ENVIRONMENTAL ASSESSMENT

MAMMAL DAMAGE MANAGEMENT IN SOUTH CAROLINA

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)
ANIMAL AND PLANT HEALTH INSPECTION SERVICE (APHIS)
WILDLIFE SERVICES (WS)

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TABLE OF CONTENTS

ACRONYMS iii

CHAPTER 1: PURPOSE AND NEED FOR ACTION
1.1 PURPOSE 1
1.2 NEED FOR ACTION 2
1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT 16
1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS 19
1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES 19
1.6 COMPLIANCE WITH LAWS AND STATUTES 20
1.7 DECISIONS TO BE MADE 24

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES
2.1 AFFECTED ENVIRONMENT 25
2.2 ISSUES ASSOCIATED WITH MAMMAL DAMAGE MANAGEMENT ACTIVITIES 26
2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE 32

CHAPTER 3: ALTERNATIVES
3.1 DESCRIPTION OF THE ALTERNATIVES 37
3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL 46
3.3 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT .. 51
3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES 52

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES
4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL 55
4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE 118

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED
5.1 LIST OF PREPARERS/REVIEWERS 125
5.2 LIST OF PERSONS CONSULTED 125

LIST OF APPENDICES:

APPENDIX A – LITERATURE CITED A-1
APPENDIX B – METHODS AVAILABLE FOR RESOLVING OR PREVENTING MAMMAL DAMAGE IN SOUTH CAROLINA B-1
APPENDIX C – STATE LISTED THREATENED AND ENDANGERED SPECIES C-1

ACRONYMS

AMDUCA	Animal Medicinal Drug Use Clarification Act
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CUDPR	Clemson University Department of Pesticide Regulation
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLIR	Forward Looking Infrared
FY	Fiscal Year
GnRH	Gonadotropin-releasing Hormone
IC	Intracardiac
IV	Intravenous
MOU	Memorandum of Understanding
MRLC	Multi-Resolution Land Characteristics
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLCD	National Land Cover Dataset
NWRC	National Wildlife Research Center
ORV	Oral Rabies Vaccination
PEP	Post - Exposure Prophylaxis
PL	Public Law
SCDA	South Carolina Department of Agriculture
SCDNR	South Carolina Department of Natural Resources
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TNR	Trap, Neuter, Release Program
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Services
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in South Carolina continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with muskrats (*Ondatra zibethicus*), woodchucks (*Marmota monax*), gray squirrels (*Sciurus carolinensus*), raccoons (*Procyon lotor*), river otters (*Lontra canadensis*), coyotes (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), bobcats (*Lynx rufus*), feral cats (*Felis domesticus*), feral dogs (*Canis familiaris*), Virginia opossum (*Didelphis virginiana*), nine-banded armadillo (*Dasypus novemcinctus*), and white-tailed deer (*Odocoileus virginianus*). In addition, WS could occasional receive requests for assistance with feral or free-ranging non-native mammals[2].

Individual damage management projects conducted by the WS program could be categorically excluded from further analysis under the National Environmental Policy Act (NEPA), in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c), 60 FR 6000-6003). The purpose of this Environmental Assessment (EA) is to evaluate cumulatively the individual damage management projects that WS could conduct to manage damage and threats to agricultural resources, property, natural resources, and threats to people caused by those mammal species identified previously. This EA will assist in determining if the proposed cumulative management of mammal damage could have a significant impact on the environment based on previous activities conducted by WS and based on the anticipation of conducting additional efforts to manage damage caused by those species. Because the goal of WS would be to conduct a coordinated program to alleviate mammal damage in accordance with plans, goals, and objectives developed to reduce damage, and because the program's goals and directives[3] would be to provide assistance when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and the analyses would apply to actions that may occur in any locale and at any time within South Carolina as part of a coordinated program.

This EA analyzes the potential effects of mammal damage management when requested, as coordinated between WS and the South Carolina Department of Natural Resources (SCDNR). In addition to those species listed previously, WS also receives requests to address damage and threats of damage associated with beaver (*Castor canadensis*) and feral swine (*Sus scrofa*). Activities conducted by WS to alleviate damage or threats of damage associated with beaver and feral swine were evaluated in separate EAs (USDA 2002, USDA 2013).

WS is preparing this EA to: 1) facilitate planning, 2) promote interagency coordination, 3) streamline program management, 4) clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities, and 5) 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, published documents (see Appendix A), interagency consultations, and public involvement.

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[1]The WS program is authorized to protect agriculture and other resources from damage caused by wildlife through the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c).

[2]See further discussion in Chapter 4, Section 4.1.

[3]At the time of preparation, WS' Directives occurred at the following web address: http://www.aphis.usda.gov/wildlife_damage/ws_directives.shtml.

The EA evaluates the need for action to manage damage associated with mammals in the State, the potential issues associated with managing damage, and the environmental consequences of conducting different alternatives to meet the need for action while addressing the identified issues. WS initially developed the issues and alternatives associated with managing damage caused by mammals in consultation with the SCDNR and the South Carolina Department of Agriculture (SCDA). To assist with identifying additional issues and alternatives to managing damage associated with mammals in South Carolina, WS will make this EA available to the public for review and comment prior to the issuance of a Decision[4].

WS previously developed an EA that addressed WS' activities to manage damage associated with white-tailed deer in the State. Based on the analyses in that EA, a Decision and Finding of No Significant Impact was signed selecting the proposed action alternative. The proposed action alternative implemented a damage management program using a variety of methods in an integrated approach. This EA will: (1) assist in determining if the proposed management of damage associated with mammals, including white-tailed deer, could have a significant impact on the environment for both people and other organisms, (2) analyze several alternatives to address the need for action and the identified issues, (3) coordinate efforts between WS and the SCDNR, (4) inform the public, and (5) document the environmental consequences of the alternatives to comply with the NEPA. Since activities conducted under the previous EA to manage damage caused by white-tailed deer will be re-evaluated under this EA to address the new need for action and the associated affected environment, the previous EA that addresses deer damage management will be superseded by this analysis and the outcome of the Decision issued for this EA.

1.2 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between people and wildlife. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety.

Wildlife can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard wildlife as providing economic, recreational, and aesthetic benefits. Knowing that wildlife exists in the natural environment provides a positive benefit to some people. However, activities associated with wildlife may result in economic losses to agricultural resources, natural resources, property, and threaten human safety. Therefore, an awareness of the varying perspectives and values are required to balance the needs of people and the needs of wildlife. When addressing damage or threats of damage caused by wildlife, wildlife damage management professionals must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well.

Resolving wildlife damage problems 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

[4]After the development of the EA by WS and after public involvement with identifying new issues and alternatives, WS will issue a Decision. Based on the analyses in the EA after public involvement, WS will make a decision to publish a Notice of Intent to prepare an Environmental Impact Statement or WS will issue a Finding of No Significant Impact notice to the public in accordance to the NEPA and the Council of Environmental Quality regulations.

wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define 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. 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.

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, The Wildlife Society 2010). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. Those animals have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter) where they can find a niche. If their activities result in lost economic 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 with resolving damage or reducing threats to human safety. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage 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 wildlife 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 aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with mammals in South Carolina arises from requests for assistance[5] received by WS. WS receives requests to reduce or prevent damage from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. WS has identified those mammal species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. Table 1.1 lists WS' technical assistance projects involving mammal damage or threats of damage to those four major resource types in South Carolina from the federal fiscal year[6] (FY) 2009 through FY 2014.

Technical assistance provides information and recommendations on activities to alleviate mammal damage that the requester could conduct without WS' direct involvement in managing or preventing the damage. This EA discusses technical assistance activities further in Chapter 3. Table 1.1 does not include direct operational assistance projects conducted by WS where a person requested WS' assistance through the direct application of methods.

The technical assistance projects conducted by WS are representative of the mammal species that cause damage and threats in South Carolina. As shown in Table 1.1, WS has conducted 43 technical assistance

[5] WS would only conduct mammal damage management after receiving a request for assistance. Before initiating damage management activities, WS and the cooperating entity would sign a Memorandum of Understanding, work initiation document, or other comparable document that would list all the methods the property owner or manager would allow WS to use on property they owned and/or managed.

[6] The federal fiscal year begins on October 1 and ends on September 30 the following year.

projects in South Carolina that addressed damage and threats associated with those mammal species addressed in this assessment from FY 2009 through FY 2014.

Table 1.1 – Technical assistance projects conducted by WS from FY 2009 through FY 2014

Species	Projects	Species	Projects
Muskrats	1	**Gray Fox**	0
Gray Squirrel	3	**Red Fox**	1
Raccoon	7	**Bobcat**	0
River Otter	4	**Feral Cat**	0
Coyote	17	**Feral Dog**	0
Virginia Opossum	0	**Nine-banded Armadillo**	0
Woodchuck	0	**White-tailed Deer**	10

Table 1.2 lists those mammal species addressed in this EA and the resource types that those mammal species can cause damage to in South Carolina. Many of the mammal species can cause damage to or pose threats to a variety of resources. In South Carolina, most requests for assistance received by WS are related to threats associated with those mammal species causing damage or posing threats of damage to property, agriculture, and human safety.

Table 1.2 – Mammal species that WS could address and the resource type damaged by those species

	Resource[a]					Resource			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Muskrat	X	X	X	X	**Gray Fox**	X	X	X	X
Gray Squirrel			X		**Red Fox**	X	X	X	X
Raccoon	X	X	X	X	**Bobcat**	X	X		X
River Otter	X	X			**Feral Cat**	X	X	X	X
Coyote	X	X	X	X	**Feral Dog**	X	X	X	X
Virginia Opossum	X	X	X	X	**Nine-banded Armadillo**	X	X	X	X
Woodchuck	X		X	X	**White-tailed Deer**	X	X	X	X

[a]A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

More specific information regarding mammal damage to those main categories are discussed in the following subsections of the EA:

Need for Mammal Damage Management to Protect Human Health and Safety

Zoonoses (*i.e.*, diseases of animals that are transmissible to people) are often a major concern of cooperators when requesting assistance with managing threats from mammals. Disease transmission could occur from direct interactions between people and mammals or from interactions with pets and livestock that have direct contact with wild mammals. Pets and livestock often encounter and interact with wild mammals, which can increase the opportunity of transmission of disease to people. Table 1.3 shows common diseases that could affect people that wild mammals can transmit in addition to diseases that could affect other animals, including domestic species. Those threats include viral, bacterial, mycotic (fungal), protozoal, and rickettsial diseases.

Individuals or property owners that request assistance with mammals frequently are concerned about potential disease risks but are unaware of the types of diseases that can be transmitted by those animals. In those types of situations, assistance is requested because of a perceived risk to human health or safety associated with wild animals living in close association with people, from animals acting out of character

by roving in human-inhabited areas during daylight, or from animals showing no fear when people are present. Under the proposed action, WS could assist in resolving those types of requests for assistance.

Table 1.3 - Wildlife diseases in the Eastern United States that pose potential health risks through transmission to people (Beran 1994, Davidson 2006)[†]

Disease	Causative Agent	Hosts[‡]	Human Exposure
Anthrax	*Bacillus antracis*	cats, dogs	inhalation, ingestion
Tetanus	*Clostridium tetani*	mammals	direct contact
Dermatophilosis	*Dermatophilus congolensis*	mammals	direct contact
Leprosy	*Mycobacterium leprae*	armadillo	inhalation, direct contact
Pasteurellaceae	*Haemophilus influenzae*	mammals	bite or scratch
Salmonellosis	*Salmonella* spp.	mammals	ingestion
Yersinosis	*Yersinia* spp.	cats	ingestion
Chlamydioses	*Chlamydophilia felis*	cats	inhalation, direct contact
Typhus	*Rickettsia prowazekii*	opossums	inhalation, ticks, fleas
Sarcoptic mange	*Sarcoptes scabiei*	red fox, coyotes, dogs	direct contact
Trichinosis	*Trichinella spiralis*	raccoons, fox	ingestion, direct contact
Rabies	*Lyssavirus* spp.	mammals	direct contact
Visceral larval	*Baylisascaris procyonis*	raccoons, skunks	ingestion, direct contact
Leptospirosis	*Leptospira interrogans*	mammals	ingestion, direct contact
Echinococcus	*Echinococcus multilocularis*	fox, coyotes	ingestion, direct contact
Toxoplasmosis	*Toxoplasma ondii*	cats, mammals	ingestion, direct contact
Spirometra	*Spirometra mansonoides*	bobcats, raccoons, fox	ingestion, direct contact
Giardiasis	*Giardia lamblia, G. duodenalis*	mammals	ingestion, direct contact

[†]Table 1.3 is not an exhaustive list of wildlife diseases considered infectious to people. The zoonoses provided are the more common infectious diseases for the species addressed in this EA and are only a representation of the approximately 100 to 3,000 zoonoses known to exist.

[‡] The host species provided for each zoonosis includes only those mammalian species addressed in this EA unless the zoonoses listed potentially infects a broad range of mammalian wildlife. The use of the general term "*mammals*" as the host species denotes zoonoses that could infect a broad range of mammals. The diseases listed do not necessarily infect only those mammalian species covered under this EA but likely infect several species of mammals or groups of mammals. For a complete discussion of the more prevalent diseases in free-ranging mammals, please refer to Beran (1994) and Davidson (2006).

In many circumstances when human health concerns are the primary reason for requesting WS' assistance there may have been no actual cases of transmission of disease to people by mammals. Thus, the risk of disease transmission would be the primary reason for requesting assistance from WS. Situations in South Carolina where the threat of disease associated with wild or feral mammal populations may include:

- Exposure of residents to the threat of rabies due to high densities of raccoons or from companion animals encountering infected raccoons.
- Exposure of people to the threat of rabies posed by skunks that den under buildings or from companion animals interacting with infected skunks.
- Threats of parasitic infections to people from *Giardia* spp. that could occur from high feral cat populations in a park or recreation area.
- Accumulated droppings from denning or foraging raccoons and the subsequent exposure of the public to raccoon roundworm in fecal deposits.

The most common disease concern expressed by individuals requesting assistance is the threat of rabies transmission to people, pets, and livestock. 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 to 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. The vast majority of rabies cases reported to the Centers for Disease Control and Prevention (CDC) each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order Chiroptera) (CDC 2011).

Over the last 100 years, the vector of rabies in the United States has changed dramatically. About 90% or greater of all animal cases reported annually to CDC now occur in wildlife (Krebs et al. 2000, CDC 2011). Before 1960, the majority of cases the CDC received occurred in domestic animals. The principal rabies hosts today are wild carnivores and bats. 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. 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 2011). 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, exceeding $300 million annually. 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 2011).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the United States each year is unknown, it has been estimated to be as high as 40,000. 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 five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2011) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in wildlife populations, the risk of 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 people (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 during 1994 in Concord, New Hampshire when a kitten from a pet store 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 $1.1 million (Noah et al. 1995). The American Veterinary Medical Association (AVMA) estimated the total cost for this specific incident, including investigation, laboratory testing, and rabies immunoglobulin and vaccines was more than $1.5 million (AVMA 2004).

Raccoons have been associated with the spread of rabies throughout the eastern United States. Rabies in raccoons was virtually unknown prior to the 1950s. It was first described in Florida and spread slowly during the next three decades into Georgia, Alabama, and South Carolina. It was unintentionally introduced into the Mid-Atlantic States, probably by translocation of infected animals (Krebs et al. 1998). The first cases appeared in West Virginia and Virginia in 1977 and 1978, respectively. Since then, the raccoon variant of rabies expanded to form the most intensive rabies outbreak in the United States. The variant is now enzootic in all of the eastern coastal states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and most recently, parts of Ohio (Krebs et al. 2000). The raccoon rabies epizootic front reached Maine in 1994, reflecting a movement rate of about 30 to 35 miles per year. The westward movement of the raccoon rabies front has slowed, probably in response to both natural geographic and man-made barriers. The Appalachian Mountains and perhaps river systems flowing eastward have helped confine the raccoon variant to the eastern United States. In addition, the USDA has created an oral rabies

vaccine (ORV) "*barrier*" of vaccinated wild animals on the western edge of the Appalachian Mountains (USDA 2010*a*). If this combined barrier were breached by raccoon variant rabies, research suggests that raccoon populations would be sufficient for rabies to spread westward at a rate similar to or greater than the rate at which this rabies strain has spread in the eastern United States (Sanderson and Huber 1982, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999).

The raccoon variant of rabies presents a human health threat through potential direct exposure to rabid raccoons, or indirectly through the exposure of pets that have an encounter with rabid raccoons. Additionally, the number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested, and the number of post exposure treatments are all higher when raccoon rabies is present in an area. Human and financial resources allocated to rabies-related human and animal health needs also increase, often at the expense of other important activities and services.

Skunks are also an important wildlife host for the rabies virus in North America and are second only to raccoons in being the most commonly reported rabid wildlife species in the United States (Majumdar et al. 2005). The skunk variant of rabies occurs in the Midwest and California; however, different variants of rabies can infect skunks throughout North America, such as the raccoon variant. The distribution of rabies in skunks extends from Georgia to Maine east of the Appalachians, Texas to the Canadian border, and throughout the northern two thirds of California (Majumdar et al. 2005). The fox is one of the four major maintenance hosts for rabies in North America. In the 1950s, rabies in red fox spread throughout Canada, parts of New England, and Alaska. The range has since decreased, but fox rabies persists in Alaska and parts of Texas. Clinical signs of rabies in fox often manifest as the "*furious*" form of rabies (Majumdar et al. 2005).

Majumdar et al. (2005) implicated increasing populations of raccoons in certain areas to outbreaks of distemper. Distemper has not been identified as transmissible to people. However, people who feel threatened by the possibility of disease transmission often request assistance after observing sick raccoons on their property. Symptoms of distemper often lead to abnormal behavior in raccoons that are similar to symptoms associated with rabies. Raccoons with distemper often lose their fear of people and can act aggressively, which increases the risk to people, livestock, or companion animals from bites. Distemper can also occur in coyotes, red fox, and gray fox with symptoms that are similar to those symptoms exhibited by animals infected with the rabies virus.

Diseases and parasites affecting feral cats and dogs can have particularly serious implications to human health given the close association of those animals with people and companion animals. The topic of feral animals and their impacts on native wildlife and human health elicits a strong response in numerous professional and societal groups with an interest in the topic. Feral cats and dogs are considered by most professional wildlife groups to be non-native species that have detrimental effects to the native ecosystems, especially in the presence of a human altered landscape. However, a segment of society views feral animals to be an extension of companion animals that should be cared for and for which affection bonds are often developed, especially when societal groups feed and care for individual feral 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 freely or unrestrained 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. Those zoonoses 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 also are likely to affect multiple people if disease transmission occurs since those animals are likely to come in direct contact with several members of families and friends before diagnosis of a disease occurs.

Several known diseases that are infectious to people, including rabies, have been found in feral cats and dogs. A common zoonosis found in cats is ringworm. Ringworm (*Tinea* spp.) is a contagious fungal disease contracted through direct interactions with an infected person, animal, or soil. Other common zoonoses of cats are pasteurella, salmonella, cat scratch disease, and numerous parasitic diseases, including roundworms, tapeworms, and toxoplasmosis.

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 are 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 (AVMA 2004). In 1994, five children in Florida were hospitalized with encephalitis that was associated with cat scratch fever (AVMA 2004). In another example, the 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. The fleas at the facility originated from a feral cat colony that had grown from 100 cats to over 1,000, despite a trap, neuter, and release effort (AVMA 2004).

A study in France determined that stray cats serve as major reservoirs for the bacterium *Bartonella* spp. Consequently, stray cats and their fleas (*Ctenocephalides felis*) are the only known vectors for infecting house bound cats and people with this bacterium. People are not infected via the flea, but pet cats often are infected by fleabites. Human infections that may result from exposure of this bacterium via stray cats include cat scratch disease in immunocompetent patients, bacillary angiomatosis, hepatic peliosis in immunocompromised patients, endocarditis, bacteremia, osteolytic lesions, pulmonary nodules, neuroretinitis, and neurologic diseases (Heller et al. 1997). In areas where dog rabies has been eliminated, but rabies in wildlife has not, cats often are the primary animal transmitting rabies to people (Vaughn 1976, Eng and Fishbein 1990, Krebs et al. 1998).

The intention of this brief discussion on zoonoses is to address the more commonly known zoonoses found in the United States for those species specifically addressed in this EA and is not an exhaustive discussion of all potential zoonoses. Limited information and understanding of disease transmission from wildlife to people exists for most infectious zoonoses. In most cases, when human exposure occurs, the presence of a disease vector across a broad range of naturally occurring sources, including occurring in wildlife populations, can complicate determining the origin of the vector. For example, a person with salmonella poisoning may have contracted salmonella bacterium from direct contact with an infected pet but also may have 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 people fearful of exposure requesting assistance since disease transmission could occur. WS actively attempts to educate the public about the risks associated with disease transmission from wildlife to people through technical assistance and by providing technical leaflets on the risks of exposure.

In addition to disease transmission threats, WS also receives requests for assistance from perceived threats of physical harm from wildlife, especially from predatory wildlife. Human encroachment into wildlife habitat increases the likelihood of human-wildlife interactions. Those species that people 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 increase 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 disease. Overabundant wildlife that congregate into small areas because of the unlimited amount of food, water, and shelter can confound the prevalence of diseases.

As people are increasingly living with wildlife, the lack of harassing 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 people and human activity, a loss of apprehension occurs that can lead to threatening behavior toward people. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can be in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although wildlife attacking people occurs rarely, the number of attacks appears to be on the increase. Timm et al. (2004) reported that coyotes attacking people have increased in California and the recent, highly publicized coyote attacks, including a fatal attack on a 19-year old woman in Nova Scotia (Canadian Broadcast Company 2009), have only heightened people's awareness of the threat of such encounters.

As part of the proposed program, WS could provide mammal damage management assistance, upon request, involving those mammal species addressed in this EA that pose a threat to human health and safety in South Carolina.

Disease Surveillance and Monitoring

Public awareness and the health risks associated with zoonoses have increased in recent years. This EA briefly addresses some of the more commonly known zoonotic diseases associated with mammals. Those zoonotic diseases remain a concern and continue to pose threats to human safety where people encounter mammals. WS has received requests to assist with reducing damage and threats associated with several mammal species in South Carolina and could conduct or assist with disease monitoring or surveillance activities for any of the mammal species addressed in this EA. Most disease sampling would occur ancillary to other wildlife damage management activities (*i.e.*, disease sampling would occur after wildlife have been captured or lethally removed for other purposes). For example, WS may sample deer harvested during the annual hunting season or collect samples during other damage management programs for Chronic Wasting Disease. WS could collect ticks from the carcasses of raccoons after lethally removing the raccoon to alleviate damage occurring to property.

