure. Chronic exposure situations generally occur in areas near commercial airports and military flight training facilities. The use of firearms from aircraft would occur in remote areas where tree cover and vegetation allows for visibility of target animals from the air. WS spends relatively little time over any one area.

WS has used helicopters for aerial shooting in areas inhabited by wildlife throughout the United States for years. WS conducts aerial activities on areas only under signed agreement and concentrates efforts during certain times of the year and to specific areas. WS flies very little over any one property under agreement in any given year. As a result, no known problems to date have occurred with WS' aerial shooting overflights on wildlife, nor are they anticipated in the future. As with any aerial operations, the WS program aircraft-use policy helps ensure that aerial surveys would be conducted in a safe and environmentally sound manner, in accordance with federal and Commonwealth laws. Pilots and aircraft must also be certified under established WS program procedures and policies. For more information on firearms and WS' use of firearms, see USDA (2019*f*). Section E(3) and Section E(4) in Chapter 2 of USDA (2015) provides additional information on the use of ground shooting and aerial shooting for Feral Swine.

Cervical dislocation: Cervical dislocation is sometimes used to euthanize small rodents that are captured in live traps and when relocation is not a feasible option. The animal is stretched and the neck is hyper-

extended and dorsally twisted to separate the first cervical vertebrae from the skull. When done properly, the AVMA approves this technique as humane method of euthanasia and states that cervical dislocation is a humane technique for euthanasia of small rodents (Beaver et al 2001). Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (Beaver et al 2001).

Egg destruction: Egg destruction could be used by WS' personnel to render Green Iguana eggs unviable. Egg destruction would involve breaking an egg, shaking an egg, or soaking an egg in water. WS' personnel would first gather the eggs. After gathering the eggs, WS' personnel could break the eggs open or vigorously shaken numerous times, which causes the embryo to detach from the egg sac. WS' personnel could also soak the eggs in water for 24 hours.

Carbon dioxide: Carbon dioxide is sometimes used to euthanize mammals that are captured in live traps and when relocation is not a feasible option. Live mammals are placed in a sealed chamber. Carbon dioxide gas is released into the chamber and the animal quickly dies after inhaling the gas. The AVMA (2020) guidelines on euthanasia list carbon dioxide as conditionally acceptable methods of euthanasia for free-ranging target species that can lead to a humane death. Carbon dioxide gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is the gas released by dry ice. The use of carbon dioxide by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

APPENDIX C
FEDERAL AND COMMONWEALTH THREATENED AND ENDANGERED SPECIES FOR PUERTO RICO

Table C.1 – Federal list of Threatened or Endangered species in Puerto Rico by the USFWS

Common Name	Scientific Name	Status[†]	Determination[‡]
Animals			
Reptiles			
Culebra Island Giant Anole	*Anolis roosevelti*	E	MANLAA
Virgin Islands Tree Boa	*Chilabothrus granti*	E	MANLAA
Mona Ground Iguana	*Cyclura stejnegeri*	T	MANLAA
Leatherback Sea Turtle	*Dermochelys coriacea*	E	MANLAA
Puerto Rican Boa	*Epicrates inornatus*	E	MANLAA
Mona Boa	*Epicrates monensis monensis*	T	MANLAA
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	MANLAA
Amphibian			
Puerto Rican Rock Frog	*Eleutherodactylus cooki*	T	MANLAA
Golden Coqui	*Eleutherodactylus jasperi*	T	MANLAA
Coquí Llanero	*Eleutherodactylus juanariveroi*	E	MANLAA
Puerto Rican Crested Toad	*Peltophryne lemur*	T	MANLAA
Birds			
Puerto Rican Sharp-shinned Hawk	*Accipiter striatus venator*	E	MANLAA
Yellow-shouldered Blackbird	*Agelaius xanthomus*	E	MANLAA
Puerto Rican Parrot	*Amazona vittata*	E	MANLAA
Puerto Rican Broad-winged Hawk	*Buteo platypterus brunnescens*	E	MANLAA
Puerto Rican Nightjar	*Caprimulgus noctitherus*	E	MANLAA
Red Knot	*Calidris canutus rufa*	T	MANLAA
Piping Plover	*Charadrius melodus*	T	MANLAA
Puerto Rican Plain Pigeon	*Columba inornata wetmorei*	E	MANLAA
Elfin-woods Warbler	*Setophaga angelae*	T	MANLAA
Roseate Tern	*Sterna dougallii dougallii*	T	MANLAA
Mammals			
West Indian Manatee	*Trichechus manatus*	T	MANLAA
Insects			
Puerto Rico Harlequin Butterfly	*Atlantea tulita*	PT	MANLAA
Plants			
No common name	*Adiantum vivesii*	E	NE
No common name	*Aristida chaseae*	E	NE
Pelos del Diablo	*Aristida portoricensis*	E	NE
No common name	*Auerodendron pauciflorum*	E	NE
Palo de Ramón	*Banara vanderbiltii*	E	NE
Vahl's Boxwood	*Buxus vahlii*	E	NE
Capa Rosa	*Callicarpa ampla*	E	NE
Thomas' Lidflower	*Calyptranthes thomasiana*	E	NE
Palma de Manaca	*Calyptronoma rivalis*	T	NE
No common name	*Catesbaea melanocarpa*	E	NE
Tamarindillo	*Chamaecrista glandulosa* var. *mirabilis*	E	NE

No common name	*Cordia bellonis*	E	NE
Palo de Nigua	*Cornutia obovata*	E	NE
No common name	*Cranichis ricartii*	E	NE
Higuero de Sierra	*Crescentia portoricensis*	E	NE
Elfin Tree Fern	*Cyathea dryopteroides*	E	NE
No common name	*Daphnopsis helleriana*	E	NE
No common name	*Elaphoglossum serpens*	E	NE
Uvillo	*Eugenia haematocarpa*	E	NE
No common name	*Eugenia woodburyana*	E	NE
No common name	*Gesneria pauciflora*	T	NE
Beautiful Goetzea	*Goetzea elegans*	E	NE
No common name	*Gonocalyx concolor*	E	NE
Higo Chumbo	*Harrisia portoricensis*	T	NE
Cook's Holly	*Ilex cookii*	E	NE
No common name	*Ilex sintenisii*	E	NE
West Indian Walnut	*Juglans jamaicensis*	E	NE
No common name	*Lepanthes eltoroensis*	E	NE
No common name	*Leptocereus grantianus*	E	NE
No common name	*Lyonia truncata* var. *proctorii*	E	NE
No common name	*Mitracarpus maxwelliae*	E	NE
No common name	*Mitracarpus polycladus*	E	NE
Ausú	*Myrcia paganii*	E	NE
Palo de Rrosa	*Ottoschulzia rhodoxylon*	E	NE
Wheeler's Peperomia	*Peperomia wheeleri*	E	NE
Chupacallos	*Pleodendron macranthum*	E	NE
No common name	*Polystichum calderonense*	E	NE
Araña	*Schoepfia arenaria*	T	NE
Erubia	*Solanum drymophilum*	E	NE
Cóbana Negra	*Stahlia monosperma*	T	NE
Palo de Jazmin	*Styrax portoricensis*	E	NE
No common name	*Tectaria estremerana*	E	NE
Palo Colorado	*Ternstroemia luquillensis*	E	NE
No common name	*Ternstroemia subsessilis*	E	NE
No common name	*Thelypteris inabonensis*	E	NE
No common name	*Thelypteris verecunda*	E	NE
No common name	*Thelypteris yaucoensis*	E	NE
Bariaco	*Trichilia triacantha*	E	NE
No common name	*Varronia rupicola*	T	NE
No common name	*Vernonia proctorii*	E	NE
St. Thomas Prickly-ash	*Zanthoxylum thomasianum*	E	NE