Need for Mammal Damage Management at Airports

Airports provide ideal conditions for many wildlife species due to the large open grassy areas around runways and taxiways adjacent to brushy, forested habitat used as noise barriers. Access to most airport properties is restricted so mammal species living within airport boundaries are not harvestable during hunting and trapping seasons and insulated from many other human disturbances.

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. 2001, Dolbeer 2009). 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, Thorpe 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).

Between 1990 and 2013, there were 3,149 reported aircraft strikes involving terrestrial mammals in the United States (Dolbeer et al. 2014). The number of mammal strikes actually occurring is likely to be much greater, since Dolbeer (2009) estimated that entities reported 39% of actual civil wildlife strikes.

Aircraft have collided with a reported 42 species of terrestrial mammals from 1990 through 2013. Including, white-tailed deer, raccoons, gray fox, red fox, cats, coyotes, river otters, opossums, and striped skunks (Dolbeer et al. 2014). Of the terrestrial mammals reported struck by aircraft, 36% were carnivores (primarily coyotes), causing nearly $4.2 million in damages (Dolbeer et al. 2014). White-tailed deer accounted for 32% of the reported strikes involving terrestrial mammals in the United States causing nearly $44 million in damages (Dolbeer et al. 2014). Data also indicates that a much higher percentage of mammal strikes resulted in aircraft damage compared to bird strikes (Dolbeer et al. 2014). Costs of those collisions vary, but data from the Federal Aviation Administration (FAA) reveals that mammal strikes in the United States cost the civil aviation industry approximately 306,051 hours of down time and over $58 million in direct monetary losses between 1990 and 2013 (Dolbeer et al. 2014).

From 1990 through 2013, about 33% of terrestrial mammal strikes in the United States have resulted in damage compared to 9% for birds (Dolbeer et al. 2014). In addition to direct damage, an aircraft striking a mammal can pose serious threats to human safety if the damage from the strike causes a catastrophic failure of the aircraft leading to a crash. 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, which can increase the threat to human safety. Nearly 64% of the reported mammal strikes from 1990 through 2013 occurred at night, with 64% occurring during the landing roll or the takeoff run (Dolbeer et al. 2014).

According to reports filed with the FAA (2014), between 1990 and August 2014, aircraft have struck six coyotes, one cat, and 29 white-tailed deer in South Carolina. Airports in South Carolina have requested assistance with managing threats to human safety and damage to property caused by mammals present inside the area of operations of an airport. The infrequency of mammal strikes does not lessen the need to prevent threats to human safety and the prevention of damage to property. Preventing damage and reducing threats to human safety would be the goal of cooperators requesting assistance at airports in South Carolina given that a potential strike could lead to the loss of human life and considerable damage to property.

Wildlife populations near or found confined within perimeter fences at airports can be a threat to human safety and cause damage to property when struck by aircraft. Those wildlife confined inside an airport perimeter fence would not be considered distinct populations nor separate from those populations found outside the perimeter fence. Wildlife found within the boundaries of perimeter fences originate from populations outside the fence. Those individuals of a species inside the fence neither exhibit nor have unique characteristics from those individuals of the same species that occur outside the fence; therefore, those individuals of a species confined inside an airport perimeter fence do not warrant consideration as a unique population under this analysis.

Need for Mammal Damage Management to Alleviate Damage to Agricultural Resources

Red fox, gray fox, bobcats, coyotes, deer, woodchucks, raccoons, river otters, feral cats, feral dogs, and opossum can cause losses or injury to crops, livestock (*e.g.*, sheep, goats, cattle, pigs, horses), and poultry (*e.g.*, chickens, turkeys, geese, ducks) through consumption or predation. 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. Those losses include destruction of or damage to crops in the field and death or injury to livestock. In 2001, the National Agricultural Statistics Service (NASS) reported that raccoons were responsible for 6%, 3%, and 6% of the total damage to field crops; livestock and poultry; and vegetables, fruits, and nuts, respectively, in the United States (NASS 2002). In addition, white-tailed deer accounted for 58% of the total field crop damage and 33% of vegetable, fruit, and nut damage.

In 2010, the NASS (2011) reported cattle and calf losses from animal predation totaled 219,900 head in the United States according to livestock producers. Animal predation represented 5.5% of the total cattle and calf losses reported by livestock producers in 2010 totaling $98.5 million in economic losses. Agricultural producers identified coyotes as the primary predator of livestock with 53.1% of cattle and calf losses attributed to coyotes. Producers also identified livestock losses associated with bobcats and dogs. Producers spent nearly $188.5 million on non-lethal methods to reduce cattle and calf losses from predation by animals in 2010 (NASS 2011). The primary non-lethal method employed by livestock producers was the use of guard animals with a reported 36.9% of producers using guard animals. Producers also reported using exclusion fencing, frequent checking, and culling as additional employed methods for reducing predation (NASS 2011).

In South Carolina, the NASS (2011) reported 300 cattle and 1,000 calves were killed in 2010 by animal predators. The economic loss from animal predators in South Carolina was estimated at over $568,000 in 2010 (NASS 2011). Coyotes were attributed to 65.8% of the cattle losses and 80.2% of the calves lost in South Carolina. Dogs accounted for 6.3% of the cattle reported lost while 5.0% of the calves lost were attributed to dogs in the State (NASS 2011). Cattle producers in South Carolina reported using a number of non-lethal methods to reduce losses due to predators. The use of exclusion fencing was reported as being employed by 65.7% of South Carolina cattle producers along with 16.5% reporting the use of guard animals (NASS 2011).

The NASS (2011) reported that 0.5% of the calves lost to animal predator were attributed to mountain lions and bobcat predation in South Carolina. Cattle producers in the United States indicated mountain lions and bobcats[7] caused 7.8% of the cattle and calf losses attributed to animal predators in 2010 (NASS 2011). Bobcats can also prey on other livestock.

Woodchucks (commonly referred to as groundhogs) can cause damage to field crops, such as row and forage crops, orchards, nursery plants, and commercial gardens. Cottontail rabbits and voles are reported to damage orchard trees by gnawing at the base of the tree. Trees can be badly damaged when the bark is girdled, which may occur when feeding by rabbits and voles is severe. Similar damage can occur in nurseries that grow landscape ornamentals and shrubs.

River otters and, to a lesser extent raccoons, may prey on fish and other cultured species at hatcheries and aquaculture facilities (Bevan et al. 2002). River otters may even prey on fish in marine aquaculture facilities (Goldburg et al. 2001).

The domestic cat has been found to transmit *Toxoplasma gondii* to both domestic and wild animal species. Cats have been found to be important reservoirs and the only species known to allow for the completion of the life cycle for the protozoan parasite *T. gondii* (Dubey 1973). 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 and 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 and the major reservoir for this disease. The main sources for infecting cats are thought to be birds and mice.

Diseases that may be communicable from feral cats to companion cats include feline panleukopenia infection, feline calicivirus infection, feline reovirus infection, and feline syncytium-forming virus

[7]The 2011 NASS cattle loss report groups mountain lion and bobcat predation into one category and does not separate losses attributed to the two species. Mountain lions, given their preference for larger prey, are likely the cause of most of the losses attributed to this category, especially to adult cattle. However, bobcats are known to prey upon calves though infrequently.

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. Feline panleukopenia infection is cyclic in nature, being more prevalent in the July to September period.

Muskrats eat a variety of natural emergent vegetation (Perry 1982, Linzey 1998) and cultivated crops (Perry 1982). Some of the cultivated crops eaten by muskrats include corn, alfalfa, carrots, rice, and soybeans (Perry 1982).

Examples of some of the requests for assistance to resolve or alleviate damage to agricultural resources that the WS' program in South Carolina has responded to include:

- Coyotes attacking and killing calves, lambs, and chickens
- Raccoons digging up grass and sod while foraging for insects
- Gray squirrels feeding on strawberries, peaches, and pecans
- Gray fox killing chickens and domestic waterfowl
- Striped skunks killing chickens

Need for Mammal Damage Management to Resolve Damage Occurring to Natural Resources

Natural resources can be those assets belonging to the public that government agencies, as representatives of the people, often manage and hold in trust. Such resources may be plants or animals, including threatened and endangered (T&E) species, historic properties, or habitats in general. Examples of natural resources in South Carolina are historic structures and places; parks and recreational areas; natural areas, including unique habitats or topographic features; threatened or endangered plants and animals; and any plant or animal populations that the public has identified as a natural resource.

Mammals can also cause damage to natural resources. Mammals causing damage are often locally overabundant at the damage site and threaten the welfare of another species' population. An example of this would be nest predation of a local ground-nesting bird population by mammalian predators, such as raccoons, opossum, armadillos, feral cats, coyotes, or fox.

Raccoons, coyotes, fox, and armadillos can predate the eggs and hatchlings of sea turtles, as well as, adult sea turtles. Besides direct predation, those predators can also expose turtle nests to the elements and to predation by crabs, birds, and other mammals. Several species of sea turtles can nest along the beaches of the State, including loggerheads (*Caretta caretta*), green turtles (*Chelonia mydas*), leatherbacks (*Dermochelys coriacea*), and Kemp's Ridley (*Lepidochelys kempii*) sea turtles (Seaturtle.org 2015). The recovery plan for the loggerhead sea turtle lists the following recovery goal: "*Reduce the annual rate of mammalian predation to at or below 10% of nests….using ecologically sound predator control programs*". In addition, the recovery plan states, "*individual problem animals can be targeted and removed without negatively affecting the local populations of native species*" (National Marine Fisheries Service and United States Fish and Wildlife Service 2008). Some beaches in South Carolina have reported high predation rate on sea turtle nests with raccoons, fox, and coyotes being the major nest predators in the State (Seaturtle.org 2015). Several studies have documented the effectiveness of predator management in turtle nesting areas (Stancyk 1982, Garmestani and Percival 2005, Engeman et al. 2010). WS could receive requests for assistance to conduct predator management at sea turtle nesting colonies in order to meet the 10% predation tolerance listed in the recovery plan for loggerhead sea turtles.

Nationwide, scientists estimate that cats kill hundreds of millions of birds and more than a billion small mammals, such as rabbits, squirrels, and chipmunks, each year. Feral and free-ranging cats are known to

prey on birds as large as mallard ducks (Figley and VanDruff 1982) and young brown pelicans (Anderson et al. 1989) along with mammals as large as hares and rabbits. Langham (1990) found that mammals made up 74% of a feral cats diet in the farmlands of New Zealand, while 24% were birds. The American Bird Conservancy (2011) stated that "*cats often kill common* [bird] *species such as cardinals, blue jays, and house wrens, as well as rare and endangered species such as piping plovers, Florida scrub-jays, and California least terns*". Some feral and free-ranging cats kill more than 100 animals each year. For example, at a wildlife experiment station, a roaming, well-fed cat killed more than 1,600 animals over 18 months, primarily small mammals (American Bird Conservancy 2011). Researchers at the University of Wisconsin coupled their four-year cat predation study with the data from other studies, and estimated that rural feral and free-ranging cats killed at least 7.8 million and perhaps as many as 217 million birds a year in Wisconsin (Coleman et al. 1997). In some parts of Wisconsin, feral and free ranging cat densities reached 114 cats per square mile, outnumbering all similarly sized native predators (Coleman et al. 1997). Churcher and Lawton (1989) observed 77 well-fed, free-ranging cats in a British village for one year and estimated that 30% to 50% of the animals caught by the cats were birds. Based on information acquired in the study, Churcher and Lawton (1989) estimated that cats killed more than 20 million birds in Britain each year with cats catching more than 70 million animals overall annually. Based on surveys conducted by Woods et al. (2003) in Great Britain, 986 free-ranging cats caught 14,370 prey items between April 1 and August 31 during 1997. During their study, Woods et al. (2003) found that free-ranging cats killed a minimum of 44 species of birds, 20 species of mammals, four species of reptiles, and 3 species of amphibian. Woods et al. (2003) then estimated that free-ranging cats killed 92 million animals across Great Britain between April 1 and August 31 during 1997.

The diet of feral and free-ranging cats varies depending on availability, abundance, and geographic location. In a survey of New Zealand scientific literature, Fitzgerald (1990) concluded that prey selection of feral and free-ranging cats was dependent on availability. Fitzgerald (1990) found that cats on the mainland of New Zealand fed most heavily on mammals while cats on the islands fed almost exclusively on birds (particularly seabirds). Liberg (1984) found that cats in southern Sweden fed predominantly on native mammals. Pearson (1971) found that cats were serious predators of California voles and that the greatest pressure on voles occurred when vole numbers were lowest.

Many cat populations rely heavily on people either for handouts and/or for garbage. A study on a southern Illinois farmstead concluded that well-fed cats preferred small rodents; however, they also consumed birds (George 1974). Small rodents may be particularly susceptible to over harvest by cats and other predators (Pearson 1964). Coman and Brunner (1972) found that small mammals were the primary food item for feral cats in Victoria, Australia. Prey selection was directly related to proximity of cats to human habitation. Pearson (1964) found rodents composed a large portion of a cat's diet. Some people view the predation of rodents by cats as beneficial, but native small mammals are important to maintaining biologically diverse ecosystems. Field mice and shrews are also important prey for birds, such as great horned owls (*Bubo virginianus*) and red-tailed hawks (*Buteo jamaicensis*).

Childs (1986) and Childs (1991) found that urban cat predation on rats was size limiting. Few rats of reproductive size or age were preyed on by domesticated cats. In rural areas, rats were more vulnerable to cat predation for longer periods. The duration of susceptibility of rats to predation was attributed to abundance of garbage and artificial food sources in the urban environment. Artificial feeding of cats also reduces predation to non-native rodents because of size differences in urban rats. In rural setting, cats can control rat populations for longer durations but ultimate suppression of population growth typically is achieved via chemicals (poisons). Jackson (1951) found that feral and free-ranging cats in urban areas of Baltimore, Maryland were insignificant predators of Norway rats. The largest percentage of ingested food was comprised of garbage. It was estimated that a cat in the study area would consume roughly 28 rats per year.

Reptiles are thought to provide an important food source to cats when birds and mammals are less abundant, and in some situations, cats have been observed preying on threatened species of reptiles. Domesticated cats have been identified as major nest and/or hatchling predators of sea turtles. A study by Seabrook (1989) on the Aldabra Atoll, Seychelles found feral cats had an adverse effect on green turtle hatchlings. Seabrook (1989) found a positive correlation in cat activity and green turtle nesting at Aldabra Atoll. Cats are known to have contributed to the near extirpation of the West Indian rock iguana (*Cyclura carinata*) on Pine Cay in the Caicos Islands (Iverson 1978).

Cats can adversely affect local wildlife populations, especially in habitat "*islands*", such as suburban and urban parks, wildlife refuges, and other areas surrounded by human development (Wilcove 1985). The loss of bird species from habitat islands is well documented and nest predation is an important cause of the decline of neotropical migrant birds (Wilcove 1985). Hawkins et al. (1999) conducted a two-year study in two parks with grassland habitat. One park had no cats but more than 25 cats were being fed daily in the other park. There were almost twice as many birds seen in the park with no cats as in the park with cats. The California thrasher (*Toxostoma redivivum*) and the California quail (*Callipepla californica*), both ground-nesting birds, were seen during surveys in the no-cat area; however, they were never seen in the cat area. In addition, more than 85% of the native deer mice and harvest mice trapped were in the no-cat area; whereas, 79% of the house mice, an exotic pest species, were trapped in the cat area. The researchers concluded, "*Cats at artificially high densities, sustained by supplemental feeding, reduce abundance of native rodent and bird populations, change the rodent species composition, and may facilitate the expansion of the house mouse into new areas*" (Hawkins et al. 1999).

Impacts from cat predation are not always direct, but may be indirect in the form of competition for food resources. George (1974) speculated that domestic cats were not a direct limiting factor on bird populations. However, the author did find evidence indicating cats indirectly could affect some birds of prey by competing for a limited resource (primarily small rodents).

Deer overabundance can affect native vegetation and natural ecosystems in addition to ornamental landscape plantings. White-tailed deer selectively forage on vegetation (Strole and Anderson 1992), and thus, can negatively affect certain herbaceous and woody species and on overall plant community structure (Waller and Alverson 1997). These changes can lead to adverse effects on other wildlife species, which depend on those plants for food and/or shelter. Numerous studies have shown that over browsing by deer can decrease tree reproduction, understory vegetation cover, plant density, and diversity (Warren 1991). By one count, deer browsing disturbed 98 species of threatened or endangered plants, many of them orchids and lilies (Ness 2003).

The alteration and degradation of habitat from over-browsing by deer can have a detrimental effect on the health of local deer populations and may displace other wildlife communities (*e.g.*, neotropical migrant songbirds and small mammals) that depend upon the understory vegetative habitat destroyed by deer browsing (Virginia Department of Game and Inland Fisheries 2007). Similarly, deCalesta (1997) reported that deer browsing affected vegetation that songbirds need for foraging, escape cover, and nesting. In certain areas, higher deer densities reduced species richness and abundance of intermediate canopy nesting songbirds (deCalesta 1997). Intermediate canopy-nesting birds declined 37% in abundance and 27% in species diversity at higher deer densities. Five species of birds disappeared from areas with densities of 38.1 deer per square mile and another two disappeared at 63.7 deer per square mile. Casey and Hein (1983) found that three species of birds no longer could be found in a research preserve stocked with high densities of ungulates and that the densities of several other bird species were lower than in an adjacent area with lower deer density. Waller and Alverson (1997) hypothesize that by competing with squirrels and other fruit-eating animals for oak mast, deer may further affect many other animal and insect species.

Muskrats are largely herbivores; however, they also eat other animals as part of their diet (Perry 1982). Schwartz and Schwartz (1959), Neves and Odom (1989), and Miller (1994) reported muskrats also ate animal matter including mussels, clams, snails, crustaceans (*e.g.*, crayfish), and young birds. Fish, frogs, and small turtles have also been reported as being consumed by muskrats. Neves and Odom (1989) reported that muskrats appeared to be inhibiting the recovery of some endangered mussel species, and they were likely placing pigtoe mussels in further jeopardy along the Clinch and Holston Rivers in Virginia. Muskrats can negatively affect native vegetation. When muskrats become over-populated an "*eat-out*" may occur which denudes large areas of aquatic vegetation. Those events may result in the feeding area being unsuitable for other wildlife species for a number of years (O'Neil 1949). The loss of vegetation removes food and cover for muskrats and other wildlife. Marsh damage from muskrats is inevitable when areas heavily populated by muskrats are under-trapped (Lynch et al. 1947). While overgrazing of vegetation can be beneficial to some bird species, it can also result in stagnant water, which predisposes the same birds to diseases (Lynch et al. 1947).

WS has received numerous requests in the past for assistance in resolving mammal damage and conflicts caused to natural resources. As part of the proposed program, WS could provide assistance, upon request, involving target mammal species to any requester experiencing such damage throughout South Carolina.

Need for Mammal Damage Management to Alleviate Property Damage

Mammals cause damage to a variety of property types in South Carolina each year. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Mammal damage to property occurs primarily through direct damage to structures. Aircraft striking mammals can also cause substantial damage requiring costly repairs and aircraft downtime. Raccoons, skunks, woodchucks, and armadillos can cause damage to property by digging under porches, buildings, homes, and many other places. Raccoon and armadillos often cause damage to lawns and turf while digging for grubs and insects. From FY 2009 through FY 2014, complainants reported to WS over $1.4 million in property damages caused by mammals in South Carolina.

Deer can damage and destroy landscaping and ornamental trees, shrubs, and flowers by browsing on those trees and plants. Developing rural areas into residential areas could enhance deer habitat in those areas. Fertilized lawns, gardens, and landscape plants in those 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.

Deer-vehicle collisions 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). State Farm Mutual Automobile Insurance (2012) estimated that 1.23 million deer-vehicle collisions occur annually in the United States causing approximately 200 fatalities. In 1995, the estimated damage to vehicles associated with vehicles striking deer was $1,500 per strike (Conover et al. 1995). Estimated damage costs associated with deer collisions in 2011 were $3,171 per incident, which was an increase of 2.2% over the 2010 estimate (State Farm Mutual Automobile Insurance 2011). An estimated 26,408 deer-vehicle collisions occurred in South Carolina from July 1, 2011 through June 30, 2012 (State Farm Mutual Automobile Insurance 2012). Based on the average repair costs associated with vehicle strikes estimated at $3,171 in 2010 and

the number of strikes that have occurred in the State estimated at 26,408 from July 2011 through June 2012, deer-vehicle collisions resulted in over $83.7 million in damage to property in the State. Often, deer-vehicle collisions go unreported, especially when there was no recovery of a deer carcass or when little vehicle damage occurred. A Cornell University study estimated that the actual number of deer-vehicle collisions could be as high as six times the reported number (Decker et al. 1990).

Damage caused by muskrats is usually not a major problem, but can be important in some situations (Wade and Ramsey 1986), such as in aquaculture systems or when burrowing into earthen embankments. Economic loss is often associated with muskrat feeding and burrowing into banks, dikes, levees, shorelines, and dams associated with ponds, lakes, and drainages (Perry 1982, Miller 1994, Linzey 1998). In some states, damage may be as much as $1 million per year (Miller 1994). Elsewhere, economic losses caused by muskrats may be limited and confined primarily to burrowing or feeding on desirable plants in farm ponds. In such areas, the cost of the damage can often outweigh the value of the muskrat population.

Burrowing activity of muskrats can seriously weaken dams and levees (Perry 1982) causing them to leak or collapse. Loss of water from irrigated areas or flooding may lead to loss of crops (Wade and Ramsey 1986). Entrances to burrows are normally underwater and may not be evident until serious damage has occurred. Associated burrows and dens can erode along the shorelines of lakes and create washouts of associated properties when they collapse, posing a hazard to humans, livestock, and equipment used on site.

Woodchuck burrow in roadbeds and embankments and have been documented to weaken or cause the collapse of these structures. Woodchucks also cause damage by chewing underground utility cables, sometimes resulting in power outages. Additionally, woodchuck burrows may cause damage to property when tractors and other equipment drop into a burrow or roll over due to a burrow.

WS has received numerous requests in the past for assistance in resolving property damage caused by mammals. As part of the proposed program, WS could provide assistance, upon request, involving target mammal species to any requester experiencing such damage throughout South Carolina.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA documents the need for managing damage caused by mammals, the issues associated with meeting that need, and alternative approaches to address those issues and to meet the need for action. WS mission is to provide federal leadership with managing damage and threats of damage associated with animals (see WS Directive 1.201). WS would only provide assistance when the appropriate property owner or manager requested WS' assistance. WS could receive a request for assistance from a property owner or manager to conduct activities on property they own or manage, which could include federal, state, tribal, municipal, and private land within the State of South Carolina.