† E=Endangered; T=Threatened; PT=Proposed Threatened

‡NE=No effect; MANLAA=May affect, not likely to adversely affect

Table C.2 – Critical habitats designated in Puerto Rico by the USFWS

Common Name	Scientific Name	Status†	Determination‡
Animals			
Amphibians			
Puerto Rican Rock Frog	*Eleutherodactylus cooki*	CH	NE

Common Name	Scientific Name	Status†	Determination‡
Golden Coquí	*Eleutherodactylus jasperi*	CH	NE
Coquí Llanero	*Eleutherodactylus juanariveroi*	CH	NE
Reptiles			
Culebra Island Giant Anole	*Anolis roosevelti*	CH	NE
Green Sea Turtle	*Chelonia mydas*	CH	NE
Mona Ground Iguana	*Cyclura stejnegeri*	CH	NE
Mona Boa	*Epicrates monensis monensis*	CH	NE
Hawksbill Sea Turtle	*Eretmochelys imbricata*	CH	NE
Birds			
Yellow-shouldered Blackbird	*Agelaius xanthomus*	CH	NE
Elfin-woods Warbler	*Setophaga angelae*	CH	NE
Insects			
Puerto Rico Harlequin Butterfly	*Atlantea tulita*	PCH	NE
Plants			
No common name	*Gonocalyx concolor*	CH	NE
No common name	*Varronia rupicola*	CH	NE

†CH=Critical Habitat; PCH=Proposed Critical Habitat
‡NE=No Effect; No adverse modification

Table C.3 – Species listed as Critically Endangered, Endangered, or Vulnerable in Puerto Rico by the DNER.

VERTEBRATES

AMPHIBIANS

Common Name	*Scientific Name*	Status
Puerto Rican Rock Frog	*Eleutherodactylus cooki*	VU
Mottled Coquí	*Eleutherodactylus eneidae*	CR
Golden Coquí	*Eleutherodactylus jasperi*	CR
Coquí Llanero	*Eleutherodactylus juanariveroi*	CR
Web-footed Coquí	*Eleutherodactylus karlschmidti*	CR
Locust Coquí	*Eleutherodactylus locustus*	VU
Forest Coquí	*Eleutherodactylus portoricensis*	VU
Bronze Coquí	*Eleutherodactylus richmondi*	VU
Puerto Rican Crested Toad	*Peltophryne lemur*	EN

BIRDS

Common Name	*Scientific Name*	Status
Puerto Rican Sharp-shinned Hawk	*Accipiter striatus venator*	CR
Yellow-shouldered Blackbird	*Agelaius xanthomus*	EN
Puerto Rican Parrot	*Amazona vittata vittata*	CR
White-cheeked Pintail	*Anas bahamensis*	VU
Puerto Rican Broad-winged Hawk	*Buteo platypterus brunnescens*	CR
Puerto Rican Nightjar	*Caprimulgus noctitherus*	EN
Snowy Plover	*Charadrius alexandrines*	CR
Wilson's Plover	*Charadrius wilsonia*	VU

White-necked Crow	*Corvus leucognaphalus*	Extirpated[1]
Black Swift	*Cypseloides niger*	VU
West Indian Whistling Duck	*Dendrocygna arborea*	CR
Magnificent Frigatebird	*Fregata magnificens*	VU
Caribbean Coot	*Fulica caribaea*	VU
American Oystercatcher	*Haematopus palliates*	VU
Masked Duck	*Nomonix dominica*	EN
Ruddy Duck	*Oxyura jamaicensis*	VU
Puerto Rican Plain Pigeon	*Patagioenas inornata wetmorei*[2]	EN
Brown Pelican	*Pelicanus occidentalis*	EN
Red-billed Tropicbird	*Phaethon aethereus*	VU
White-tailed Tropicbird	*Phaethon lepturus*	VU
Audubon's Shearwater	*Puffinus lherminieri*	VU
Elfin-woods Warbler	*Setophaga angelae*	EN
Yellow Warbler	*Setophaga petechial*	VU
Least Tern	*Sterna antillarum*	VU
Roseate Tern	*Sterna dougallii dougallii*	VU
Masked Booby	*Sula dactylatra*	VU
Red-footed Booby	*Sula sula*	VU
Puerto Rican Vireo	*Vireo latimeri*	VU

FISH

Common Name	***Scientific Name***	**Status**
Jewfish	*Epinephelus itajara*	CR
Nassau Grouper	*Epinephelus striatus*	EN
Nurse Shark	*Ginglymostoma cirratum*	VU
Seahorses	*Hippocampus spp.*	VU
Midnight Parrotfish	*Scarus coelestinus*	VU
Blue Parrotfish	*Scarus coeruleus*	VU
Rainbow Parrotfish	*Scarus guacamaia*	VU

MAMMALS

Common Name	***Scientific Name***	**Status**
Brown Flower Bat	*Erophylla bombifrons*	VU
Humpback Whale	*Megaptera novaeangliae*	EN
Red Fig-eating Bat	*Stenoderma rufum*	VU
Antillean Manatee	*Trichechus manatus*[3]	EN

REPTILES

Common Name	***Scientific Name***	**Status**
Cook's Anole	*Anolis cooki*	EN
Ponce Small-fanned Anole	*Anolis poncensis*	VU
Culebra Giant Anole	*Anolis roosevelti*	CR
Green Sea Turtle	*Chelonia mydas*	EN
Virgin Islands Tree Boa	*Chilabothrus granti*	CR
Mona Ground Iguana	*Cyclura stejnegeri*	EN
Leatherback Sea Turtle	*Dermochelys coriacea*	EN

Puerto Rican Boa	*Epicrates inornatus*[4]	VU
Mona Boa	*Epicrates monensis monensis*[5]	VU
Hawksbill Sea Turtle	*Eretmochelys imbricata*	EN
Puerto Rican Skink	*Spondylurus nitidus*[6]	VU
Monito Gecko	*Sphaerodactylus micropithecus*	CR

INVERTEBRATES

CORALS

Common Name	***Scientific Name***	**Status**
Staghorn Coral	*Acropora cervicornis*	VU
Elkhorn Coral	*Acropora palmata*	VU
Pillar Coral	*Dendrogyra cylindrus*	VU
Rough Cactus Coral	*Mycetophyllia ferox*	VU
Lobed Star Coral	*Orbicella annularis*	VU
Mountainous Star Coral	*Orbicella faveolata*	VU
Boulder Star Coral	*Orbicella franksi*	VU

CRUSTACEANS

Common Name	***Scientific Name***	**Status**
Blind Amphipod/Fresh Water Cave Shrimp	*Alloweckellia gurnee*	CR
Purple Land Crab	*Gecarcinus ruricola*	VU
Green Lobster	*Panulirus laevicauda*	VU
Mona's Cave Shrimp	*Typhlatya monae*	CR

ECHINODERMS

Common Name	***Scientific Name***	**Status**
West Indian Sea Cucumber	*Actinopyga agassizi*	VU
Furry Sea Cucumber	*Astichopus multifidis*	VU
Three-rowed Sea Cucumber	*Isostichopus badionotus*	VU

INSECTS

Common Name	***Scientific Name***	**Status**
Puerto Rican Harlequin Butterfly	*Atlantea tulita*	CR

MOLLUSKS

Common Name	***Scientific Name***	**Status**
West Indian Topshell	*Cittarium pica*	VU

PLANTS

Common Name	***Scientific Name***	**Status**
Puerto Rico Maidenhair	*Adiantum vivesii*	CR
Fern Dwarf Forest	*Alsophyla amintae*	EN
No common name	*Aristida chaseae*	EN
Pelos del Diablo	*Aristida portoricensis*	EN
No common name	*Auerodendron pauciflorum*	CR