Appendix B of this EA discusses the methods available for use or recommendation under each of the alternative approaches evaluated[8]. The alternatives and Appendix B also discuss how WS and other entities could recommend or employ methods to manage damage and threats associated with mammals in

[8]Appendix B contains a complete list of chemical and non-chemical methods available for use under the identified alternatives. However, listing methods neither implies that all methods would be used by WS to resolve requests for assistance nor does the listing of methods imply that all methods would be used to resolve every request for assistance.

the State. Therefore, the actions evaluated in this EA are the use or recommendation of those methods available under the alternatives and the employment or recommendation of those methods by WS to manage or prevent damage and threats associated with mammals from occurring when requested by the appropriate resource owner or manager. WS' activities that could involve the lethal removal of target mammal species under the alternatives would only occur when agreed upon by the requester and when permitted by the SCDNR, when required, and only at levels permitted.

Federal, State, County, City, and Private Lands

WS could continue to provide damage management activities on federal, state, county, municipal, and private land in South Carolina when WS receives a request for such services by the appropriate resource owner or manager. In those cases where a federal agency requests WS' assistance with managing damage caused by mammals on property they own or manage, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA. However, this EA could cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, the scope of this EA analyzes actions that could occur on federal lands, when requested.

Native American Lands and Tribes

The WS program in South Carolina would only conduct damage management activities on Native American lands when requested by a Native American Tribe. WS would only conduct activities after WS and the Tribe requesting assistance signed a Memorandum of Understanding (MOU), a work initiation document, or another comparable document. Therefore, the Tribe would determine what activities would be allowed and when WS' assistance was required. Because Tribal officials would be responsible for requesting assistance from WS and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would likely occur. Those methods available to alleviate damage associated with mammals on federal, state, county, municipal, and private properties under the alternatives analyzed in this EA would be available for use to alleviate damage on Tribal properties when the Tribe requesting WS' assistance approved the use of those methods. Therefore, the activities and methods addressed under the alternatives would include those activities that WS could employ on Native American lands, when requested and when agreed upon by the Tribe and WS.

Period for which this EA is Valid

If the preparation of an Environmental Impact Statement (EIS) is not warranted, based on the analyses associated with this EA, WS would conduct reviews of activities conducted under the selected alternative to ensure those activities occurred within the parameters evaluated in this EA. This EA would remain valid until WS, in consultation with the SCDNR, determined that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Under the alternative analyzing no involvement by WS, no review or additional analyses would occur based on the lack of involvement by WS. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of damage management activities conducted by WS in South Carolina under the selected alternative, when requested.

Site Specificity

As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. In addition, WS' activities that could involve the lethal removal

of mammals under the alternatives would only occur when permitted by the SCDNR, when required, and only at levels permitted.

This EA analyzes the potential impacts of mammal damage management based on previous activities conducted on private and public lands in South Carolina where WS and the appropriate entities entered into a MOU, work initiation document, or another comparable document. The EA also addresses the potential impacts of managing damage caused by mammals in areas where WS and a cooperating entity could sign additional agreements in the future. Because the need for action would be to reduce damage and because the program's goals and directives would be to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and analyzes the impacts of those efforts as part of the alternatives.

Many of the mammal species addressed in this EA occur statewide and throughout the year in the State; therefore, damage or threats of damage could occur wherever those mammals occur. Planning for the management of mammal damage must be viewed as being conceptually similar to the actions of other entities whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire departments, police departments, emergency clean-up organizations, and insurance companies. Although WS could predict some locations where mammal damage would occur, WS could not predict every specific location or the specific time where such damage would occur in any given year. In addition, the threshold triggering an entity to request assistance from WS to manage damage associated with mammals is often unique to the individual; therefore, predicting where and when WS would receive such a request for assistance would be difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever mammal damage and the resulting management actions occurs, and are treated as such.

Chapter 2 of this EA identifies and discusses issues relating to mammal damage management in South Carolina. The standard WS Decision Model (Slate et al. 1992; see WS Directive 2.201) would be the site-specific procedure for individual actions that WS could conduct in the State (see Chapter 3 for a description of the Decision Model and its application). Decisions made using the model would be in accordance with WS' directives and Standard Operating Procedures (SOPs) described in this EA, as well as relevant laws and regulations in accordance with WS Directive 2.210.

The analyses in this EA would apply to any action that may occur in any locale and at any time within South Carolina. In this way, WS believes the agency meets the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with the NEPA and still be able to accomplish the mission of the agency.

Summary of Public Involvement

WS initially developed the issues associated with conducting mammal damage management in consultation with the SCDNR. WS defined the issues and identified the preliminary alternatives through the scoping process. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS implementing regulations for the NEPA, WS will make this document available to the public for review and comment. WS will make the document available to the public through legal notices published in local print media, through direct notification of parties that have requested notification, or that WS has identified as having a potential interest in the reduction of threats and damage associated with mammals in the State. In addition, WS will post this EA on the APHIS website for review and comment.

WS will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. WS will fully consider new issues, concerns, or alternatives the public identifies during the public involvement period to determine whether WS should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Environmental Assessment - Reducing Beaver Damage through an Integrated Wildlife Damage Management Program in the State of South Carolina

As was stated previously, WS previously developed an EA that addressed WS' activities to manage damage associated with beaver in the State (USDA 2002). Based on the analyses in that EA, a Decision and Finding of No Significant Impact was signed by WS selecting the proposed action alternative. The proposed action alternative implemented a beaver damage management program using a variety of methods in an integrated approach (USDA 2002). Pertinent information has been incorporated by reference into this EA.

WS' Environmental Assessment – Feral Swine Damage and Disease Management in South Carolina:

WS developed an EA that analyzed feral swine damage and disease surveillance in the State (USDA 2013). Based on the analyses in that EA, a Decision and Finding of No Significant Impact was signed by WS selecting the proposed action alternative. WS determined the action would not have any significant impact on the quality of the human environment. Pertinent information has been incorporated by reference into this EA.

South Carolina Comprehensive Wildlife Conservation Strategy

The SCDNR has developed an extensive wildlife conservation plan that evaluates all species of plant and animal known to exist within the State. This plan identifies all of the species and habitats that are currently listed as endangered, threatened, or species of concern, both federally by the United States Fish and Wildlife Service (USFWS) and at the state level by SCDNR. It also incorporates additional species of which little is known or with questionable population trends, and creates a comprehensive prioritized list of species in need of conservation. This Comprehensive Wildlife Conservation Strategy was consulted as part of this analysis and no species found in the Comprehensive Wildlife Conservation Strategy will be considered for management herein.

1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES

Below are brief discussions of the authorities of WS and other agencies, as those authorities relate to conducting wildlife damage management.

WS' Legislative Authority

The primary statutory authority for the WS program is the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources,

property, and threats to human safety associated with wildlife. WS' directives define program objectives and guide WS' activities when managing wildlife damage.

United States Environmental Protection Agency (EPA)

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

South Carolina Department of Natural Resources

The agency as organized on July 1, 1994, under the South Carolina Restructuring Act has the primary mission to serve as the principal advocate for and steward of South Carolina's natural resources.

South Carolina Department of Agriculture (SCDA)

The SCDA is a state agency established by the South Carolina Legislature in 1879. The mission of the South Carolina Department of Agriculture is to promote and nurture the growth and development of South Carolina's agriculture industry and its related businesses while assuring the safety and security of the buying public.

Clemson University Department of Pesticide Regulation (CUDPR)

The CUDPR is responsible for enforcing all pesticide regulations and laws, both state and federal in South Carolina. The CUDPR is responsible for carrying out provisions of the South Carolina Pesticide Control Act and the South Carolina Chemigation Act. Through cooperative agreements with the Environmental Protection Agency, the department also implements provisions of the FIFRA.

1.6 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes would authorize, regulate, or otherwise affect WS' activities under the alternatives. WS would comply with applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Below are brief discussions of those laws and regulations that would relate to damage management activities that WS could conduct in the State

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows the CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with the USDA (7 CFR 1b) and the APHIS implementing guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities that federal agencies must accomplish as part of any project: public involvement, analysis, documentation, implementation, and monitoring. The NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. In part, the CEQ, through regulations in 40 CFR, Parts 1500-1508, regulate federal activities that could affect the physical and biological environment. In accordance with regulations of the CEQ and the USDA, the APHIS has published guidelines concerning the implementation of the NEPA (see 44 CFR 50381-50384).

Pursuant to the NEPA and the CEQ regulations, this EA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that WS infuses the

policies and goals of the NEPA into agency actions. WS prepared this EA by integrating as many of the natural and social sciences as warranted, based on the potential effects of the alternatives, including the potential direct, indirect, and cumulative effects of the alternatives.

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 Act (Sec.2(c)). WS conducts consultations with the USFWS pursuant to Section 7 of the ESA 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 will use the best scientific and commercial data available*" (Sec.7 (a)(2)). Evaluation of the alternatives in regards to the ESA will occur in Chapter 4 of this EA.

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA 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 FIFRA. The EPA and the CUDPR regulate pesticides that could be available to manage damage associated with mammals in the State.

National Historic Preservation Act (NHPA) of 1966, as amended

The NHPA 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. None of the methods described in this EA that would be available cause major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor would involve the sale, lease, or transfer of ownership of any property. In general, the use of such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas that could result in effects on the character or use of historic properties. Therefore, the methods that would be available under the alternatives would not generally be the types of methods that would have the potential to affect historic properties. If WS planned an individual activity with the potential to affect historic resources under an alternative selected because of a decision on this EA, WS would conduct the site-specific consultation, as required by Section 106 of the NHPA, as necessary.

The use of noise-making methods, such as firearms, at or in close proximity to historic or cultural sites for the purposes of removing wildlife have the potential for audible effects on the use and enjoyment of historic property. However, WS would only use such methods at a historic site at the request of the owner or manager of the site to resolve a damage problem, which means such use, would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually 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. WS would conduct site-specific consultation as required by the Section 106 of the NHPA, as necessary, in those types of situations.

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) 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 agencies are to discontinue work until the agency has made a reasonable effort to protect the items and notify the proper authority.

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 mammals that may cause safety and health concerns at workplaces.

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

This law places administration of pharmaceutical drugs, including those immobilizing drugs used for wildlife capture and handling, under the 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 wildlife capture and handling.

Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act (AMDUCA) 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 and euthanasia 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.

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 State's Coastal Zone Management Program.

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 alternatives for their potential impacts on the human environment and compliance with Executive Order 12898.

WS would use only legal, effective, and environmentally safe damage management methods, tools, and approaches. The EPA through the FIFRA, the CUDPR, the United States Drug Enforcement Administration, MOUs with land managing agencies, and WS' Directives would regulate chemical methods that could be available for use by WS pursuant to the alternatives. WS would properly dispose of any excess solid or hazardous waste. WS does not anticipate the alternatives would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. In contrast, the alternatives may benefit minority or low-income populations by reducing threats to public health and safety and property damage.

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. WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. WS has considered the impacts that this proposal might have on children. The proposed activities would occur by using only legally available and approved methods where it is highly unlikely that activities conducted pursuant to the alternatives would adversely affect children. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing the alternatives. Additionally, the need for action identified a need to reduce threats to human safety, including risks to children; therefore, cooperators could request WS' assistance with reducing threats to the health and safety of children posed by mammals.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. 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.

South Carolina Permit to Remove Destructive Wildlife (§ 50-11-1050)

A permit is required from the SCDNR to remove damaging wildlife, including mammals, *"where wildlife is destroying property, the department, upon the request of the property owner, may issue a permit authorizing the property owner, under supervision of the department, to take action necessary to remove the destructive wildlife from his property."*

No closed season on coyotes (§ 50-11-1080)

Under Section 50-11-1080 of the South Carolina Code of Laws, there is no closed season for hunting or taking coyotes with weapons in the State.

Authority of department to permit taking of game animal (§ 50-11-1090)

Section 50-11-1090 of the South Carolina Code of Laws states, "*The department has the authority during any season of the year to permit the taking of any game animal and prescribe the method by which they may be taken when they cause damage to crops or property or when they pose a significant human health risk. Any animal taken under these conditions is under the supervision of the department*".

Issuance of special permit to capture destructive wildlife (§ 50-11-2570)

Under Section 50-11-2570(A), "*the department may issue special permits, at no cost to the applicant, for the taking, capturing, or transportation of wildlife which is destroying or damaging private or public property, wildlife habitat, game species, timber, crops, or other agriculture so as to be a nuisance or for scientific, research, or wildlife management purposes*." In addition, under Section 50-11-2570(B), "*the permit provided in subsection (A) is not required by the property owner or his designee when capturing furbearing animals or squirrels within one hundred yards of the owner's home when the animal is causing damage to the home or the owner's property. An animal captured pursuant to this subsection must be destroyed or with a department permit may be relocated*."

South Carolina Pesticide Control Act (§ 46-13-10)

The South Carolina Pesticide Control Act defines public health control activities as, *"the use of any pesticide with the intent to prevent, destroy, repel, or otherwise mitigate any pest of public health significance or engaging in any other activities intended or claimed to mitigate pests of public health significance for compensation or as a government employee on the property of another, including the installation of devices."*

1.7 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. The SCDNR is responsible for managing wildlife in the State of South Carolina, including those wildlife species addressed in this EA. As the authority for the management of wildlife populations in the State, the SCDNR was involved in the development of the EA and provided input throughout the EA preparation process to ensure an interdisciplinary approach according to the NEPA and agency mandates, policies, and regulations. The SCDNR establishes and enforces regulated hunting and trapping seasons in the State. The lethal removal of many of the species addressed in this EA can only occur when authorized by the SCDNR; therefore, the lethal removal of those species to alleviate damage or reduce threats of damage would only occur at the discretion of SCDNR and only at the levels the SCDNR permits. Those activities that WS could

conduct pursuant to the respective alternatives to reduce and/or prevent mammal damage in the State would be coordinated with the SCDNR, which would ensure the SCDNR had the opportunity to incorporate any activities WS' conducts into population objectives established for mammal populations in the State.

Based on the scope of this EA, the decisions to be made are: 1) should WS conduct activities to alleviate damage, 2) should WS conduct disease surveillance and monitoring in mammal populations when requested, 3) should WS implement an integrated methods approach to meet the need for action, 4) if not, should WS attempt to implement one of the alternatives to an integrated methods strategy, and 5) would the proposed action or the other alternatives result in effects to the environment requiring the preparation of an EIS.

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental impact analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues WS did not consider in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues. Additional descriptions of the affected environment occur during the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

Those mammal species addressed in this EA are capable of utilizing a variety of habitats in the State. Most species of mammals addressed in this EA occur throughout the year across the State where suitable habitat exists for foraging and shelter. Damage or threats of damage caused by those mammal species could occur statewide in South Carolina wherever those mammals occur. However, mammal damage management would only be conducted by WS when requested by a landowner or manager and only on properties where a MOU, work initiation document, or another comparable document were signed between WS and a cooperating entity.

Upon receiving a request for assistance, WS could conduct activities to reduce mammal damage or threats of damage on federal, state, tribal, municipal, and private properties in South Carolina. Areas where damage or threats of damage could occur include, but would not be limited to agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, aquaculture facilities, fish hatcheries, grain mills, grain handling areas, railroad yards, waste handling facilities, industrial sites, natural resource areas, park lands, and historic sites; state and interstate highways and roads; railroads and their right-of-ways; property in or adjacent to subdivisions, businesses, and industrial parks; timberlands, croplands, and pastures; private and public property where burrowing mammals cause damage to structures, dams, dikes, ditches, ponds, and levees; public and private properties in rural/urban/suburban areas where mammals cause damage to landscaping and natural resources, property, and were a threat to human safety through the spread of disease. The area would also include airports and military airbases where mammals were a threat to human safety and to property; areas where mammals negatively affect wildlife, including T&E species; and public property where mammals were negatively affecting historic structures, cultural landscapes, and natural resources. Chapter 4 also contains additional information on the affected environment.

Environmental Status Quo

As defined by the NEPA implementing regulations, the "*human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment*" (40 CFR 1508.14). Therefore, when a federal action agency analyzes their potential

impacts on the "*human environment*", it is reasonable for that agency to compare not only the effects of the federal action, but also the potential impacts that occur or could occur in the absence of the federal action by a non-federal entity. This concept is applicable to situations involving federal assistance to reduce damage associated with wildlife species.

Neither state nor federal laws protect some animal species, such as most non-native invasive species. State authority or law manages most mammal species without any federal oversight or protection. In some situations, with the possible exception of restrictions on methods (*e.g.*, firearms restrictions, pesticide regulations), unprotected wildlife species and certain resident wildlife species are managed with little or no restrictions, which allows anyone to lethally remove or take those species at any time when they are committing damage. The SCDNR has the authority to manage wildlife populations in the State.

When a non-federal entity (*e.g.*, agricultural producers, municipalities, counties, private companies, individuals, or any other non-federal entity) takes an action to alleviate mammal damage or threat of damage, the action is not subject to compliance with the NEPA due to the lack of federal involvement in the action. Under such circumstances, the environmental baseline or status quo would be an environment that includes those resources as other non-federal entities manage or affect those resources in the absence of the federal action. Therefore, in those situations in which a non-federal entity has decided that a management action directed towards mammals should occur and even the particular methods that should be used, WS' involvement in the action would not affect the environmental status quo since the entity could take the action in the absence of WS' involvement. WS' involvement would not change the environmental status quo if the requester had conducted the action in the absence of WS' involvement in the action.

A non-federal entity could lethally remove mammals to alleviate damage without the need for a permit when those species are non-native or are unregulated by the SCDNR. In addition, other entities could remove some species of mammals to alleviate damage during the hunting and/or trapping season and/or through the issuance of permits by the SCDNR. Most methods available for resolving damage associated with mammals would also be available for use by other entities. Therefore, WS' decision-making ability would be restricted to one of three alternatives. WS could take the action using the specific methods as decided upon by the non-federal entity, provide technical assistance only, or take no action. If WS' takes no action or provides just technical assistance, another entity could take the action anyway using those same methods without the need for a permit, during the hunting or trapping season, or through the issuance of a permit by the SCDNR. Under those circumstances, WS would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of WS' direct involvement.

Therefore, based on the discussion above, it is clear that in those situations where a non-federal entity has obtained the appropriate permit or authority, and has already made the decision to remove or otherwise manage mammals to stop damage with or without WS' assistance, WS' participation in carrying out the action would not affect the environmental status quo.

2.2 ISSUES ASSOCIATED WITH MAMMAL DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns regarding potential effects that might occur from a proposed action. Federal agencies must consider such issues during the NEPA decision-making process. Initially, WS developed the issues related to managing damage associated with mammals in South Carolina in consultation with the SCDNR. In addition, WS will invite the public to review and comment on the EA to identify additional issues. Chapter 4 discusses the issues, as those issues relate to the possible implementation of the alternatives, including the proposed action. WS evaluated, in detail, the following issues.

Issue 1 - Effects of Mammal Damage Management Activities on Target Mammal Populations

A common issue when addressing damage caused by wildlife are the potential impacts of management actions on the populations of target species. Lethal and non-lethal methods would be available to resolve mammal damage or threats to human safety. Non-lethal methods could disperse, translocate, or otherwise make an area unattractive to target species causing damage, which could reduce the presence of those species at the site and potentially the immediate area around the site where an entity employed those methods. Employing lethal methods could remove a mammal or those mammals responsible for causing damage or posing threats to human safety. Therefore, the use of lethal methods could result in local population reductions in the area where damage or threats were occurring. The number of individual animals from a target species that WS could remove from the population using lethal methods would be dependent on the number of requests for assistance received, the number of individual animals involved with the associated damage or threat, the efficacy of methods employed, and the number of individuals the SCDNR permits to be removed.

The analysis will measure the number of individual animals lethally removed in relation to that species' abundance to determine the magnitude of impact to the populations of those species from the use of lethal methods. Magnitude may be determined either quantitatively or qualitatively. Determinations based on population estimates, allowable harvest levels, and actual harvest data would be quantitative. Determinations based on population trends and harvest trend data, when available, would be qualitative.

In addition, many of the mammal species addressed in this EA can be harvested in the State during annual hunting and/or trapping seasons and can be addressed using available methods by other entities in the State when those species cause damage or pose threats of damage when permitted by the SCDNR, when required. Therefore, any damage management activities conducted by WS under the alternatives addressed would be occurring along with other natural process 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.

Under certain alternatives, WS could employ methods available to resolve damage and reduce threats to human safety that target an individual animal of a mammal species or a group of animals after applying the WS Decision Model (Slate et al. 1992) to identify possible techniques. Chapter 4 analyzes the effects on the populations of target mammal populations in the State from implementation of the alternatives addressed in detail, including the proposed action.

Issue 2 - Effects of Mammal Damage Management Activities on Non-target Wildlife Species Populations, Including T&E Species

The issue of non-target species effects, including effects on T&E species arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. There are also concerns about the potential for adverse effects to occur to non-target wildlife from the use of chemical methods. Chemical methods that would be available for use to manage damage or threats associated with those mammal species addressed in this EA include immobilizing drugs, euthanasia chemicals, reproductive inhibitors, fumigants, rodenticides, and taste repellents. Chapter 4 and Appendix B further discuss those chemical methods available for use to manage damage and threats associated with mammals in South Carolina.

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 pursuant to Section 7 of the Act to ensure compliance with the ESA. Consultations are also conducted 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)].

As part of the scoping process for this EA, WS consulted with the USFWS pursuant to Section 7 of the ESA to facilitate interagency cooperation between WS and the USFWS. Chapter 4 discusses the potential effects of the alternatives on this issue.

Issue 3 - Effects of Mammal Damage Management Activities on Human Health and Safety

An additional issue often raised is the potential risks to human safety associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. WS' employees could use and would recommend only those methods that were legally available under each of the alternatives. Still, some concerns exist regarding the safety of methods available despite their legality and selectivity. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public. In addition to the potential risks to the public associated with the methods available under each of the alternatives, risks to WS' employees would also be an issue. Injuries to WS' employees could occur during the use of methods, as well as subject to workplace accidents. Selection of methods, under the alternatives, would include consideration for public and employee safety.

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use or recommendation of chemical methods could include immobilizing drugs, euthanasia chemicals, fumigants, reproductive inhibitors, rodenticides, and repellents. The EPA through the FIFRA and the CUDPR through State laws would regulate pesticide use. The United States Drug Enforcement Administration and the United States Food and Drug Administration would regulate immobilizing drugs and euthanasia chemicals. In addition, the use of all chemical methods by WS would be subject to South Carolina laws and WS' Directives.

Immobilizing drugs that could be available include ketamine and Telazol which are anesthetics (*i.e.*, general loss of pain and sensation) used during the capture of wildlife to eliminate pain, calm fear, and reduce anxiety in wildlife when handling and transporting wildlife. Xylazine is a sedative that wildlife professionals often use in combination with ketamine to calm nervousness, irritability, and excitement in wildlife during the handling and transporting of wildlife. Euthanasia chemicals could include sodium pentobarbital and potassium chloride, all of which WS would administer after anesthetizing an animal.

Gonacon™ is the only product currently registered as a reproductive inhibitor and is only available to manage local deer populations. However, Gonacon™ is not currently registered for use in the State. If registered to manage a local deer population in the State, Gonacon™ would only be available for use by WS and/or the SCDNR, and agents under their direct supervision. The application of Gonacon™ to manage local deer herds could only occur after the SCDNR authorized the use of the reproductive inhibitor.

Rodenticides would include products containing the active ingredient zinc phosphide, which could be available to address damage and threats associated with muskrats and woodchucks. According to the EPA, zinc phosphide, when ingested, reacts with the acids in the gut releasing phosphine gas, which interferes with cell respiration leading to the death of the animal (EPA 1998). Purchasing and using zinc phosphide requires a restricted-use pesticide applicators license from the CUDPR. Products containing zinc phosphide as the active ingredient would not be restricted to use by WS' personnel only but would be available to anyone that possesses the appropriate restricted-use pesticide applicators license.

Repellents for many mammal species contain different active ingredients with most ingredients occurring naturally in the environment. The most common ingredients of repellents are coyote urine, putrescent whole egg solids, and capsaicin. Repellents for mammals are not generally restricted-use products; therefore, a person does not need a pesticide applicators license to purchase or apply those products. People generally apply repellents directly to affected resources, which elicits an adverse taste 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). WS could employ or recommend for use those rodenticides and repellents that were available for use in the State (*i.e.*, registered with the EPA pursuant to the FIFRA and registered with the CUDPR for use in South Carolina).

Gas cartridges could be available to fumigate burrows and den sites of woodchucks, coyotes, fox, and skunks in areas where damages were occurring. Gas cartridges act as a fumigant by producing carbon monoxide gas when ignited. The cartridges contain sodium nitrate, which when burnt, produces carbon monoxide gas. WS would place the cartridges inside active burrows and dens at the entrance, ignite the cartridge, and seal the entrance to the burrow or den with dirt, which allows the burrow or den to fill with carbon monoxide.

Another concern would be the potential for immobilizing drugs used in animal capture and handling to cause adverse health effects in people that hunt or trap and consume the species involved. Among the species that WS could capture and handle under the proposed action, this issue would be a primary concern for wildlife species that people hunt or trap and consume as food.

Most methods available to alleviate damage and threats associated with mammals would be non-chemical methods. Non-chemical methods may include cultural methods, limited habitat modification, animal behavior modification, and other mechanical methods. Changes in cultural methods could include improved animal husbandry practices, altering feeding schedules, changes in crop rotations, or conducting structural repairs. Limited habitat modification would be practices that alter specific characteristics of a localized area, such as removing bushes to eliminate shelter locations or planting vegetation that was less palatable to certain mammal species. Animal behavior modification methods would include those methods designed to disperse mammals from an area through harassment or exclusion. Behavior modification methods could include pyrotechnics, propane cannons, barriers, electronic distress calls, effigies, Mylar tape, and lasers. Other mechanical methods could include cage traps, foothold traps, body-gripping traps, cable restraints, cannon nets, shooting, or the recommendation that hunters and/or trappers reduce a local population of mammals during the annual hunting and/or trapping seasons.

The primary safety risk of most non-chemical methods occurs directly to the applicator or those persons assisting the applicator. However, risks to others do exist when employing non-chemical methods, such as when using firearms, cannon nets, pyrotechnics, or body-gripping traps. Most of the non-chemical methods available to address mammal damage in South Carolina would be available for use under any of the alternatives and by any entity, when permitted. Chapter 4 further discusses the risks to human safety from the use of non-chemical methods as this issue relates to the alternatives. Appendix B provides a complete list of non-chemical methods available to alleviate damage associated with mammals.

Another concern is the threat to human safety from not employing methods or not employing the most effective methods to reduce the threats that mammals could pose. The need for action in Chapter 1 addresses the risks to human safety from diseases associated with certain mammal populations. The low risk of disease transmission from mammals does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has

only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

Additional concerns occur when inadequately addressing threats to human safety associated with aircraft striking mammals at airports in the State. Mammals have the potential to cause severe damage to aircraft, which can threaten the safety of passengers. Limiting or preventing the use of certain methods to address the potential for aircraft striking mammals could lead to higher risks to passenger safety. Chapter 4 further evaluates those concerns in relationship to the alternatives.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of the target mammals to the public, resource owners, or neighboring residents. People generally regard wildlife as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics 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 and mammals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing wildlife. Therefore, the public reaction can be variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between people and wildlife.

Wildlife populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing wildlife exists and contributes 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).

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 wildlife, reading about wildlife, 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 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 aesthetic enjoyment.

In some cases, the presence of overabundant mammal species offends people, such as raccoons, armadillos, gray squirrels, coyotes, or feral species, such as cats or dogs. 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 mammal species proliferate in such numbers and appear to remain unbalanced.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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 can 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 (1987) has previously described suffering as a "…*highly unpleasant emotional response usually associated with pain and distress*." However, suffering "…*can occur without pain*…," and "…*pain can occur without suffering*…". Because suffering carries with it the implication of a time frame, a case could be made for "…*little or no suffering where death comes immediately*…" (California Department of Fish and Game 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 can occur when a person does 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 in animals 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).

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 using AVMA accepted methods of euthanasia when killing all animals, including wild and invasive animals. The AVMA has stated, "[f]*or 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).

Pain and suffering, as it relates to methods available for use to manage mammals has both a professional and lay point of arbitration. Wildlife managers and the public must recognize the complexity of defining suffering, since *"…neither medical nor veterinary curricula explicitly address suffering or its relief"* (California Department of Fish and Game 1991). Research suggests that with some methods (*e.g.*, foothold trap) changes in the blood chemistry of trapped animals indicate the existence of some level of "*stress*" (Kreeger et al. 1990). However, such 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).

The decision-making process involves tradeoffs between the above aspects of pain and humaneness. Therefore, 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. The challenge in coping with

this issue is how to achieve the least amount of animal suffering. Chapter 4 further discusses the issue of humaneness and animal welfare. Chapter 3 discusses SOPs intended to alleviate pain and suffering.

Issue 6 - Effects of Mammal Damage Management Activities on the Regulated Harvest of Mammals

Another issue commonly identified is a concern that damage management activities conducted by WS would affect the ability of persons to harvest those species during the regulated hunting and trapping seasons either by reducing local populations through the lethal removal of mammals or by reducing the number of mammals present in an area through dispersal techniques. Those target species that people can hunt and/or trap during regulated seasons in the State include muskrats, gray squirrels, raccoons, river otters, coyotes, gray fox, red fox, bobcats, nine-banded armadillos, Virginia opossum, and white-tailed deer.

Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to alleviate damage caused by those mammal species could reduce mammal densities through dispersal in areas where damage or the threat of damage was occurring. Similarly, lethal methods used to reduce damage associated with those mammals could lower densities in areas where damage was occurring resulting in a reduction in the availability of those species during the regulated harvest season. WS' mammal damage management activities would primarily be conducted in areas where hunting or trapping access was restricted (*e.g.*, airports) or had been ineffective. The use of non-lethal or lethal methods often disperses mammals from areas where damage was occurring to areas outside the damage area, which could serve to move those mammal species from those less accessible areas to places accessible to hunters and/or trappers.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

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

Appropriateness of Preparing an EA (Instead of an EIS) for Such a Large Area

The appropriateness of preparing an EA instead of an EIS was a concern WS identified during the scoping process. Wildlife damage management falls within the category of actions in which the exact timing or location of individual activities can be difficult to predict well enough ahead of time to describe accurately such locations or times in an EA or even an EIS. Although WS could predict some of the possible locations or types of situations and sites where some kinds of wildlife damage would occur, the program cannot predict the specific locations or times at which affected resource owners would determine a damage problem had become intolerable to the point that they request assistance from WS. In addition, the WS program would not be able to prevent such damage in all areas where it might occur without resorting to destruction of wild animal populations over broad areas at a much more intensive level than would be desired by most people, including WS and other agencies. Such broad scale population management would also be impractical or impossible to achieve within WS' policies and professional philosophies.

Lead agencies have the discretion to determine the geographic scope of their analyses under the NEPA (Kleppe v Sierra Club, 427 U.S. 390, 414 (1976), CEQ 1508.25). Ordinarily, according to the APHIS procedures implementing the NEPA, WS' individual wildlife damage management actions could be categorically excluded (7 CFR 372.5(c)). The intent in developing this EA has been to determine if the proposed action or the other alternatives could potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS. This EA

addresses impacts for managing damage and threats to human safety associated with mammals in the State to analyze individual and cumulative impacts and to provide a thorough analysis.

In terms of considering cumulative effects, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If WS made a determination through this EA that the proposed action or the other alternatives could have a significant impact on the quality of the human environment, then WS would publish a notice of intent to prepare an EIS and this EA would be the foundation for developing the EIS. Based on previous requests for assistance, the WS program in South Carolina would continue to conduct mammal damage management on a small percentage of the land area in the State where damage was occurring or likely to occur.

WS' Impact on Biodiversity

WS does not attempt to eradicate any species of native wildlife in the State. WS operates in accordance with federal and state laws and regulations enacted to ensure species viability. WS would use available methods to target individual mammals or groups of mammals identified as causing damage or posing a threat of damage. Any reduction of a local population or group is frequently temporary because immigration from adjacent areas or reproduction replaces the animals removed.

As stated previously, WS would only provide assistance under the appropriate alternatives after receiving a request to manage damage or threats. Therefore, if WS provided direct operational assistance under the alternatives, WS would provide assistance on a small percentage of the land area of South Carolina. In addition, WS would only target those mammals identified as causing damage or posing a threat. WS would not attempt to suppress wildlife populations across broad geographical areas at such intensity levels for prolonged durations that significant ecological effects would occur. The goal of WS would not be to manage animal populations but to manage damage caused by specific individuals of a species. The management of wildlife populations in the State is the responsibility of the SCDNR and activities associated with many of the mammal species addressed in the EA require authorization from the SCDNR. Therefore, those factors would constrain the scope, duration, and intensity of WS' actions under the alternatives.

Often of concern with the use of certain methods is that mammals that WS lethally removes would only be replaced by other mammals after WS completes activities (*e.g.*, mammals that relocate into the area) or by mammals the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). The ability of an animal population to sustain a certain level of removal and to return to pre-management levels demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

For example, studies suggest coyote territories would not remain vacant for very long after removing coyotes from an area. Gese (1998) noted that adjacent coyote packs adjusted territorial boundaries following social disruption in a neighboring pack, thus allowing for complete occupancy of the area despite removal of breeding coyotes. Blejwas et al. (2002) noted that a replacement pair of coyotes occupied a territory in approximately 43 days following the removal of the territorial pair. Williams et al. (2003) noted that temporal genetic variation in coyote populations experiencing high turnover (due to removals) indicated that "*...localized removal effort does not negatively impact effective population size...*".

Chapter 4 evaluates the environmental consequences of the alternatives on the populations of target and non-target species based on available quantitative and qualitative parameters. The permitting of lethal removal by the SCDNR would ensure cumulative removal levels would occur within allowable levels to

maintain species' populations and meet population objectives for each species. Therefore, activities conducted pursuant to any of the alternatives would not adversely affect biodiversity in the State.

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA processes is a concern that WS or other entities should establish a threshold of loss before employing lethal methods to resolve damage and that mammal damage should be a cost of doing business. 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 addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking mammals 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 wildlife strikes prior to an actual strike occurring would be appropriate.

In a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie National Forest, et al., the United States District Court of Utah determined that a forest supervisor could establish a need for wildlife damage management if the supervisor could show that damage from wildlife was threatened (Civil No. 92-C-0052A January 20, 1993). Thus, there is judicial precedence indicating that it is not necessary to establish a criterion, such as a percentage of loss of a particular resource, to justify the need for damage management actions.

Mammal Damage Management Should Not Occur at Taxpayer Expense

An issue identified is the concern that WS should not provide assistance at the expense of the taxpayer or that activities should be fee-based. Funding for WS' activities could occur from federal appropriations and through cooperative funding. Funding for WS' activities would occur through cooperative service agreements with individual property owners or managers. WS receives a minimal federal appropriation for the maintenance of a WS program in South Carolina. The remainder of the WS program would mostly be fee-based. WS would provide technical assistance to requesters as part of the federally funded activities; however, the majority of funding to conduct direct operational assistance in which WS' employees perform damage management activities would occur through cooperative service agreements between the requester and WS.

Additionally, damage management activities are an appropriate sphere of activity for government programs, since 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.

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives WS is considering. However, the methods determined to be most effective to reduce damage and threats to human safety caused by mammals and that prove to be the most cost effective would likely receive the greatest application. As part of an integrated approach and as part of the WS Decision Model, evaluation of methods would continually occur to allow for those methods that were most effective at resolving damage or threats to be employed under similar circumstance where mammals were causing damage or

posing a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. Therefore, the cost of methods can often influence the availability of methods to resolve damage, which can influence the effectiveness of methods.

Mammal Damage Should be managed by Private Nuisance Wildlife Control Agents

People experiencing damage caused by mammals could contact wildlife control agents and private entities to reduce mammal damage when deemed appropriate by the resource owner. In addition, WS could refer persons requesting assistance to agents and/or private individuals under all of the alternatives fully evaluated in the EA.

WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS Directive 2.345 outlines WS' policy regarding requests for assistance involving rodent species in urban areas. WS would only respond to requests for assistance received and would not respond to public bid notices. When responding to requests for assistance, WS would inform requesters that other service providers, including private entities, might be available to provide assistance.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove mammals. As described in Appendix B, the lethal removal of mammals with firearms by WS to alleviate damage or threats could occur using a handgun, rifle, or shotgun. In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996).

The removal of mammals by WS using firearms in the State would occur primarily from the use of rifles. However, WS could employ the use of shotguns or handguns to remove some species. To reduce risks to human safety and property damage from bullets passing through mammals, the use of firearms would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to ensure the bullet does not pass through mammals. Mammals that were removed using firearms would occur within areas where retrieval of mammal carcasses for proper disposal is highly likely (*e.g.*, at an airport). With risks of lead exposure occurring primarily from ingestion of bullet fragments, the retrieval and proper disposal of mammal carcasses would greatly reduce the risk of scavengers ingesting lead that carcasses may contain.

However, deposition of lead into soil could occur if, during the use of a firearm, the projectile passed through a mammal, if misses occurred, or if the retrieval of the carcass did not occur. 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 cm (about 8 inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could contaminate ground water or surface water from runoff. Stansley et al. (1992) studied lead levels in water subject to 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 (Craig et al. 1999). Therefore, the lead oxide deposits that form on the surface of bullets and shot 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 that WS could deposit and the concentrations that would occur from WS' activities to reduce mammal damage using firearms, as well as most other forms of dry land small game hunting in general, lead contamination of water from such sources would be minimal to nonexistent.

Since those mammals 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' assistance with removing those mammals would not be additive to the environmental status quo. The proficiency training received by WS' employees in firearm use and accuracy would increase the likelihood that mammals were lethally removed humanely in situations that ensure accuracy and that misses occur infrequently, which further reduces the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. Based on current information, the risks associated with lead projectiles that WS could contribute to the environment due to misses, the projectile passing through the carcass, or from mammal carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination.

Effects on Human Health from Consumption of Deer Meat Donated by WS

Of concern under this issue would be the consumption of deer meat donated to a charitable organization after being lethally removed by WS. Of recent concern is the potential for lead and other contaminants to be present in meat that has been processed for human consumption. The potential for the spreading of zoonotic diseases in deer processed and donated for human consumption is also a concern. Under the proposed action alternative, meat from deer lethally removed during damage management activities could be donated to charitable organizations for human consumption. Only meat from deer would be donated under the proposed action alternative. WS could recommend the donation or consumption of meat under the technical assistance only alternative but would not be directly involved with damage management activities under that alternative.

Stewart and Veverka (2011) documented that white-tailed deer that were shot with lead ammunition in the head or extreme upper neck in sharpshooting situations showed no deposition of lead fragments in the meat of the animals that would have been processed for human consumption. Lower neck shots do frequently experience lead fragmentation in the loin muscle and Stewart and Veverka (2011) recommended removing the loins prior to processing to ensure that fragments were not ingested. WS' personnel would be trained to shoot and target the head and upper neck of white-tailed deer. Any deer that were shot in the lower neck would not be donated or would be processed to avoid those areas that could contain lead fragments.

If WS donated deer for human consumption, WS' policies pertaining to the testing or labeling of meat would be followed in order to address potential health concerns. Deer donated for human consumption may be tested for exposure to substances such as organophosphate and carbamate insecticides, lead, mercury, arsenic, organochlorines, and organic chemicals prior to distribution. Deer immobilized using immobilizing drugs or euthanized using euthanasia chemicals would not be donated for human

consumption with disposal of carcasses occurring pursuant to WS Directive 2.515. Deer removed by any method for disease sampling or in an area where zoonotic diseases of concern were known to be prevalent and of concern to human health after consuming processed deer meat would not be donated for consumption and would be disposed of by deep burial or incineration. WS' adherence to policy would not result in adverse effects to human health from the donation of deer meat.

A Site Specific Analysis Should be made for Every Location Where Mammal Damage Management Would Occur

The underlying intent for preparing an EA is to determine if a proposed action might have a significant impact on the human environment. WS' EA development process is issue driven, meaning issues that were raised during the interdisciplinary process and through public involvement that were substantive, would be used to drive the analysis and determine the significance of the environmental impacts of the proposed action and the alternatives. Therefore, the level of site specificity must be appropriate to the issues listed.

The issues raised during the scoping process of this EA drove the analysis. In addition to the analysis contained in this EA, WS' personnel use the WS Decision Model (Slate et al. 1992) described in Chapter 3 as a site-specific tool to develop the most appropriate strategy at each location. The WS Decision Model is an analytical thought process that WS' personnel would use to evaluate and respond to requests for assistance.

As discussed previously, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis that allows for a better cumulative impact analysis. If a determination were made through this EA that the alternatives developed to meet the need for action could result in a significant impact on the quality of the human environment, then an EIS would be prepared.

CHAPTER 3: ALTERNATIVES

Section 3.1 contains a discussion of the alternatives that WS developed to meet the need for action discussed in Chapter 1 and to address the identified issues discussed in Chapter 2. WS developed the alternatives based on the need for action and issues using the WS Decision model (Slate et al. 1992). The alternatives will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences). Section 3.2 discusses alternatives considered but not analyzed in detail, with rationale. Section 3.3 discusses the SOPs that WS would incorporate into the relevant alternatives.

3.1 DESCRIPTION OF THE ALTERNATIVES

WS developed the following alternatives to meet the need for action and address the identified issues associated with managing damage caused by mammals in the State.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, when requested, as deemed appropriate using the WS Decision Model, to reduce damage and threats caused by mammals in South Carolina. A major goal of the program would be to resolve and prevent damage caused by mammals and to reduce threats to human safety. To meet this goal, WS would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding was available, operational damage management.

Funding could occur through federal appropriations or from cooperative funding. The adaptive approach to managing damage associated with mammals would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by a site-specific evaluation to reduce damage or threats to human safety for each request. WS would provide city/town managers, agricultural producers, property owners, and others requesting assistance with information regarding the use of appropriate non-lethal and lethal techniques.

Under this alternative, 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 damages caused by mammals, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The removal of many of the mammal species addressed in this EA can only legally occur under authorization by the SCDNR and only at levels authorized, unless those mammal species are afforded no protection, in which case, no authorization for lethal removal would be required. To meet the need for action, the objectives of this alternative would be to assist all of the people requesting WS' assistance, within the constraints of available funding and workforce.

WS could provide property owners or managers requesting assistance with information regarding the use of effective and practical non-lethal and lethal techniques. WS would give preference to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Property owners or managers may choose to implement WS' recommendations on their own (*i.e.*, technical assistance), use contractual services of private businesses, use volunteer services of private organizations, use the services of WS (*i.e.*, direct operational assistance), take the management action themselves, or take no further action.

WS would work with those persons experiencing mammal damage to address those mammals responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should occur as soon as mammals begin to cause damage. Once mammals become familiar with a particular location (*i.e.*, conditioned to an area), dispersing those mammals or making the area unattractive can be difficult. WS would work closely with those entities requesting assistance to identify situations where damage could occur and begin to implement damage management activities under this alternative as early as possible to increase the likelihood of those methods achieving the level of damage reduction requested by the cooperating entity.

The WS Decision Model would be the implementing mechanism for a damage management program under the proposed action alternative that could be adapted to an individual damage situation. This alternative would allow WS to use the broadest range of methods to address damage or the threat of damage. When WS received a request for direct operational assistance, WS would conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage. Discussion of the Decision Model and WS' use of the Model under the proposed action occurs below. In addition, WS would give preference to non-lethal methods when practical and effective (see WS Directive 2.101). When receiving requests for assistance associated with squirrels and woodchucks, the WS program in South Carolina would follow WS Directive 2.345.

Non-lethal methods that would be available for use by WS under this alternative include, but are not limited to minor habitat modification, behavior modification, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods that would be available to WS under this alternative include body-gripping traps, cable restraints, the recommendation of harvest during hunting and/or trapping seasons, fumigants, euthanasia chemicals,

rodenticides, and shooting. Target mammal species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. In addition, WS could use foothold traps and submersion rods or cables in drowning sets[9]. The lethal control of target mammals would comply with WS Directive 2.505.

Discussing methods does not imply that all methods would be used or recommended by WS to resolve requests for assistance and does not imply that all methods would be used to resolve every request for assistance. The most appropriate response would often be a combination of non-lethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy. For example, if an entity requesting assistance had already attempted to alleviate damage using non-lethal methods, WS would not necessarily employ those same non-lethal methods, since the previous use of those methods were ineffective at reducing damage or threats to an acceptable level to the requester.

Many lethal and non-lethal methods are intended to be short-term attempts at reducing damage occurring at the time those methods were employed. Long-term solutions to managing mammal damage could include limited habitat manipulations and changes in cultural practices, which are techniques addressed further below and in Appendix B.

Non-lethal methods can disperse or otherwise make an area unattractive to mammals causing damage; thereby, reducing the presence of mammals at the site and potentially the immediate area around the site where non-lethal methods were employed. WS would give preference to non-lethal methods when addressing requests for assistance (see WS Directive 2.101). However, WS would not necessarily employ non-lethal methods to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model, especially when the requesting entity had used non-lethal methods previously and found those methods to be inadequate to resolving the damage or threats of damage. WS' employees could use non-lethal methods to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from an area resulting in a reduction in the presence of those mammals at the site where a person employed those methods. For any management methods employed, the proper timing would be essential in effectively dispersing those mammals causing damage. Employing methods soon after damage begins or soon after a property owner or manager identifies threats, increases the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods would be necessary to be effective in achieving expedient resolution of mammal damage.