Palo de Ramón	*Banara vanderbiltii*	CR
No common name	*Bonellia pauciflora*	CR
Vahl's Boxwood	*Buxus vahlii*	EN
Capa Rosa	*Callicarpa ampla*	CR
No common name	*Calyptranthes estremerae*	EN
Palma de Manaca	*Calyptronoma rivalis*	EN
No common name	*Calytranthes acevedoi*	EN
No common name	*Catesbaea melanocarpa*	CR
Tamarindillo	*Chamaecrista glandulosa var. mirabilis*	CR
No common name	*Chromolaena borinquensis*	EN
Palo de Nigua	*Cornutia obovata*	CR
No common name	*Cranichis ricartii*	CR
Higuero de Sierra	*Crescentia portoricensis*	CR
No common name	*Daphnopsis hellerana*	EN
No common name	*Elaphoglossum serpens*	CR
No common name	*Eugenia fajardensis*	CR
Uvillo	*Eugenia haematocarpa*	EN
No common name	*Eugenia woodburyana*	EN
Palma de Lluvia	*Gaussia attenuata*	EN
No common name	*Gesneria pauciflora*	VU
Beautiful Goetzea	*Goetzea elegans*	EN
No common name	*Gonocalyx concolor*	CR
Higo Chumbo	*Harrisia portoricensis*	EN
Cook's Holly	*Ilex cooki*	CR
No common name	*Ilex sintenisi*	EN
West Indian Walnut	*Juglans jamaicensis*	CR
No common name	*Lepanthes eltoroensis*	VU
No common name	*Leptocereus grantianus*	CR
No common name	*Lyonia truncata var. proctorii*	CR
No common name	*Marsdenia woodburyana*	EN
No common name	*Mitracarpus maxwelliae*	EN
No common name	*Mitracarpus polycladus*	EN
Ausú	*Myrcia paganii*	CR
Palo de Rosa	*Ottoschulzia rhodoxylon*	CR
Wheeler's Peperomia	*Peperomia wheeleri*	EN
Chupacallos	*Pleodendron macranthum*	CR
No common name	*Polystichum calderonense*	CR
No common name	*Pseudophoenix sargentii*	EN
Palma de Sombrero	*Sabal causiarum*	EN
Araña	*Schoepfia arenaria*	EN
Erubia	*Solanum ensifolium*	EN
Cobana Negra	*Stahlia monosperma*	CR
Quina	*Stenostomun sintenisii*	EN
Palo de Jazmin	*Styrax portoricensis*	CR
No common name	*Tectaria estremerana*	CR
Palo Colorado	*Ternstroemia luquillensis*	CR
No common name	*Ternstroemia subsessilis*	CR

No common name	*Thelypteris inabonensis*	CR
No common name	*Thelypteris verecunda*	CR
No common name	*Thelypteris yaucoensis*	CR
Bariaco	*Trichilia triacantha*	CR
No common name	*Varronia bellonis*	EN
No common name	*Varronia rupicola*	VU
No common name	*Vernonia proctorii*	CR
No common name	*Xylosma pachyphyllum*	CR
St. Thomas Prickly-ash	*Zanthoxylum thomasianum*	EN

List Abbreviations

CR = Commonwealth-designated Critically Endangered Species
EN = Commonwealth-designated Endangered Species
VU = Commonwealth-designated Vulnerable Species

List Notations

[1] Historically found in Puerto Rico, but no longer present (though populations remain elsewhere in Caribbean)
[2] Originally listed as *Columba inornata wetmorei*
[3] Federal listing includes Caribbean and South America's manatees
[4] Listed as *Chilobotrus inornatus* in SWAP
[5] Listed as *Chilobotrus monensis* by SWAP
[6] Listed as *Mabuya sloanii* in SWAP

Note:
The DNER adapted the following categories from the International Union for the Conservation of Nature Red List in order to classify T&E species (DNER 2015).

- Critically Endangered (CR): A Critically Endangered species faces an extremely high risk of extinction in the wild in the immediate future.
- Endangered (EN): A species is considered Endangered when it is not CR, but faces a very high risk of extinction in the wild in the near future.
- Vulnerable (VU): A species is considered Vulnerable when it is not CR or EN, but it faces a high risk of extinction in the wild in a foreseeable future.