Under the proposed action alternative, WS could employ only non-lethal methods when determined to be appropriate for each request for assistance to alleviate damage or reduce threats of damage using the WS Decision Model. In some situations, a cooperating entity has tried to employ non-lethal methods to resolve damage prior to contacting WS for assistance. In those cases, the methods employed by the requester were either unsuccessful or the reduction in damage or threats had not reached a level that was tolerable to the requesting entity. In those situations, WS could employ other non-lethal methods, attempt to apply the same non-lethal methods, or employ lethal methods. In many situations, the implementation of non-lethal methods, such as exclusion-type barriers, would be the responsibility of the requester, which means that, in those situations, the only function of WS would be to implement lethal methods, if determined to be appropriate using the WS Decision Model.

[9]Section 4.1 and Appendix B provides additional information on the use of foothold traps and submersion cables or rods.

WS could employ lethal methods to resolve damage associated with those mammals identified by WS as responsible for causing damage or threats to human safety under this alternative[10]; however, WS would only employ lethal methods after receiving a request for the use of those methods. The use of lethal methods could result in local population reductions in the area where damage or threats were occurring since people could remove individual mammals from the population. WS and other entities often employ lethal methods to reinforce non-lethal methods and to remove mammals that WS or other entities identify as causing damage or posing a threat to human safety. The number of mammals removed from the population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed.

Often of concern with the use of lethal methods is that mammals that were lethally removed would only be replaced by other mammals either after the application of those methods (*e.g.*, mammals that relocate into the area) or by mammals the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). As stated previously, WS would not use lethal methods as population management tools over broad areas. The use of lethal methods would be intended to reduce the number of individuals of a target mammal species present at a specific location where damage was occurring by targeting those mammals causing damage or posing threats. The intent of lethal methods would be to manage damage caused by those individuals of a mammal species and not to manage entire mammal populations.

Most lethal and non-lethal methods currently available provide only short-term benefits when addressing mammal damage. The use of those methods would be intended to reduce damage occurring at the time those methods were employed but do not necessarily ensure mammals would not return once those methods were discontinued. Long-term solutions to resolving mammal damage would often be difficult to implement and can be costly. In some cases, long-term solutions involve exclusionary devices, such as fencing, or other practices that would not be costly or difficult to implement, such as closing garbage cans. When addressing mammal damage, long-term solutions generally involve modifying existing habitat or making conditions to be less attractive to mammals. To ensure complete success, alternative sites in areas where damage was not likely to occur would often be required to achieve complete success in reducing damage and to avoid moving the problem from one area to another. Modifying a site to be less attractive to mammals would likely result in the dispersal of those mammals to other areas where damage could occur or could result in multiple occurrences of damage situations.

WS may recommend mammals be harvested during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of mammals causing damage. Managing mammal populations over broad areas could lead to a decrease in the number of mammals causing damage. Establishing hunting or trapping seasons and the allowed harvest levels during those seasons is the responsibility of the SCDNR. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons.

Appendix B contains a complete list of methods available for use under this alternative. However, listing methods neither implies that all methods would be used by WS to resolve requests for assistance nor does the listing of methods imply that all methods would be used to resolve every request for assistance. As part of an integrated approach, WS may provide technical assistance and direct operational assistance to

[10]The lethal removal of some of the mammal species addressed in this EA could only legally occur under authorization by the SCDNR and only at levels authorized, unless those mammal species are afforded no protection, in which case, no authorization for lethal removal would be required.

those people experiencing damage associated with mammals when those persons request assistance from WS.

Technical Assistance Recommendations

Under the proposed action, WS could provide technical assistance to those persons requesting assistance with managing damage as part of an integrated methods approach. Technical assistance could occur as described in Alternative 2 of this EA. From FY 2009 through FY 2014, WS conducted 43 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety (see Table 1.1).

Direct Operational Assistance

Operational damage management assistance would include damage management activities that WS' personnel conduct directly or activities that WS' employees supervise. Initiation of operational damage management assistance could occur when the problem could not be effectively resolved through technical assistance alone and there was a written MOU, work initiation document, or other comparable document signed between WS and the entity requesting assistance. The initial investigation by WS' personnel would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to resolve the problem. The professional skills of WS' personnel could be required to resolve problems effectively, especially if chemical methods were necessary or if the problems were complex.

The following examples serve as illustrations of WS' operational damage management assistance projects. The examples are intended to present realistic examples of on-going projects only and are not an inclusive or all-encompassing list of all projects conducted by WS in South Carolina.

MANAGEMENT OF WILDLIFE HAZARDS TO AIRCRAFT IN SOUTH CAROLINA

Upon receiving a request for assistance, WS evaluates wildlife hazards at an airport, prepares a Wildlife Hazard Assessment that identifies wildlife hazards, and assists the airport in developing a Wildlife Hazard Management Plan to address those hazards and threats.

Direct operational activities consist of various harassment techniques, and live capture and lethal removal techniques aimed at removing potentially injurious wildlife. WS' personnel also provide ongoing technical advice to airport managers regarding methodologies to reduce the presence of wildlife in areas of operations within airports, including providing technical advice on various habitat management projects implemented by airport personnel. In addition, WS promotes improved mammal strike record keeping, maintains a program of mammal identification, and monitors mammal numbers at participating airports to assist in developing an effective damage management program.

MANAGEMENT OF WHITE-TAILED DEER IN SOUTH CAROLINA

Upon request for assistance, WS conducts site visits and evaluates damage caused by white-tailed deer. WS' personnel provide technical assistance and demonstration of techniques available for use by the requester. Direct operational activities may consist of utilizing traps, sharp-shooting, or other methods as appropriate to reduce damage caused by deer.

Educational Efforts

Education is an important element of activities 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. In addition to the routine dissemination of recommendations and information to individuals or organizations, WS provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, WS' employees would continue to write technical papers and provide presentations at professional meetings and conferences so that other wildlife professionals and the public are made aware of recent developments in damage management technology, programs, laws and regulations, and agency policies.

Research and Development

The National Wildlife Research Center (NWRC) functions as the research unit of WS by providing scientific information and the development of methods for wildlife damage management, which are effective and environmentally responsible. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate methods and techniques for managing wildlife damage. For example, research biologists from the NWRC were involved with developing and evaluating the reproductive inhibitor known under the trade name of Gonacon™. Research biologists with the NWRC have authored hundreds of scientific publications and reports based on research conducted involving wildlife and methods.

WS' Decision Making Procedures

The WS Decision Model (see WS Directive 2.201) described by Slate et al. (1992) depicts how WS' personnel would use a thought process for evaluating and responding to damage complaints. WS' personnel would assess the problem and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic, and social considerations. Following this evaluation, WS' employees would incorporate methods deemed practical for the situation into a damage management strategy. After WS' employees implemented this strategy, employees would continue to monitor and evaluate the strategy to assess effectiveness. If the strategy were effective, the need for further management would end. In terms of the WS Decision Model, most efforts to resolve wildlife damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

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. The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on biological, environmental, 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, 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).
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, such as muskrats burrowing into levees where the use of non-lethal methods (*e.g*., rip-rap) was not possible or practical.

Community-based Decision Making

WS could receive requests for assistance from community leaders and/or representatives. In those situations, the WS program in South Carolina, under this alternative, would follow the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS could provide technical assistance regarding the biology and ecology of mammals and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This could include non-lethal and lethal methods. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources were available. Under this approach, resource owners within a community and other community members directly or indirectly affected by mammal damage or the management of damage would have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request direct operational assistance from WS, other wildlife management agencies, local animal control agencies, private businesses, or seek no further assistance.

The community representative(s) and/or decision-maker(s) for the local community would be elected officials or representatives of the communities. The community representative(s) and/or decision-maker(s) who oversee the interests and business of the local community would generally be residents of the local community or appointees that other members of the community popularly elected. 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. Identifying the decision-maker for local business communities can be more complex because building owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board.

WS could provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Under a community based decision-making process, WS could provide information, demonstration, and discussion on available methods to the appropriate representative(s) of the community and/or community decision-maker(s) that requested assistance, which would help ensure that decisions made by representatives of the community and/or the decision-makers were based on community-based input. WS would only provide direct operational assistance if the local community representative(s) and/or decision-maker(s) requested such assistance and only if the assistance requested was compatible with WS' recommendations.

By involving community representatives and/or community decision-makers in the process, WS could present information that would allow decisions on damage management to involve those individuals that the representatives and/or decision-maker(s) represent. As addressed in this EA, WS could provide technical assistance to the appropriate representative(s) and/or decision-maker(s), including demonstrations and presentation by WS at public meetings to allow for involvement of the community. Requests for assistance to manage damage caused by mammals often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives of the community, the community representative(s) and/or decision-maker(s) would be able to provide the information to local interests either through technical assistance provided by WS or through demonstrations and presentation by WS on damage management activities. This process would allow WS, the community representative(s), and/or decision-maker(s) to make decisions on damage management activities based on local input. The community leaders could implement management recommendations provided by WS or others, or may request management assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Private Property Decision-Makers

In the case of private property owners, the decision-maker is the individual that owns or manages the affected property. The decision-maker has the discretion to involve others as to what occurs or does not occur on property they own or manage. Therefore, in the case of an individual property owner or manager, the involvement of others and to what degree others were involved in the decision-making process would be a decision made by that individual. WS could provide direct operational assistance when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

Public Property Decision-Makers

The decision-maker for local, state, 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. WS could provide technical assistance to this person and make recommendations to reduce damage. WS could provide direct operational assistance when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Under this alternative, WS would provide those cooperators requesting assistance with technical assistance only. Similar to Alternative 1, WS could receive requests for assistance from community representatives, private individuals/businesses, or from public entities. Technical assistance would provide those cooperators experiencing damage or threats associated with mammals with information, demonstrations, and recommendations on available and appropriate methods. The implementation of methods and techniques to resolve 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). Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, WS would describe several management strategies to the requester for short and long-term solutions to managing damage. WS would base those strategies on the level of risk, need, and the practicality of their application. WS would use the Decision Model to recommend those methods and techniques available to the requester to manage damage and threats of damage. Those persons receiving technical assistance from WS 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.

Under a technical assistance only alternative, WS would recommend an integrated approach similar to the proposed action alternative (Alternative 1) when receiving a request for assistance; however, WS would not provide direct operational assistance under this alternative. WS would give preference to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). WS would base method and technique recommendations on information provided by the individual(s) seeking assistance using the WS Decision Model. In some instances, wildlife-related information provided to the requester by WS would result in tolerance/acceptance of the situation. In other instances, WS would discuss and recommend damage management options. WS would only recommend or loan those methods legally available for use by the appropriate individual. Similar to Alternative 1, those methods described in Appendix B would be available to those persons experiencing damage or threats associated with mammals in the State; however, Gonacon™, immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability to the public and other entities under this alternative and Alternative 3. Licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. The availability of aircraft would also be limited, especially shooting from an aircraft. Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage would require a permit from the SCDNR. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the SCDNR or those persons under the supervision of the SCDNR. At the time this EA was developed, Gonacon™ was not registered for use in the State.

The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing mammal damage. Technical assistance would include collecting information about the species involved, the extent of the damage, and previous methods that the cooperator had attempted to resolve the problem. WS would then provide information on appropriate methods that the cooperator could consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues. Between FY 2009 and FY 2014, WS has conducted 43 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those persons experiencing damage or were concerned with threats posed by mammals could seek assistance from other governmental agencies, private entities, or conduct damage management on their own. Those persons experiencing damage or threats could take action using those methods legally available to resolve or prevent mammal damage as permitted by federal, state, and local laws and regulations or those persons could take no action.

Alternative 3 – No Mammal Damage Management Conducted by WS

This alternative would preclude all activities by WS to reduce threats to human health and safety, and to alleviate damage to agricultural resources, property, and natural resources. WS would not provide

assistance with any aspect of managing damage caused by mammals in the State. WS would refer all requests for assistance to resolve damage caused by mammals to the SCDNR, other governmental agencies, and/or private entities.

Despite no involvement by WS in resolving damage and threats associated with mammals in the State, those persons experiencing damage caused by mammals could continue to resolve damage by employing those methods legally available since the removal of mammals to alleviate damage or threats could occur despite the lack of involvement by WS. The removal of mammals by other entities could occur after authorization by the SCDNR, when required, and during the hunting and/or trapping seasons. In addition, property owners or their designated agent may lethally remove furbearers (including muskrats, raccoons, river otter, coyote, gray fox, red fox, bobcat, opossum) and squirrels (including gray squirrels) causing property damage within one hundred yards of a residence without the need for authorization from the SCDNR. Similar to Alternative 2, those methods described in Appendix B would be available to those people experiencing damage or threats associated with mammals in the State; however, Gonacon™, immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability to the public and other entities under this alternative. Licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. The availability of aircraft would also be limited, especially shooting from an aircraft. Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage would require a permit from the SCDNR. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the SCDNR or those persons under the supervision of the SCDNR. At the time this EA was developed, Gonacon™ was not registered for use in the State.

Those persons experiencing damage or threats of damage could contact WS; however, WS would immediately refer the requester to the SCDNR and/or to other entities. The requester could contact other entities for information and assistance with managing damage, could take actions to alleviate damage without contacting any entity, or could take no further action.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives analyzed in detail, WS identified several additional alternatives. However, those alternatives will not receive detailed analyses for the reasons provided. Those alternatives considered but not analyzed in detail include the following.

Non-lethal Methods Implemented Before Lethal Methods

This alternative would require that WS apply non-lethal methods or techniques described in Appendix B to all requests for assistance to reduce damage and threats to safety from mammals in the State. If the use of non-lethal methods failed to resolve the damage situation or reduce threats to human safety at each damage situation, WS could employ lethal methods to resolve the request. WS would apply non-lethal methods to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by other entities or by those persons experiencing mammal damage but would only prevent the use of those methods by WS until WS had employed non-lethal methods.

Those people experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, WS could only evaluate the presence or absence of non-lethal methods. The proposed action (Alternative 1) and the technical assistance only alternative (Alternative 2) would be similar to a non-lethal before lethal

alternative because WS would give preference to the use of non-lethal methods before lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not contribute additional information to the analyses in the EA.

Use of Non-lethal Methods Only by WS

Under this alternative, WS would be required to implement non-lethal methods only to resolve damage caused by mammals in the State. WS would only employ those methods discussed in Appendix B that were non-lethal. No intentional lethal removal of mammals would occur by WS. The use of lethal methods could continue under this alternative by other entities or by those persons experiencing damage by mammals. The non-lethal methods used or recommended by WS under this alternative would be identical to those non-lethal methods identified in any of the alternatives.

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS could refer requests for information regarding lethal methods to the SCDNR, local animal control agencies, or private businesses or organizations.

Property owners or managers could conduct management using any method that was legal. Property owners or managers might choose to implement WS' non-lethal recommendations, implement lethal methods, or request assistance from a private or public entity other than WS. Property owners/managers frustrated by the lack of WS' assistance with the full range of mammal damage management techniques may try methods not recommended by WS or use illegal methods (*e.g.*, poisons). In some cases, property owners or managers may misuse some methods or use some methods in excess of what was necessary, which could then become hazardous and pose threats to the safety of people and non-target species.

The proposed action, using an integrated damage management approach, incorporates the use of non-lethal methods when addressing requests for assistance. In those instances where non-lethal methods would effectively resolve damage from mammals, WS would use or recommend those methods under the proposed action. Since non-lethal methods would be available for use under the alternatives analyzed in detail, this alternative would not add to the analyses. Those persons experiencing damage or threats of damage could lethally remove mammals under any of the alternatives even if WS was limited to using non-lethal methods only.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with mammals. However, non-lethal methods can be effective in preventing damage in certain instances. In those situations where damage could be alleviated effectively using non-lethal methods, WS would employ or recommend those methods as determined by the WS Decision Model. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Non-lethal methods have been effective in alleviating mammal damage. Therefore, WS did not consider this alternative in detail.

Live-capture and Translocation of Mammals Only

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods and WS would translocate all target mammals live-captured. Mammals could be live-captured using immobilizing drugs, live-traps, cannon nets, or rocket nets and WS would translocate those mammals to appropriate habitat for release. The success of translocation efforts would depend on efficiently capturing target mammal species and the existence of an appropriate release site (Nielsen 1988). WS would identify release sites prior to live-capture to ensure appropriate sites were available before initiating any activities.

The SCDNR would have to approve and authorize the translocation and release of the individual target animal. The translocation of mammals could only occur under the authority of the SCDNR. Therefore, the translocation of mammals by WS would only occur as directed by the SCDNR. In addition, the property owner would have to authorize WS to release target animals on their property. When the SCDNR authorizes translocation of target animals and when a property owner approves of WS releasing target animals on their property, WS could translocate mammals or recommend translocation under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, translocation by other entities could occur under Alternative 3.

Translocation may be appropriate in some situations when the population of a species is low. However, most of the target mammal species are abundant in much of the suitable habitat in South Carolina, and translocation is not necessary for the maintenance of viable populations for those species in the State. Because those mammal species are abundant in South Carolina, the mammals that WS translocated and released into suitable habitat would very likely encounter other mammals of the same species with established territories. For example, if the SCDNR authorized WS to translocate a coyote, the release of the coyote into suitable habitat would likely occur in areas where other coyotes already occur. Coyotes are territorial, and introducing a translocated coyote into a new area often disorientates the coyote because they are unfamiliar with their surroundings. Therefore, a translocated coyote would often be at a disadvantage. Territorial coyotes often viciously attack other coyotes that wander into their territories. Survival of translocated animals is generally very poor due to the stress of translocation, and in many cases, released animals suffer mortality in a new environment (Craven et al. 1998).

Generally, translocating mammals following live-capture that have caused damage to other areas would not be effective or cost-effective. Translocation is generally ineffective because problem mammal species are highly mobile and can easily return to damage sites from long distances, mammals generally already occupy habitats in other areas, and translocation could result in damage problems at the new location. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, threat of spreading diseases, poor survival rates, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988). Since WS does not have the authority to translocate mammals in the State unless the SCDNR authorizes the translocations, this alternative was not considered in detail.

Use of Non-lethal Methods and Approved Euthanasia Only

Under this alternative, WS would continue to employ an integrated methods approach but would only employ non-lethal methods to exclude, harass, or live-capture target mammal species. When deemed appropriate, WS could continue to remove target mammal species lethally; however, under this alternative, WS would only use methods that captured target mammals alive. Once live-captured, target mammals would be euthanized using methods that meet the definition of euthanasia as defined by the AVMA.

Euthanasia methods would be restricted to those defined by the AVMA (2013) as acceptable or conditionally acceptable, and would include sodium pentobarbital, potassium chloride, carbon dioxide, and firearms (once live-captured). This alternative would be similar to the proposed action alternative since WS would give preference to the use of non-lethal methods when practical and effective (see WS Directive 2.101). In addition, WS' personnel would be familiar with the euthanasia methods described by the AVMA and would use those methods to euthanize captured or restrained animals, whenever practicable (see WS Directive 2.430, WS Directive 2.505). Therefore, WS did not consider this alternative in detail.

Reducing Damage by Managing Mammal Populations through the Use of Reproductive Inhibitors

Under this alternative, the only method that would be available to resolve requests for assistance by WS would be the recommendation and the use of reproductive inhibitors to reduce or prevent reproduction in mammals responsible for causing damage. Wildlife professionals often consider reproductive inhibitors for use where wildlife populations are overabundant and where traditional hunting or lethal control programs were 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, and other factors often limit the use and effectiveness of reproductive control as a tool for wildlife population management.

Reproductive control for wildlife could occur through sterilization (permanent) or contraception (reversible). Sterilization could be accomplished through: 1) surgical sterilization (vasectomy, castration, and tubal ligation), 2) chemosterilization, and 3) through gene therapy. Contraception could be accomplished through: 1) hormone implantation (synthetic steroids such as progestins), 2) immunocontraception (contraceptive vaccines), and 3) oral contraception (progestin administered daily).

Population modeling indicates that reproductive control is more efficient 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 reproduction control technologies as a wildlife management tool for some species.

Currently, chemical reproductive inhibitors are not available for use to manage most mammal populations. Given the costs associated with live-capturing and performing sterilization procedures on mammals and the lack of availability of chemical reproductive inhibitors for the management of most mammal populations, this alternative was not evaluated in detail. If reproductive inhibitors become available to manage a large number of mammal populations and if an inhibitor has proven effective in reducing localized mammal populations, WS could evaluate the use of the inhibitor as a method available to manage damage. Currently, the only reproductive inhibitor that is registered with the EPA is Gonacon™, which is registered for use on white-tailed deer only. However, Gonacon™ was not registered for use in the State during the development of this EA. Reproductive inhibitors for the other mammal species addressed in this EA do not currently exist.

Compensation for Mammal Damage

The compensation alternative would require WS to establish a system to reimburse persons impacted by mammal damage and to seek funding for the program. Under such an alternative, 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. Evaluation of this alternative indicates that a compensation only alternative has many drawbacks. Compensation would require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation. Compensation most likely would be below full market value and would give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies. In addition, providing compensation would not be practical for reducing threats to human health and safety.

Short Term Eradication and Long Term Population Suppression

An eradication alternative would direct all WS' program efforts toward total long-term elimination of mammal populations wherever a person initiated a cooperative program with WS in South Carolina. Eradication of native mammal species is not a desired population management goal of state agencies or WS. WS did not consider eradication as a general strategy for managing mammal damage because WS and other state and federal agencies with interest in, or jurisdiction over, wildlife oppose eradication of any native wildlife species and eradication is not acceptable to most people.

Suppression would direct WS' program efforts toward managed reduction of certain problem populations or groups. In areas where WS could attribute damage to localized populations of mammals, WS could decide to implement local population suppression using the WS Decision Model. However, large-scale population suppression would not be realistic or practical to consider as the basis of the WS program. Problems with the concept of suppression would be similar to those described above for eradication. Typically, WS would conduct activities on a very small portion of the sites or areas inhabited or frequented by problem species in the State.

Bounties

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 taken from outside the area where damage was occurring. In addition, WS does not have the authority to establish a bounty program.

Trap-Neuter-Release Program for Feral and Free Ranging Cats and/or Dogs

This topic has undergone considerable debate in animal welfare and scientific communities for a number of years. The debate focuses on whether controlling feral, free-ranging, or invasive animal populations through Trap-Neuter-Release (TNR) programs are effective and alleviate problems (*i.e.*, diseases, predation, agricultural damage, and human safety).

Theoretically, TNR programs would work if all animals of one sex or both were sterilized. However, the probability of controlling invasive species in the wild with this technique would not currently be reasonable, especially with many feral animals being self-sufficient and not reliant on people to survive. Additionally, some individuals within a population can be trap-shy. Capturing or removing trap-shy individuals often requires implementing other methods.

The National Association of State Public Health Veterinarians and the AVMA oppose TNR programs based on health concerns and threats (AVMA 2003). Of major concern would be the potential for disease and parasite transmission to people from direct contact during either sterilization or the risk of exposure after the animal was released. Once live-captured, performing sterilization procedures during field operations on anesthetized animals could be difficult. Sanitary conditions could be difficult to maintain when performing surgical procedures in field conditions. To perform operations under appropriate conditions, live-captured animals would need to be transported from the capture site to an appropriate facility, which could increase the threat from handling and transporting the animal. A mobile facility could be used; however, a mobile facility would still require additional handling and transporting of the live-captured animal to the facility. Once the surgical procedure was completed, the animal would have to be held to ensure recovery and transported back to the area where capture occurred.

TNR programs are often not as successful as desired and needed to reduce immediate threats posed by wildlife, especially when human safety is a concern (AVMA 2003, Barrows 2004, Levy and Crawford 2004, Jessup 2004, Winter 2004, AVMA 2014). Feral animals subjected to a TNR program would continue to cause the same problems[11] they caused before the TNR program was initiated because of slow attrition. TNR programs can take a decade or longer to reduce target species populations (Barrows 2004, Winter 2004), especially when acute issues need rapid solutions (Levy and Crawford 2004, Stoskopf and Nutter 2004). Several studies report that target species' populations often remain stable or increase following TNR programs due to immigration and reproduction from other members of the groups (Castillo and Clarke 2003, Levy and Crawford 2004, Winter 2004) with little to no resolution of threats to human safety or damages (Barrows 2004, Slater 2004, Winter 2004).

Other concerns arise when considering the legality of TNR programs given the documented damage caused by target species, especially to native wildlife (Barrows 2004, Levy and Crawford 2004, Jessup 2004). Some people have questioned whether TNR programs are violating the Migratory Bird Treaty Act and the ESA because released animals may continue to kill migratory birds and/or endangered species (Barrows 2004, Levy and Crawford 2004, Jessup 2004). Because of the continued threat to human safety created by TNR programs and the continued threat to T&E wildlife and native wildlife in general, this alternative was not considered further.

3.3 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of activities intended to resolve wildlife damage. The WS program in South Carolina uses many such SOPs. Those SOPs would be incorporated into activities conducted by WS under the appropriate alternatives when addressing mammal damage and threats in the State.

Some key SOPs pertinent to resolving mammal damage in the State include the following:

- The WS Decision Model, which is designed to identify effective strategies to managing wildlife damage and their potential impacts, would be consistently used and applied when addressing mammal damage.

- EPA-approved label directions would be followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects occur to the environment when chemicals are used in accordance with label directions.

- Immobilizing drugs and euthanasia chemicals would be used according to the United States Drug Enforcement Administration, United States Food and Drug Administration, and WS' directives and procedures.

- All controlled substances would be registered with the United States Drug Enforcement Administration or the United States Food and Drug Administration.

- 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).

[11] Brickner (2003), Levy et al. (2003), Barrows (2004), and Jessup (2004) reported that sterilized cats that do not spend any time on courting and mating are left with more time to hunt than non-sterilized cats and therefore, continue to remain as potential reservoirs of animal and human disease, a social nuisance, and continue to hunt and kill protected species.

- WS' employees that use controlled substances would be trained to use each material and would be certified to use controlled substances.

- WS' employees who use pesticides and controlled substances would participate in State-approved continuing education to keep current of developments and maintain their certifications.

- Pesticide and controlled substance use, storage, and disposal would conform to label instructions and other applicable laws and regulations, and Executive Order 12898.

- Material Safety Data Sheets for pesticides and controlled substances would be provided to all WS' personnel involved with specific damage management activities.

- All personnel who use firearms would be trained according to WS' Directives.

- WS' employees participating in any aspect of aerial wildlife operations would be trained and/or certified in their role and responsibilities during the operations. All WS' personnel 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.

- The use of non-lethal methods would be considered prior to the use of lethal methods when managing mammal damage.

- The removal of mammals by WS under the proposed action alternative would only occur when authorized by the SCDNR, when applicable, and only at levels authorized.

- Management actions would be directed toward localized populations, individuals, or groups of target species. Generalized population suppression across South Carolina, or even across major portions of South Carolina, would not be conducted.

- Non-target animals live-captured in traps would be released unless it was determined that the animal would not survive and/or that the animal could not be released safely.

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

Several additional SOPs are applicable to the alternatives and the issues identified in Chapter 2 including the following:

Issue 1 - Effects of Mammal Damage Management Activities on Target Mammal Populations

- Lethal removal of mammals by WS would be reported and monitored by WS and the SCDNR to evaluate population trends and the magnitude of WS' removal of mammals in the State.

- WS would only target those individuals or groups of target species identified as causing damage or posing a threat to human safety.

- The WS Decision Model, designed to identify the most appropriate damage management strategies and their impacts, would be used to determine strategies for resolving mammal damage.

- WS would monitor activities to ensure those activities do not adversely affect mammal populations in the State.

- Preference would be given to non-lethal methods, when practical and effective.

Issue 2 - Effects of Mammal Damage Management Activities on Non-target Wildlife Species Populations, Including T&E Species

- When conducting removal operations via shooting, identification of the target would occur prior to application.

- As appropriate, suppressed firearms would be used to minimize noise.

- Personnel would use lures, trap placements, and capture devices that would be strategically placed at locations likely to capture a target animal and minimize the potential of non-target animal captures.

- Any non-target animals captured in cage traps, nets, or any other restraining device would be released whenever it was possible and safe to do so.

- Personnel would monitor live-capture methods or live-capture methods would be checked at least once a day or in accordance with South Carolina laws and regulations. This would help ensure non-target species were released in a timely manner or were prevented from being captured.

- Carcasses of mammals retrieved after damage management activities were conducted would be disposed of in accordance with WS Directive 2.515.

- WS has consulted with the USFWS and the SCDNR to evaluate activities to resolve mammal damage and threats to ensure the protection of T&E species.

- WS would monitor activities conducted under the selected alternative, if activities were determined to have no significant impact on the environment and an EIS was not required, to ensure those activities do not negatively affect non-target species.

Issue 3 - Effects of Mammal Damage Management Activities on Human Health and Safety

- Damage management activities would be conducted professionally and in the safest manner possible. Whenever possible, damage management activities would be conducted away from areas of high human activity. If this were not possible, then activities would be conducted during periods when human activity was low (*e.g.*, early morning).

- Shooting would be conducted during times when public activity and access to the control areas were restricted. Personnel involved in shooting operations would be fully trained in the proper and safe application of this method.

- All personnel employing chemical methods would be properly trained and certified in the use of those chemicals. All chemicals used by WS would be securely stored and properly monitored to ensure the safety of the public. WS' use of chemicals and training requirements to use those chemicals are outlined in WS Directive 2.401 and WS Directive 2.430.

- All chemical methods used by WS or recommended by WS would be registered with the EPA, the United States Drug Enforcement Administration, the United States Food and Drug Administration, and/or the CUDPR, as appropriate.

- WS would adhere to all established withdrawal times for mammals when using immobilizing drugs for the capture of mammals that were agreed upon by WS, the SCDNR, and veterinarian authorities. Although unlikely, in the event that WS was requested to immobilize mammals 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.

- Carcasses of mammals retrieved after damage management activities would be disposed of in accordance with WS Directive 2.515.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

- Management actions to reduce or prevent damage caused by mammals would be directed toward specific individuals identified as responsible for the damage, identified as posing a threat to human safety, or identified as posing a threat of damage.
- All methods or techniques applied to resolve damage or threats to human safety would be agreed upon by entering into a work initiation document, MOU, or comparable document prior to the implementation of those methods.

- Preference would be given to non-lethal methods, when practical and effective.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- Personnel would be well trained in the latest and most humane devices/methods for removing target mammals causing damage.

- WS' personnel would check methods frequently to ensure mammals captured would be addressed in a timely manner to minimize the stress of being restrained.

- When deemed appropriate using the WS Decision Model, WS' use of lethal methods would comply with WS' directives (*e.g.*, see WS Directive 2.401, WS Directive 2.430, WS Directive 2.505).

- The NWRC is continually conducting research to improve the selectivity and humaneness of wildlife damage management devices used by personnel in the field.

- The use of non-lethal methods would be considered prior to the use of lethal methods when managing mammal damage.

Issue 6 - Effects of Mammal Damage Management Activities on the Regulated Harvest of Mammals

- Management actions to reduce or prevent damage caused by mammals in the State would be directed toward specific individuals identified as responsible for the damage, identified as posing a threat to human safety, or identified as posing a threat of damage.

- WS' activities to manage damage and threats caused by mammals would be coordinated with the SCDNR.

- WS' lethal removal of mammals would be reported to and monitored by the SCDNR to ensure WS' removal was considered as part of management objectives for those mammal species in the State.

- WS would monitor activities to ensure those activities do not adversely affect mammal populations in the State.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions when selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as that alternative relates to the issues identified. The following resource values in the State are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, designated critical habitats, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Those resources will not be analyzed further.

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur because of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

This section analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. Therefore, the proposed action/no action alternative (Alternative 1) serves as the baseline for the analysis and the comparison of expected impacts among the alternatives. The analysis also takes into consideration mandates, directives, and the procedures of WS and the SCDNR.

Issue 1 - Effects of Mammal Damage Management Activities on Target Mammal Populations

Methods available to address mammal damage or threats of damage in the State that would be available for use or recommendation under Alternative 1 (proposed action/no action alternative) and Alternative 2 (technical assistance only alternative) would either be lethal methods or non-lethal methods. Many of the methods would also be available to other entities under Alternative 3 (no involvement by WS alternative). The only methods that would have limited availability under Alternative 2 and Alternative 3 would be Gonacon™, immobilizing drugs, euthanasia chemicals, and the use of aircraft. Under Alternative 2, WS could recommend lethal and non-lethal methods as part of an integrated approach to resolving requests for assistance. Alternative 1 would address requests for assistance received by WS through technical and/or operational assistance where an integrated approach to methods would be employed and/or recommended. Non-lethal methods that would be available to WS under Alternative 1 would include, but would not be limited to habitat/behavior modification, pyrotechnics, visual deterrents, live traps, translocation, cable restraints, exclusionary devices, frightening devices, nets, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods).

Non-lethal methods that would be available under all of the alternatives could disperse or otherwise make an area unattractive to mammals causing damage; thereby, reducing the presence of mammals at the site and potentially the immediate area around the site where non-lethal methods were employed. WS' personnel would give preference to non-lethal methods when addressing requests for assistance under Alternative 1 and Alternative 2 (see WS Directive 2.101). However, WS' personnel would not necessarily employ or recommend non-lethal methods to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance had already used non-lethal methods, WS would not likely recommend or continue to employ those particular methods since their use had already been proven ineffective in adequately resolving the damage or threat.

The continued use of many non-lethal methods can often lead to the habituation of mammals to those methods, which can decrease the effectiveness of those methods. For any management methods employed, the proper timing would be essential in effectively dispersing those mammals causing damage. Employing methods soon after damage begins or soon after threats were identified would increase the likelihood that those damage management activities would achieve success in addressing damage. Therefore, the coordination and timing of methods would be necessary to be effective in achieving expedient resolution of mammal damage.

WS and other entities could use non-lethal methods to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from the area resulting in a reduction in the presence of those mammals at the site. The dispersal of target mammal species to other areas would have a minimal effect on those species' populations. WS would not employ non-lethal methods over large geographical areas or applied at such intensity that essential resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods generally have minimal impacts on overall populations of wildlife since individuals of those methods do not harm target species. The use of non-lethal methods would not have adverse impacts on mammal populations in the State under any of the alternatives.

In addition to non-lethal methods available to disperse, exclude, or harass wildlife, another non-lethal method available under the alternatives would be the reproductive inhibitor under the trade name Gonacon™. The reproductive inhibitor Gonacon™ is currently not registered for use in South Carolina. However, the product is discussed in this assessment to evaluate the potential use of the chemical if it becomes registered for use in the future. Gonacon™ has been classified as a restricted-use pesticide by the EPA. Restricted-use pesticides can only be purchased and/or applied by those persons who have successfully completed an applicators course to use restricted-use pesticides. The CUDPR administers training and testing required for applicators to purchase and apply restricted-use pesticides in the State. Gonacon™ could be employed by WS and/or the SCDNR, if registered for use in the State, under Alternative 1. Only the SCDNR or their designated agents could use Gonacon™ if Alternative 2 or Alternative 3 were selected.

A common issue is whether damage management actions would adversely affect the populations of target mammal species, especially when an entity employs lethal methods. WS would maintain ongoing contact with the SCDNR to ensure activities occurred within management objectives for target species. WS would submit annual activity reports to the SCDNR. Therefore, the SCDNR would have the opportunity to monitor the total removal of mammals from all sources and would factor in survival rates from predation, disease, and other mortality data. Ongoing contact with the SCDNR would assure local, state, and regional knowledge of wildlife population trends would be considered. As discussed previously, the analysis for magnitude of impact from lethal removal can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels,

and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. Information on mammal populations and trends are often derived from several sources, including published literature and harvest data.

Lethal methods would also be available for use under all the alternatives by WS and/or by other entities. Lethal methods that would be available to address mammal damage include live-capture followed by euthanasia, shooting, body gripping traps, fumigants, cable restraints, rodenticides, and the recommendation of harvest during the hunting and/or trapping seasons, where appropriate. In addition, WS could use foothold traps for drowning sets that target muskrats. All of those methods would be available for use by WS or for recommendation by WS under Alternative 1. WS would only employ lethal methods to resolve damage under Alternative 1 after receiving a request for the use of those methods. Those same methods would also be available for WS to recommend and for other entities to use under Alternative 2. Under Alternative 3, those same lethal methods would continue to be available for use by other entities despite the lack of involvement by WS in damage management activities.

When live-captured target animals were to be lethally removed under Alternative 1, removal would occur pursuant to WS Directive 2.505 and WS Directive 2.430. Under alternative 2, WS could recommend the use of methods to lethally remove live-captured or restrained target animals in accordance with WS Directive 2.505. No assistance would be provided by WS under Alternative 3; however, many of those methods available to lethally remove live-captured or restrained animals would continue to be available for use by other entities under Alternative 3.

The use of lethal methods by any entity could result in local population reductions in the area where damage or threats were occurring since target individuals would be removed from the population. Lethal methods could be employed or recommended to remove mammals that have been identified as causing damage or posing a threat to human safety. Therefore, the use of lethal methods could result in local reductions of mammals in the area where damage or threats were occurring. The number of mammals removed from the population annually by WS using lethal methods under Alternative 1 would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed. The number of mammals removed by other entities under Alternative 2 and Alternative 3 would be unknown but would likely be similar to the removal that could occur under Alternative 1. Those persons experiencing damage or their designee could lethally remove furbearing animals and squirrels that are causing damage within 100 yards of the owner's home when those animals are causing damage to the home or the owner's property (see Section 1.6). In addition, a person experiencing damage could remove target wildlife after seeking and receiving authorization from the SCDNR. People could also seek assistance from the private entities, such as Nuisance Wildlife Control Operators, to manage damage.

Most lethal methods would be employed to reduce the number of mammals present at a location since a reduction in the number of mammals at a location could lead to a reduction in damage, which would be applicable whether using lethal or non-lethal methods. The intent of non-lethal methods would be to harass, exclude, or otherwise make an area unattractive to mammals, which disperses those mammals to other areas leading to a reduction in damage at the location where those mammals were dispersed. Similarly, the use of a reproductive inhibitor would be to reduce a local population of target mammals, which could reduce the damage occurring since fewer individuals in a localized population could lead to more tolerable damage levels. The intent of using lethal methods would be similar to the objective trying to be achieved when using non-lethal methods, which would be to reduce the number of mammals in the area where damage was occurring; thereby, reducing the damage occurring at that location.

The use of firearms could reduce the number of mammals using a location (similar to dispersing mammals) by lethally removing those target animals causing damage or posing a threat of damage. The

capture of mammals using live-traps and subsequently euthanizing those mammals would be employed to reduce the number of mammals using a particular area where damage was occurring. Similarly, the recommendation that mammals be harvested during the regulated hunting and/or trapping season for those species in the State would be intended to manage those populations in the area where damage was occurring.

Often of concern with the use of lethal methods is that mammals that were lethally removed would only be replaced by other mammals either during the application of those methods (*e.g.*, mammals that relocate into the area) or by mammals the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). As stated previously, WS would not use lethal methods during direct operational assistance as population management tools over broad areas. Lethal methods would be employed under Alternative 1 to reduce the number of target animals present at a location where damage was occurring by targeting those animals causing damage or posing threats. The return of mammals to areas where methods were previously employed does not indicate previous use of those methods were ineffective since the intent of those methods were to reduce the number of mammals present at a site where damage was occurring or could occur at the time those methods were employed.

Most lethal and non-lethal methods currently available provide only short-term benefits when addressing mammal damage. Those methods would be employed to reduce damage occurring at the time those methods were employed but do not necessarily ensure mammals would not return once those methods were discontinued or after the reproductive season (when young disperse and occupy vacant areas). Long-term solutions to resolving mammal damage can often be difficult to implement and can be costly. In some cases, long-term solutions involve exclusionary devices, such as fencing, or other practices such as structural repairs. When addressing mammal damage, long-term solutions generally involve modifying existing habitat or making conditions to be less attractive to mammals. To ensure complete success, alternative sites in areas where damage was not likely to occur would often times be required to achieve complete success in reducing damage and to avoid moving the problem from one area to another. Modifying a site to be less attractive to mammals would likely result in the dispersal of those mammals to other areas where damage could occur or could result in multiple occurrences of damage situations.

WS may recommend under Alternative 1 and Alternative 2 that property owners or managers, that request assistance, allow people to harvest mammals during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of mammals causing damage on their properties. Managing localized mammal populations by allowing hunting and/or trapping could lead to a decrease in the number of mammals causing damage. Establishing hunting and trapping seasons and the allowed harvest during those seasons is the responsibility of the SCDNR. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons. However, the harvest of those mammals during hunting and/or trapping seasons in the State would be occurring in addition to any removal that could occur by WS under the alternatives or recommended by WS. Table 4.1 shows the number of target animals that people have harvested in the State since the 2002-2003 hunting and trapping season for those species. In addition, mammals could also be lethally removed by other entities to alleviate damage or threats of damage under all the alternatives. The total number of individuals from each species that were lethally removed by other entities to alleviate damage or threats of damage is currently not available.

The analysis for each of the species includes an estimate of annual removal by WS as compared to statewide population estimates of the species. The statewide population has been estimated using the most current reliable information possible. Frequently, there is no current reliable information available for a species and conservative estimates are calculated based upon habitat availability and species use of those habitats. Habitat availability was calculated using the 2006 National Land Cover Dataset (NLCD) created through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC)

Consortium. The MRLC Consortium is a partnership of federal agencies, consisting of the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, the EPA, USDA-Natural Resources Conservation Service, the United States Forest Service, the National Park Service, the USFWS, the Bureau of Land Management, the National Aeronautics and Space Administration, and the Office of Surface Mining.

Table 4.1 - South Carolina furbearer harvest data (J. Butfiloski, SCDNR pers. comm. 2014).

SPECIES	Year										Average
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	
Raccoon	2,651	2,536	2,911	2,344	2,727	2,716	3,123	2,357	3,406	3,775	**2,855**
Opossum	2,424	2,687	2,855	2,335	2,452	1,958	2,506	2,376	2,684	3,326	**2,560**
Gray Fox	2,201	2,513	2,068	1,455	1,328	1,666	1,726	1,319	1,201	1,275	**1,675**
Red Fox	723	691	677	425	614	576	643	500	487	512	**585**
Coyote	295	700	1,045	1,023	1,223	1,520	2,384	2,123	2,205	2,546	**1,506**
Bobcat	244	271	343	366	425	465	494	447	419	446	**392**
Muskrat	80	122	92	116	177	130	112	51	79	106	**107**
Otter	463	539	818	863	412	281	317	242	388	330	**465**

The 2006 NLCD was created from satellite imagery that was digitally rendered to produce a land-cover database comprised of three elements: land cover, impervious surface and canopy density. These elements were then combined to create a digital map of the United States in which each pixel, covering 30 m^2 each, is classified into one of 29 different land classes. By adding all of the individually quantified pixels together, the resulting number is the most accurate number currently available for quantifying land within the state in any given land class. The State of South Carolina includes 15 of the 29 possible classes and this information is presented in Table 4.2. The land class data presented in Table 4.2 serves as the basis for current population estimates as presented in each species' population information and effects analysis.

Table 4.2 - South Carolina Land Cover Area by Class as calculated from the 2006 NLCD

Land Cover Class	Area in South Carolina (km^2)	Area in South Carolina (mi^2)	Definition
Open Water	2,438.60	941.54	All areas of open water, generally with less than 25% cover of vegetation or soil.
Developed Open Space	4,511.86	1,742.03	Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover.
Developed Low Intensity	1,837.24	709.36	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.
Developed Medium Intensity	549.26	212.07	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover.
Developed High Intensity	194.86	75.24	Includes highly developed areas where people reside or work in high numbers. Impervious surfaces account for 80% to 100% of the total cover.
Barren Land	352.76	136.20	Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and

Land Cover Class	Area in South Carolina (km^2)	Area in South Carolina (mi^2)	Definition
			other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Deciduous Forest	10,595.04	4,090.75	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
Evergreen Forest	19,737.13	7,620.51	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
Mixed Forest	1,163.13	449.08	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
Shrub/Scrub	5,212.40	2,012.51	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Grassland/ Herbaceous	4,616.13	1,782.29	Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
Pasture Hay	6,543.67	2,526.51	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
Cultivated Crops	6,508.88	2,513.08	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Woody Wetlands	13,627.33	5,261.51	Areas where forest or scrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Emergent Herbaceous	2,275.13	878.43	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative

Land Cover Class	Area in South Carolina (km^2)	Area in South Carolina (mi^2)	Definition
Wetlands			cover and the soil or substrate is periodically saturated with or covered with water.
Total Area of All Land Cover Classes	**80,163.44**	**30,951.10**	

Population and density information specific to South Carolina for many of the target species is not available and is not known. Frequently, population information is not available for a species and conservative estimates can be calculated based upon the density of a species, the availability of habitat, and a species use of the habitats available. To evaluate the potential impacts to a target species population and to evaluate the magnitude of the potential impacts from activities that could be conducted by WS under the proposed action alternative, a statewide population estimate for many of the target species has been calculated using available information from published literature and other sources. Population estimates were primarily derived from available density data for individual species, when available, and the land classification most likely to contain that particular species. When density data was available, the population estimates were based on those species occupying a certain percentage of the land classifications that likely represented suitable habitat for a particular species. Since information on actual populations and densities was not available for most target species in South Carolina, calculating a statewide population estimate based on a species only occupying a certain percentage of the available habitat was used during the evaluation to estimate a minimum population or a worst-case scenario to evaluate the magnitude of WS' potential annual lethal removal.

For example, the statewide population of gray fox was estimated based on the species occupying only 50% of the habitat types where the species could be found within the State, which excluded urban areas. Gray fox can be found statewide in a variety of habitats, including urban areas, so gray fox occupying only 50% of the land area of the State is unlikely. However, similar to many of the target species, gray fox occupying only 50% of certain land classifications was used to provide a minimum population estimate to evaluate potential impacts based on a worst-case scenario.

The analysis of potential impacts on each of the species populations includes the anticipated annual lethal removal by WS, which was based on previous requests for assistance and in anticipation of additional efforts to manage damage or threats of damage in the future. The anticipated number of animals from a species' population that WS could lethally remove annually was then compared to the calculated statewide population estimate for a species to determine the magnitude of lethal removal on the estimated statewide population of a species under a worst-case scenario.

In addition to the annual lethal removal that could occur from WS during damage management activities using lethal methods, many of the target mammal species can also be harvested during annual hunting and/or trapping seasons in the State. To evaluate potential cumulative impacts, harvest data from the hunting and/or trapping seasons is also included in the effects analysis for some of the mammal species, when available.

As discussed previously, the analysis to determine the magnitude of impact from lethal removal can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. The issue of the potential impacts of conducting the alternatives on the populations of those mammal species addressed in this assessment is analyzed for each alternative below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

Under the proposed action, WS would continue to provide both technical assistance and direct operational assistance to those persons requesting assistance with managing damage and threats associated with mammals in the State. WS could employ those methods described in Appendix B in an adaptive approach that would integrate methods to effectively reduce damage and threats associated with mammals in the State.

Generally, WS only conducts damage management on species whose population densities are high and usually only after they have caused damage. WS monitors the magnitude of animals lethally removed by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal was maintained below the level that would cause undesired adverse effects to the viability of native species' populations. The potential impacts on the populations of target mammal species from the implementation of the proposed action are analyzed for each species below.

MUSKRAT POPULATION INFORMATION AND EFFECTS ANALYSIS

Muskrats are fairly large rodents with dense, glossy fur, dark brown above, lighter on the sides, paler below to nearly white on the throat. They have long scaly tails that are nearly naked and laterally flattened, tapering to a point. They build houses, or lodges of aquatic plants, especially cattails, up to 2.4 m (8 feet) in diameter and 1.5 m (5 feet) high. Muskrats build those structures atop piles of roots, mud, or similar support in marshy areas, streams, lakes, or along water banks. They also burrow in stream or pond banks with entrances often above the water line. Another sign of the presence of muskrat includes the presence of feeding platforms that muskrats build out of cut vegetation in water or on ice. Discarded or uneaten grasses or reed cuttings and floating blades of cattails, sedges, and similar vegetation located near the banks mark the feeding platforms. This species is most active at dusk, dawn, and at night, but they can be active at any time of the day in all seasons, especially spring. Muskrats are excellent swimmers and spend much of their time in the water. They inhabit fresh, salt, and brackish waters throughout most of Canada and the United States, except for the Arctic regions (National Audubon Society 2000). They can occur in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1987).

Muskrats are prolific and produce three to four litters per year that average five to eight young per litter (Wade and Ramsey 1986), which makes them relatively immune to overharvest (Boutin and Birkenholz 1987). Harvest rates of three to eight animals per acre could be sustainable in muskrat populations (Boutin and Birkenholz 1987). Muskrat home ranges can vary from 529 square feet to 11,970 square feet (0.1 to 0.25 acres), with the size of home ranges occupied by muskrats dependent upon habitat quality and population density (Boutin and Birkenholz 1987).

Young muskrats are especially vulnerable to predation. Adult muskrats may also be subject to predation, but rarely in numbers that would lower populations. Predation alone cannot solve damage problems caused by muskrats (Miller 1994). Predators of muskrat include great horned owls, barred owls, red-tailed hawks, bald eagles, raccoons, mink, river otter, red fox, gray fox, coyotes, bobcat, Northern pike (*Esox lucius*), largemouth bass (*Micropterus salmoides*), snapping turtles (*Chelydra serpentine*), and bullfrogs (*Rana catesbeiana*). Adult muskrats also occasionally kill young muskrats (Miller 1994).

No population estimates are available in South Carolina for muskrats; however, muskrats are abundant in the Piedmont of South Carolina, and there are scattered populations in the Upper Coastal Plain as well. Wetland estimates in South Carolina range from 4.5 million acres (see Table 4.2) to 4.6 million acres (Hefner et al. 1994).

Since population estimates are not currently available, WS will derive a population estimate based on the best available information for muskrats to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Using the lowest acreage of wetlands in South Carolina of 4.5 million acres and using a single muskrat home range of 0.25 acres and assuming only one muskrat occupies a home range with no overlap of ranges, a statewide population could be estimated at 18 million muskrats. However, not all wetlands likely provide suitable habitat for muskrats. If only 25% of the wetland acreage in the State were suitable habitat for muskrats, the population could be approximately 4.5 million muskrats.

The SCDNR considers muskrats to be a furbearing species in South Carolina that people can harvest annually during hunting and trapping seasons. The SCDNR is responsible for establishing the annual seasons and the allowed harvest during the seasons. Currently, the SCDNR places no limit on the number of muskrats that hunters and trappers can harvest during the length of the hunting and trapping seasons. Between 2003 and 2012, trappers have harvested an average of 107 muskrats per year in the State. The highest annual harvest occurred in 2007 when trappers harvested 177 muskrats (see Table 4.2). The number of muskrats that hunters harvest annually in the State is currently unknown. In addition, the number of muskrats that people lethally remove to alleviate damage in the State is unknown.

Between FY 2009 and FY 2014, the WS program in South Carolina lethally removed 19 muskrats unintentionally during activities targeting other animals, primarily activities associated with beaver. WS has not received requests for direct operational assistance associated with muskrats in the State between FY 2009 and FY 2014. However, WS could receive requests for direct operational assistance to manage damage or threats of damage associated with muskrats. People could request direct operational assistance from the WS program in South Carolina, including the use of lethal methods to remove muskrats causing damage or posing a threat of damage. Based on the number of muskrats unintentionally lethally removed by WS between FY 2009 and FY 2014 and in anticipation of receiving requests for direct operational assistance, the WS program could lethally remove up to 50 muskrats cumulatively per year in the State.

Using a population estimated at 4.5 million muskrats, the lethal removal of up to 50 muskrats annually would represent 0.001% of the estimated statewide population. As mentioned previously, trappers have harvested an average of 107 muskrats per year in the State, with the highest annual harvest occurring in 2007 when trappers harvested 177 muskrats. If the average number of muskrats harvested annually by trappers were representative of future harvest levels, the cumulative removal of muskrats (*i.e.*, WS' removal of 50 muskrats and the harvest of 107 muskrats annually) would represent 0.003% of a statewide population estimated at 4.5 million muskrats. If WS lethally removed 50 muskrats and the annual harvest reached 177 muskrats, the cumulative removal would represent 0.01% of the estimated statewide population.

Although the actual number of muskrats harvested annually in the State during the hunting and trapping season is unknown, the cumulative removal is not likely to reach a magnitude where adverse effects would occur to the muskrat population. The unlimited harvest allowed by the SCDNR provides an indication that the statewide densities of muskrats are sufficient that overharvest is not likely to occur. In addition, requests for assistance that WS would likely receive associated with muskrats would probably occur in habitats where little or no trapping by fur harvesters occurred. Damage management activities associated with muskrats would target single animals or localized populations at sites where their presence was causing unacceptable damage to agriculture, human health and safety, natural resources, or property.

WOODCHUCK POPULATION INFORMATION AND EFFECTS ANALYSIS

The woodchuck, also known as the "*groundhog*", is a large rodent, often seen in pastures, meadows, and fields in South Carolina. They dig large burrows, generally eight to 12 inches at the opening, sometimes five feet deep and 30 feet long with more than one entrance, which opens to a spacious grass-filled chamber. Green vegetation, such as grass, clover, and alfalfa, forms its diet. At times, the woodchuck will feed heavily on corn and can cause extensive damage in a garden to other crops (National Audubon Society 2000). Woodchucks may also jeopardize the integrity of earthen dams, present hazards to livestock and farm equipment because of burrowing, gnawing electrical cables, and damaging hoses and other accessories on automobiles by gnawing (Bollengier 1994).

The breeding season for woodchucks is usually from March through April (Bollengier 1994). Female woodchucks usually produce from four to six young per year (Armitage 2003). The offspring breed at one year of age and live four to five years. Mammal species with high mortality rates, such as rodents (*e.g.*, woodchucks) and lagomorphs (*e.g.*, rabbits), typically possess high reproductive rates, and produce large and frequent litters of young (Smith 1996). For example, if a pair of woodchucks and their offspring all survived to breed as soon as possible, they could produce over 645 woodchucks through their lifetime based on an average litter size of four and a 1:1 sex ratio. The range of woodchucks in the United States extends throughout the East, northern Idaho, northeastern North Dakota, southeastern Nebraska, eastern Kansas, northeastern Oklahoma, and south to Virginia and Alabama.

Woodchucks seldom stray far from their home dens. Armitage (2003) estimated that distances of daily travel ranged from 100 m in colonies occupying good habitat to 400 m in somewhat lacking habitat, which makes a home range of seven to 124 acres in size. Woodchuck colonies have not been extensively studied to determine the social structure of a typical colony. However, in order for the species to survive, a colony would have to be comprised of at minimum two adults and the young of that year, totaling at least six to eight individuals.

Woodchucks are an unregulated species in South Carolina that people can lethally remove at any time with no limit on the number that people can remove. Like many mammal species, the statewide population of woodchucks is unknown. As stated previously, woodchucks are typically associated with pastures, meadows, fields, open woodlands, and clearings (Armitage 2003). The land cover categories most likely to encompass those habitats include pasture, shrub/scrub, grassland, and mixed forest, which cumulatively total approximately 17,535 km^2 (6,770 mi^2) in South Carolina (see Table 4.2). If only 50% of those land classes supported woodchucks, under a worst-case scenario, with an estimate of a single woodchuck home range at 124 acres and assuming that only one woodchuck occupied a home range and no home ranges overlapped, the woodchuck population would be approximately 17,500 woodchucks in South Carolina. This would be a worst-case scenario since the woodchuck population likely inhabits a much larger portion of those land classifications, woodchuck colonies likely consist of six to eight individuals, and some portion of most other land cover categories can support woodchuck populations.

WS has not received requests for direct operational assistance associated with woodchucks in the State between FY 2009 and FY 2014. However, WS could receive requests for direct operational assistance to manage damage or threats of damage associated with woodchucks. People could request direct operational assistance from the WS program in South Carolina, including the use of lethal methods to remove woodchucks causing damage or posing a threat of damage. When receiving requests for assistance associated with woodchucks, the WS program in South Carolina would follow WS Directive 2.345. In anticipation of receiving requests for direct operational assistance, the WS program could lethally remove up to 200 woodchucks per year in the State. In addition, WS could receive requests to treat woodchuck burrows using gas cartridges (EPA Reg. No. 56228-2). WS anticipates treating up to 200 woodchuck burrows per year in the State using gas cartridges.

WS could employ gas cartridges to fumigate woodchuck burrows in areas where damage was occurring. Gas cartridges act as a fumigant by producing carbon monoxide gas when ignited. The cartridges contain sodium nitrate that when burnt, produces carbon monoxide gas. The cartridges would be placed inside active burrows at the entrance, the cartridge would be ignited, and the entrance to the burrow would be sealed with dirt, which allows the burrow to fill with carbon monoxide.

The number of entrances to burrow systems used by woodchucks varies. Twichell (1939) found the number of entrances to burrow systems used by woodchucks ranged from two to six entrances in Missouri with the average number being 2.8 entrances. Other studies note the number of entrances per burrow system ranged from one to five entrances (Grizzell, Jr. 1955) to a high of 11 entrances per system (Merriam 1971). Merriam (1971) found the mean number of entrances per burrow system was 2.98 entrances. The use of burrow systems is usually restricted to a male and a reproductive female (Swihart 1992, Armitage 2003). The number of woodchucks lethally removed when using gas cartridges to fumigate burrows would be based on the mean number of entrances per burrow system of approximately three entrances (Twichell 1939, Merriam 1971) and each burrow system occupied by a male and a female (Swihart 1992, Armitage 2003). The removal of woodchucks could also occur using other methods, such as shooting, live traps, and body gripping traps. However, WS does not expect the number of woodchucks lethally removed using gas cartridges and the number removed by other methods to exceed 200 woodchucks annually.

Damage management activities associated with woodchucks would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced because of damage management activities conducted under the proposed action alternative aimed at reducing damage at a local site. If WS' annual removal reached 200 woodchucks, the removal would represent 1.4% of a statewide population estimated at 17,500 woodchucks, if the population remained at least stable. However, WS' annual removal of woodchucks would likely represent a smaller percentage of the actual population given the population estimate derived represents a worst-case scenario. The unlimited removal and continuous open season for woodchucks provides an indication that densities are sufficient that overharvest is unlikely to occur.

GRAY SQUIRREL POPULATION INFORMATION AND EFFECTS ANALYSIS

Gray squirrels occur throughout most of the eastern United States, including South Carolina. They inhabit mixed hardwood forests, especially those containing nut trees such as oak and hickory. While people commonly refer to them as tree squirrels, they spend quite a bit of time on the ground foraging. Squirrels feed on a wide variety of foods and adapt quickly to unusual food sources. Typically, they feed on wild tree fruits and nuts in fall and early winter. Acorns, hickory nuts, walnuts, and Osage orange fruits are favorite fall foods. Squirrels often cache nuts for later use. In late winter and early spring, they prefer tree buds. In summer, they eat fruits, berries, and succulent plant materials. They will also feed on fungi, corn, and cultivated fruits when available. They may also chew bark during high population peaks, when food is scarce and may eat insects and other animal matter (Jackson 1994*a*).

Gray squirrels produce young during early spring but may actually produce at any time until early September (National Audubon Society 2000). Older adults may produce two litters per year (Burt and Grossenheider 1976, Jackson 1994*a*). The gestation period is 42 to 45 days, and about three young comprise a litter. Young begin to explore outside the nest at about 10 to 12 weeks of age (Jackson 1994*a*). Home ranges of squirrels range from 1.2 to over 40 acres in size (Flyger and Gates 1982) with gray squirrels generally occupying home ranges up to seven acres.

Squirrel populations periodically increase and decline. Gray squirrels can have mass emigrations of thousands or millions of individuals moving simultaneously during which time many die. Squirrels are vulnerable to numerous parasites and diseases such as ticks, mange mites, fleas, and internal parasites. Squirrel hunters often notice bot fly larvae, called "*wolves*" or "*warbles*", protruding from the skin of animals killed. Larvae do not impair the quality of the meat for eating. In addition to being a food source for some people, squirrels are also prey for hawks, owls, snakes, and several mammalian predators. Predation seems to have little effect on squirrel populations. Typically, about half the squirrels in a population die each year and wild squirrels over four years old are rare, while captive individuals may live 10 years or more (Jackson 1994*a*).

Gray squirrel densities fluctuate based on available food sources but long-term densities tend to be stable (Gurnell 1987). Manski et al. (1981) found gray squirrel densities were typically less than 1.2 squirrels per acre in continuous areas of woodlands in North Carolina. Doebel and McGinnes (1974) found gray squirrel densities in small woodlots of less than 10 ha in area can be as high as 16 squirrels per ha. In urban parks, Manski et al. (1981) found gray squirrel densities can be more than 8.4 squirrels per acre. A three acre park in Washington, D.C. had a density of 50 squirrels per ha (20 per acre) (Hadidian et al. 1987).

The gray squirrel occurs statewide. However, statewide population estimates for the gray squirrel are currently not available. To determine a statewide population, the best available information will be used to estimate a population. The rural land cover classifications most likely to encompass suitable squirrel habitats are deciduous, evergreen, and mixed forests, which cumulatively total approximately 31,495 km^2 (12,160 mi^2) in South Carolina (see Table 4.2). If only 50% of those land classes supported squirrels, under a worst-case scenario, with an estimate of one gray squirrel per every 7 acres, the statewide population could be approximately 555,900 gray squirrels in South Carolina, if only one squirrel occupied a home range and no home ranges overlapped. This would be a worst case scenario since gray squirrel populations are likely to inhabit a much larger portion of the land classes in the State, squirrels typically occur at much higher densities, and no urban or suburban lands were included in the calculations where squirrel densities are likely to be high.

The SCDNR classifies the gray squirrel as a small game species in South Carolina with a regulated hunting season. During the development of this EA, the limit on the number of squirrels that hunters could harvest daily during the length of the season was 10 squirrels, with no limit on the number of squirrels that a hunter could possess during the length of the season (SCDNR 2014*a*). However, the number of gray squirrels that hunters harvest annually in the State is unknown.

WS has previously received requests for direct operational assistance associated with gray squirrels. Requests for assistance were primarily associated with squirrels causing damage to ornamental trees, electrical utilities, and residential buildings. Requesters reported over $1,300,000 in damage caused by squirrels from FY 2009 through FY 2014. Based on requests for assistance, WS employed lethal methods to remove 200 gray squirrels to alleviate damage or threats of damage during this period. Based on previous requests for assistance and in anticipation of conducting additional efforts to alleviate damage, WS could lethally remove up to 400 gray squirrels annually in the State to alleviate damage. In addition, WS could unintentionally live-capture squirrels during damage management activities targeting other animals; however, WS would release those squirrels unharmed. WS could also lethally remove squirrels unintentionally as non-targets during other damage management activities targeting other mammal species. However, WS does not anticipate the cumulative lethal removal of squirrels to exceed 400 individuals annually.

If WS lethally removed up to 400 gray squirrels, the lethal removal would represent 0.1% of the estimated gray squirrel population in the State under a worst-case scenario. However, WS' annual removal of gray

squirrels would likely represent a smaller percentage of the actual population given the population estimate derived represents a worst-case scenario. As stated previously, the SCDNR allows hunters to harvest gray squirrels in the State with no limit on the number of squirrels that a hunter could possess during the length of the season, which provides an indication that densities are sufficient that overharvest is unlikely to occur.

RACCOON POPULATION INFORMATION AND EFFECTS ANALYSIS

The raccoon is a stocky mammal about 61 to 91 cm (2 to 3 feet) long, weighing 4.5 to 13.5 kg (10 to 30 lbs). It is distinctly marked, with a prominent black mask over the eyes and a heavily furred, ringed tail. The animal is a grizzled salt-and-pepper gray and black above, although some individuals are strongly washed with yellow (Boggess 1994).

Raccoons are omnivorous and they will eat carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, and a wide variety of grains, various fruits, and other plant materials. They will also eat most foods prepared for human or animal consumption (Sanderson 1987). They occasionally kill poultry (Boggess 1994).

The raccoon occurs throughout most of the United States, with the exception of the higher elevations of mountainous regions and some areas of the arid southwest (Boggess 1994, National Audubon Society 2000). Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains (Boggess 1994), and are frequently found in cities or suburbs as well as rural areas (National Audubon Society 2000). Movements and home ranges of raccoons vary according to sex, age, habitat, food sources, season, and other factors. In general, males have larger home ranges than females. Home range diameters of raccoons can range from one to three km (0.6 to 2.9 mi) maximum, with some home range diameters of dense suburban populations to be 0.3 to 0.7 km (0.2 to 0.4 mi).

In South Carolina, raccoons can cause damage to a variety of resources, including agricultural resources and property. Results of their feeding may be the total loss of ripened sweet corn in a garden. Damage to buildings generally occurs when they seek to gain entry or begin denning in those structures. Raccoons may den in uncapped chimneys, or may tear off shingles or fascia boards to gain access to attics or wall spaces. They may also damage or destroy sod by rolling it up in search of earthworms and other invertebrates (Boggess 1994).

Many people who request assistance are also concerned about health and safety issues associated with raccoons. Those risks could include disease transmission from raccoons to people, pets, or livestock. Disease threats could include, but would not be limited to, canine distemper, rabies, and the roundworm *Baylisascaris procyonis*, the eggs of which survive for extremely long periods in raccoon feces and soil. Ingestion of *B. procyonis* eggs can result in serious or fatal infections in other animals, as well as people (Davidson 2006) (see Table 1.3).

Absolute raccoon population densities are difficult or impossible to determine because of the difficulty in knowing what percentage of the population that people had already counted or estimated with the additional difficulty of knowing how large an area the raccoons were using (Sanderson 1987). Due to their adaptability, raccoon densities reach higher levels in urban areas than that of rural areas. Researchers have inferred relative raccoon population densities based on the removal of animals per unit area. For example, Twichell and Dill (1949) reported removing 100 raccoons from tree dens in a 41 hectares (101 acres) waterfowl refuge area, while Yeager and Rennels (1943) studied raccoons on 881 hectares (2,177 acres) in Illinois and reported trapping 35 to 40 raccoons in 1938-1939, 170 in 1939-1940, and 60 in 1940-1941. Slate (1980) estimated one raccoon per 7.8 ha (19.3 acres) in New Jersey in predominantly agricultural land on the inner coastal plain. Raccoon densities of 100 per square mile (1

raccoon per 6.4 acres) may occur around abundant food sources (Kern 2002). Riley et al. (1998) summarized rural raccoon densities based on published literature that ranged from two to 650 per square mile in rural habitats, with an average of 10 to 80 raccoons per square mile.

Similar to the other species addressed in this EA, the raccoon population in the State is unknown. In addition, raccoon density information specifically for South Carolina is not available. Therefore, WS will use the best available information to estimate a statewide population. The rural land cover classifications most likely to encompass suitable raccoon habitats are deciduous forest, mixed forest, shrub/scrub, and woody wetlands, which cumulatively total approximately 30,598 km^2 (11,814 mi^2) in South Carolina (see Table 4.2). If only 50% of those land classifications supported raccoons, under a worst-case scenario and densities ranged from 10 to 80 raccoons per square mile, the statewide population would range from 59,000 raccoons to 472,600 raccoons. This would be a worst-case scenario since raccoon populations are likely to inhabit a much larger portion of those land classifications, raccoons are frequently found at much higher densities, and no urban or suburban lands were included in these calculations where raccoon populations are likely to be at their highest. Similar to estimates derived for the other mammal species addressed in this EA, estimating that raccoons inhabit only 50% of certain land classifications in the State allows WS to determine a minimum population estimate to compare the potential effects of WS' proposed removal of raccoons and to determine the magnitude of WS' proposed removal.

The SCDNR classifies raccoons as small game and as furbearers in State with an annual regulated hunting and trapping season. During the annual hunting and trapping season, the SCDNR places no limit on the number of raccoons a person may harvest during the length of those seasons (SCDNR 2014*a*). As shown in Table 4.1, trappers harvested an average of 2,855 raccoons per year from 2003 through 2012, with the highest annual reported harvest occurring in 2012 when trappers reported harvesting 3,775 raccoons in the State. In addition, people can lethally remove raccoons to alleviate damage when authorized by the SCDNR. However, the number of raccoons lethally removed by other entities to alleviate damage in the State is unknown.

WS could provide assistance in efforts to contain the spread of raccoon rabies in South Carolina. Those activities are part of the national rabies barrier program addressed under separate environmental analyses (USDA 2010*a*). Other rabies monitoring or control activities may occur as part of this program. A separate EA addresses raccoons killed under the ORV program (USDA 2010*a*) but are included in this EA for cumulative impact analysis.

During all damage management activities conducted by WS from FY 2009 through FY 2014, WS lethally removed 74 raccoons, which is an annual removal of 12 raccoons. Of the 74 raccoons lethally removed by WS between FY 2009 and FY 2014, WS removed 59 raccoons unintentionally during activities that targeted other animal species. A separate EA discusses the potential impacts to the raccoon population and to non-targets from the ORV program (USDA 2010*a*). The WS program in South Carolina has not previously conducted activities related to the ORV program; however, WS could conduct activities related to the ORV program in the future. WS' activities conducted under the ORV program would primarily be non-lethal and would not involve the lethal removal of raccoons for monitoring purposes.

Based on previous requests for assistance received by WS and in anticipation of additional efforts to manage raccoon damage, up to 200 raccoons could be lethally removed by WS annually under the proposed action and unintentionally during activities that target other animal species. Using the lowest population estimate of 59,000 raccoons, the removal of 200 raccoons under the proposed action would represent 0.3% of the estimated population. Activities conducted to prevent the further spread of raccoon rabies in the State generally do not result in the lethal removal of raccoons. Raccoons are live-captured, sampled, and released on-site as part of the post-baiting protocols (USDA 2010*a*). However, if raccoons were visibly injured or exhibited signs of disease, WS often euthanizes those raccoons and processes them

for rabies testing. The number of raccoons lethally removed in the State during the post-baiting trapping varies, but is not likely to exceed 50 individuals annually. Therefore, the statewide cumulative removal of raccoons by WS in South Carolina under all damage and disease management activities would not exceed 250 raccoons annually, which would represent 0.4% of the lowest population estimate of raccoons in the State.

Trappers have harvested approximately 2,855 raccoons per year between 2003 and 2012, with the highest annual harvest occurring in 2012 when trappers harvested 3,775 raccoons. If the average number of raccoons harvested annually by trappers were representative of future harvest levels, the cumulative removal of raccoons (*i.e.*, WS' removal of 250 raccoons and the harvest of 2,855 raccoons annually) would represent 5.3% of a statewide population estimated at 59,000 raccoons. If WS lethally removed 250 raccoons and the annual harvest reached 3,775 raccoons, the cumulative removal would represent 6.8% of the estimated statewide population.

Raccoon populations can remain relatively abundant if annual harvest levels are below 49% (Sanderson 1987). In addition, the statewide population is likely much higher than 59,000 raccoons. As with many of the other mammals species harvested for fur in the State, the unlimited harvest levels allowed by the SCDNR provides an indication that overharvest of raccoons is not likely to occur during annual harvest seasons and from damage management activities. Although the statewide population of raccoons and the annual harvest levels are unknown, the cumulative removal of raccoons would be of low magnitude when compared to the actual statewide population. In addition, the live-capture and subsequent release of raccoons would not likely result in adverse effects to the statewide population since those animals would be released unharmed (USDA 2010*a*).

RIVER OTTER POPULATION INFORMATION AND EFFECTS ANALYSIS

Historically, river otters inhabited aquatic ecosystems throughout much of North America, excluding the frozen Arctic and arid Southwest (Hall and Kelson 1959). Information on historic numbers and distribution is limited. As its broad geographic distribution suggests, the river otter is able to adapt to diverse aquatic habitats. Otters occur in both marine and freshwater environments, ranging from coastal to high elevation mountainous habitat. Riparian vegetation adjacent to lakes, streams, and other wetland areas is a key component of otter habitat.

Human encroachment, habitat destruction, and overharvest have eliminated river otters from marginal portions of their range. However, present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987). Otter populations occur in every county in South Carolina and densities of otter in the State are sufficient to allow an annual hunting and trapping season (SCDNR 2014*a*). The SCDNR currently allows people to harvest an unlimited number of river otter during the length of the annual hunting and trapping season for river otter. Between 2003 and 2012, trappers in the State harvested an estimated 465 otters per year, with the highest annual harvest occurring in 2006 when trappers harvested 863 otters. In addition, the population is sufficient in the State to allow some otters to be live-captured and transported to West Virginia and Tennessee as part of restocking efforts (SCDNR 2015*a*).

The current statewide otter population is currently unknown. Melquist and Dronkert (1987) summarized studies estimating river otter densities, which showed that densities were about 1 per 175 to 262 acres in Texas coastal marshes, and ranged from 1 per 1.8 miles to 1 per 3.6 miles of waterway (stream or river). Woolington (1984) found one otter per 0.7 miles of linear waterways in southeast Alaska. The results of a Missouri study found one otter per 2.5 to 5.0 miles of linear waterways (Erickson et al. 1984).

Wetland estimates in South Carolina range from 4.5 million acres (see Table 4.2) to 4.6 million acres (Hefner et al. 1994), including an estimated 30,000 miles of streams (EPA 2012). As was discussed previously, otters are closely associated with aquatic habitats where they forage and den along shorelines. Using 30,000 miles of streams in South Carolina and the range of one otter per 2.5 to 5.0 miles of waterway would result in a statewide population estimate ranging from 6,000 otters to 12,000 otters. If only 50% of those streams supported river otters, the minimum statewide river otter population could range from 3,000 to 6,000 river otters in South Carolina. This would be a worst-case scenario since the otter population is likely to inhabit a much larger portion of the streams and rivers of South Carolina. In addition, otters also inhabit other aquatic habitats besides streams; therefore, the actual population is likely to be higher.

The WS program in South Carolina has not received requests for direct operational assistance associated with river otters. However, WS could receive requests for direct operational assistance. WS' personnel have also lethally removed river otters unintentionally during activities that target other animals, primarily activities associated with managing damage caused by beaver. From FY 2009 through FY 2014, WS' personnel killed 223 river otters unintentionally in South Carolina, which is an average of 37 otters killed annually by WS. All of the otters lethally removed by WS from FY 2009 through FY 2014 were unintentional non-targets during activities targeting other animal species. The highest unintentional removal occurred during FY 2014 when WS removed 54 otters unintentionally during other damage management activities. The analyses will include WS' unintentional removal of otters during activities targeting other animal species to evaluate cumulative removal. In addition, WS live-captured five otters unintentionally during activities targeting other animal species between FY 2009 and FY 2014 and WS released those otter unharmed.

Based on previous lethal removal and in anticipation of receiving future requests for assistance associated with river otters, WS reasonably expects the cumulative removal (intentional and unintentional) of otters would not exceed 100 otters annually in South Carolina. WS anticipates receiving requests primarily from aquaculture producers that were experiencing unacceptable predation of fish stock by river otters. Based upon the aforementioned population estimate, WS' lethal removal of 100 river otters annually under the proposed action would represent 3.3% of the otter population in South Carolina estimated at 3,000 otters and 1.7% of a statewide population estimated at 6,000 otters.

As mentioned previously, trappers have harvested an average of 465 otters per year in the State, with the highest annual harvest occurring in 2006 when trappers harvested 863 otters. If the average number of otters harvested annually by trappers were representative of future harvest levels, the cumulative removal of otter would represent 18.8% of a statewide population estimated at 3,000 otters. If WS lethally removed 100 otters and the annual harvest reached 863 otters, the cumulative removal would represent 32.1% of the estimated statewide population. However, the population of river otters in the State likely exceeds 3,000 otter and likely exceeds 6,000 otters.

Although the actual number of otters harvested annually in the State during the hunting and trapping season is unknown, the cumulative removal is not likely to reach a magnitude where adverse effects would occur to the otter population. The unlimited harvest allowed by the SCDNR provides an indication that the statewide densities of otter are sufficient that overharvest is not likely to occur. Damage management activities associated with otters would target a single animal or localized animals at sites where their presence was causing unacceptable damage to agriculture, human health and safety, natural resources, or property. The proposed removal of otters in the State by WS would be of low magnitude when compared to the actual statewide population estimates.

COYOTE POPULATION INFORMATION AND EFFECTS ANALYSIS

Coyotes are a familiar mammal to most people. Their coloration is blended, primarily gray mixed with a reddish tint. The belly and throat are a paler color than the rest of the body (Beckoff 1982). Coyotes have long, rusty or yellowish legs with dark vertical lines on the lower foreleg. They are similar in appearance to gray and red wolves (National Audubon Society 2000). Coloration of coyotes varies from nearly black to red or nearly white in some individuals and local populations. Most have dark or black guard hairs over their back and tail (Green et al. 1994). They sometimes breed with domestic dogs producing hybrids called "*coydogs*" (National Audubon Society 2000). The size of coyotes varies from 20 to 40 lbs (9 to 18 kg) (Voigt and Berg 1987).

Coyotes range throughout the United States with the highest densities occurring on the Plains and in the south-central United States. The distribution of coyotes in eastern North America began to expand around 1900. Now, all eastern states and Canadian provinces have at least a small population of coyotes (Voigt and Berg 1987). Houndsmen established coyote populations in Pickens and Oconee Counties in the State by the late 1970s from coyotes imported into the State and released. From those populations established by houndsmen and from the natural expansion of coyotes into the eastern United States, the coyote has expanded its range in the State. Today, coyotes occur in every county of the State (Butfiloski and Baker 2002).

Coyotes often include many items in their diet. Rabbits are one of their most common prey species. Other items in the coyote's diet include carrion, rodents, deer (usually fawns), insects (such as grasshoppers), as well as livestock and poultry. Coyotes readily eat fruits, such as watermelons, berries, persimmons, and other vegetative matter when it is available. In some areas, coyotes feed on human refuse at dumpsites and prey on small domestic pets, such as cats and dogs (Voigt and Berg 1987).

Coyotes breed between January and March and are able to breed prior to reaching one year of age (Kennelly and Johns 1976), but the percentage of yearlings having litters varies from zero to 80% in different populations (Gier 1968). This variation is influenced by a number of factors causing large annual variations in total number of coyotes breeding. In a Texas study, the percentage of females having litters varied from 48% to 81% (Knowlton 1972). Pups are born after a gestation period of 60 to 63 days, with litter sizes varying primarily with prey availability. Gier (1968) reported average litter sizes of 4.8 to 5.1 in years with low rodent numbers, but litters of 5.8 to 6.2 during years with high rodent numbers. Litter sizes of one to 19 pups have been reported (National Audubon Society 2000).

Many references indicate that coyotes were originally found in relatively open habitats, particularly grasslands and sparsely wooded areas of the western United States. Today, coyotes have adapted to, and now exist in virtually every type of habitat, arctic to tropic, in North America. Coyotes live in deserts, swamps, tundra, grasslands, brush, dense forests, from below sea level to high mountain ranges, and at all intermediate altitudes. High densities of coyotes also appear in the suburbs of major cities (Green and Gipson 1994).

The coyote is probably the most extensively studied carnivore (Bekoff and Gese 2003), and considerable research has been conducted on population dynamics. Coyote densities as high as two per km^2 (5 per mi^2) have been reported in the southwestern and west-central United States, but are lower in other portions of the country, including eastern North America; although, few studies have accurately determined densities (Voigt and Berg 1987). Although coyote densities vary based on local habitat quality, Knowlton (1972) published that density estimates of 0.5 to 1.0 coyotes per mi^2 would likely be applicable to coyote densities across much of their range. However, methods for estimating carnivore populations are crude and often produce estimates with broad confidence intervals (Crawford et al. 1993).

Because determinations of absolute coyote densities are frequently unknown (Knowlton 1972), many researchers have estimated coyote populations using various methods (Clark 1972, Knowlton 1972, Camenzind 1978, Pyrah 1984). The cost to determine absolute coyote densities accurately over large areas would be prohibitive (Connolly 1992) and that cost would not appear to be warranted given the coyote's overall relative abundance. The presence of unusual food concentrations and the assistance provided to a breeding pair by non-breeding coyotes at the den can influence coyote densities and complicate efforts to estimate abundance (Danner and Smith 1980). Coyote densities are lowest in late winter prior to whelping, highest immediately after whelping, followed by a continued decline to the next whelping season (Parker 1995).

Predator abundance indices suggest that densities of coyotes in North America increase from north to south (Knowlton and Stoddart 1985, Parker 1995). Coyote densities range from 0.2 per square mile when populations are low (pre-whelping) to 3.6 coyotes per square mile when populations are high post-whelping) (Knowlton 1972). Although coyote densities vary considerably between habitat types and vary based on numerous environmental variables, Knowlton (1972) concluded that coyote densities might approach a high of five to six coyotes per square mile under extremely favorable conditions with densities of 0.5 to 1.0 per square mile possible over the entire range of the coyote in the United States. Such an estimate is speculative but represents some the best available information for estimating coyote populations.

Population modeling information suggests that a viable coyote population can withstand an annual removal of 70% of their population without causing a decline in the population (Connolly and Longhurst 1975, Connolly 1995). The unique resilience of the coyote, its ability to adapt, and its perseverance under adverse conditions is commonly recognized among biologists and land managers. Despite intensive historical damage management efforts in livestock production areas and despite sport hunting and trapping for fur, coyotes continue to thrive and expand their range, occurring widely across North and Central America (Miller 1995). Connolly and Longhurst (1975) determined that, "*...if 75% of the coyotes are killed each year, the population would be exterminated in slightly over 50 years*". However, Connolly and Longhurst (1975) go on to explain that their "*...model suggests that coyotes, through compensatory reproduction, can withstand an annual population mortality of 70%*" and that coyote populations would regain pre-control densities (through recruitment, reproduction, and migration) by the end of the fifth year after control was terminated even though 75% mortality had occurred for 20 years. In addition, other researchers (Windberg and Knowlton 1988) recognized that immigration, (not considered in the Connolly and Longhurst (1975) model) could result in rapid occupancy of vacant territories, which helps to explain why coyotes have thrived in spite of intensive damage management activities (Connolly 1978).

Actual population estimates or density information for coyotes in South Carolina are not available. Coyotes are common throughout the State and inhabit a variety of habitats. Given that coyotes are distributed throughout all rural habitats (excluding developed areas and open water), the cumulative area of these classifications in South Carolina is 75,144 km^2 (29,013 mi^2) (see Table 4.2). If coyotes only occupy 50% of the rural habitat in South Carolina and the density of coyotes in the State ranges from 0.5 coyotes per square mile to five coyotes per square mile, the statewide population could be estimated to range from 7,300 coyotes to a high of 72,500 coyotes.

Coyotes are a non-protected species in South Carolina with a continuous open hunting season and no limit on the number of coyotes that people can harvest (SCDNR 2014*a*). People can also harvest coyotes during annual trapping seasons in the State with no limit on the number of coyotes that people can harvest during the open season. Trappers have harvested an average of 1,506 coyotes in the State from 2003 through 2012, with the highest annual harvest occurring in 2009 when trappers harvested 2,384 coyotes during the trapping season. The number of coyotes that hunters harvest each year in the State is currently

not available. Similarly, the number of coyotes that people lethally remove annually to alleviate damage in the State is unknown. However, the SCDNR (2014*a*) stated that hunters and trappers harvest approximately 30,000 coyotes in the State per year. Despite the annual mortality of coyotes, coyote populations continue to increase in the State (SCDNR 2014*a*).

Between FY 2009 and FY 2014, WS conducted 17 technical assistance projects associated with damage and threats of damages caused by coyotes, which includes only those projects where WS provided information on managing damage or threats caused by coyotes. In most cases, WS refers requests for assistance associated with coyotes to the SCDNR and WS makes no record regarding the outcome. Requests for assistance were primarily associated with threats to human safety and predation on other animals. WS also provided direct operational assistance associated with coyotes from FY 2009 through FY 2014, primarily at airports where coyotes posed strike risks to aircraft. During direct operational assistance projects, WS lethally removed 61 coyotes from FY 2009 through FY 2014, which is an average annual removal of 10 coyotes. In addition, the WS program dispersed 23 coyotes using non-lethal methods and live-captured and released on coyote between FY 2009 and FY 2014. WS' employees could also remove coyotes unintentionally during activities targeting other animal species.

In anticipation of receiving additional requests for assistance and based on the number of requests for assistance received previously, WS anticipates lethally removing up to 200 coyotes annually under the proposed action to alleviate damage, including coyotes that could be lethally removed unintentionally during other activities. Using a statewide coyote population ranging from 7,300 to 72,500 coyotes, removal of up to 200 coyotes annually would represent from 0.3% to 2.7% of the estimated population. The statewide population of coyotes exceeds 7,300 coyotes if hunters and trappers actually harvest approximately 30,000 coyotes per year in the State. The actual statewide population likely exceeds 72,500 coyotes. The annual harvest of 30,000 coyotes would represent 41% of a statewide coyote population estimated at 72,500 coyotes. Despite the annual cumulative mortality of coyotes in the state, including harvest and damage management activities, the coyote population appears to be increasing in the State (SCDNR 2014*a*). As stated previously, population modeling suggests that a viable coyote population can withstand an annual removal of 70% of their population without causing a decline in the population (Connolly and Longhurst 1975, Connolly 1995). Although exact population estimates for coyotes in South Carolina and actual annual harvest rates are not available, the unlimited harvest allowed by the SCDNR for the species during hunting and trapping seasons and the continuous open hunting season indicates the species is not at risk of overharvesting. Since the statewide population could reasonably be expected to be higher than 72,500 coyotes, the proposed removal of 200 coyotes annually by WS and the cumulative removal of coyotes could actually be a smaller percentage of the actual statewide population.

GRAY FOX POPULATION INFORMATION AND EFFECTS ANALYSIS

The gray fox is common in many parts of the United States where deciduous woodlands provide habitat. Yet, people seldom see this secretive carnivore. This species is somewhat smaller in stature than the red fox, having shorter legs and extremities. Gray fox exhibit striking pelage that has grizzled upper parts resulting from individual guard hairs banded with white, gray, and black. A predominance of black-tipped hairs in the middle of the back forms a dark longitudinal stripe that extends into a conspicuous black mane of coarse hair at the top of the black -tipped tail. Portions of the neck, sides, and limbs are cinnamon-colored. The ventral areas of a gray fox are buff colored. White shows on the ears, throat, chest, belly, and back legs, and the black, white, and reddish facial markings provide distinctive accents (Fritzell 1987).

Gray fox adults weigh about three to seven kilograms (6.5 to 15 lbs), with males being slightly larger than females. Generally, adult gray fox measure 80 to 113 cm (31.5 to 44 inches) from the tip of the nose to

the tip of the tail. They inhabit wooded, brushy, and rocky habitats from extreme southern Canada to northern Venezuela and Colombia, excluding portions of the mountainous northwestern United States, the Great Plains, and eastern Central America. Gray fox occur over most of North America, north and east from southern California, Arizona, and central Texas (Fritzell 1987).

Gray fox prefer habitat with dense cover such as thickets, riparian areas, swampland, or rocky pinyon-cedar ridges. In eastern North America, this species is closely associated with edges of deciduous forest. They can also occur in urban areas where suitable habitat exists (Phillips and Schmidt 1994).

Gray fox mate from January through March and produce litters of one to seven kits after a gestation period of 53 days (National Audubon Society 2000). They rear young in a maternity den, commonly located in woodpiles, rocky outcrops, hollow trees, or brush piles (Phillips and Schmidt 1994). The male parent helps tend to the young but does not occupy a den with them. The young are weaned at three months and hunt for themselves at four months, when they weigh about 3.2 kg (7 lbs). Rabies and distemper are associated with this species (National Audubon Society 2000).

Accurate estimates of carnivore populations are rare and those for gray fox populations are no exception. Estimates based on knowledge of the species, experience, and intuition may be as accurate as those estimates based on recognized methods, such as mark-recapture studies. Published estimates of gray fox density vary from 1.2 to 2.1 per km^2 (3.1 to 5.4 per mi^2) depending on location, season, and method of estimation (Errington 1933, Gier 1948, Lord 1961, Trapp 1978). Over areas larger than 5,000 km^2 (1,930 mi^2) in which habitat quality varies, densities are likely lower. However, exceptionally high fox densities have been recorded in some situations (Grinnell et al. 1937, Hallberg and Trapp 1984).

Home ranges for gray fox vary throughout the year. Both males and females travel over larger areas during fall and winter, probably in response to increased energy demands and a declining food base (Follmann 1973, Nicholson 1982). During April, when young fox require regular feeding, a female's home range is less extensive than it is without the demands of those young (Follmann 1973). Although exceptions exist, eastern gray fox generally have larger home ranges than western animals (Fritzell 1987). For instance, 16 adult fox were tracked for more than one month in Alabama (Nicholson 1982) and Missouri (Haroldson and Fritzell 1984) and it was determined that they all had home ranges larger than 200 hectares (500 acres), and many exceeded 500 hectares (1,235 acres).

Gray fox feed on a wide variety of plant and animal matter (Fritzell 1987). Although active primarily at twilight and at night, the gray fox is sometimes seen foraging by day in brush, thick foliage, or timber. The only American canid with true climbing ability, gray fox occasionally forage in trees and often take refuge in them, especially leaning or thickly branched trees. The gray fox feeds heavily on cottontail rabbits, mice, voles, other small mammals, birds, insects, and plant material including corn, apples, persimmons, nuts, cherries, grapes, pokeweed fruit, grass, and blackberries. Grasshoppers and crickets are often a very important part of the diet in late summer and autumn (National Audubon Society 2000).

Gray fox occur statewide in South Carolina but current population and density estimates are not available. Given the habitat preferences of gray fox, the most likely land cover types that would support gray fox are developed open space, deciduous forest, mixed forest, shrub/scrub, and woody wetlands. The cumulative area of those classifications in South Carolina is 35,110 km^2 (13,556 mi^2) (see Table 4.2). If gray fox only occupied 50% of those land classifications in the State and the density of gray fox in the State were 3.1 gray fox per square mile, the statewide population could be estimated at 21,000 gray fox. The estimate would be based on one gray fox occupying each home range and home ranges not overlapping. Gray fox can be found in a variety of habitats, including urban areas, so gray fox occupying only 50% of the land area of the State is unlikely since fox can be found almost statewide. However, similar to the

other furbearing species, gray fox occupying only 50% of the land area was used to provide a minimum population estimate to evaluate the magnitude of the proposed removal by WS.

People can harvest gray fox during annual hunting and trapping season in the State without a limit on the number of gray fox that people can harvest during the open season (SCDNR 2014*a*). Table 4.1 shows the number of gray fox that people harvest annually in the State during the trapping season. Between 2003 and 2012, trappers have harvested an average of 1,675 gray fox per year in the State. The number of gray fox that people harvest during the hunting season in the State is unknown. Gray fox are also likely lethally removed to alleviate damage and threats of damage; however, the number of fox lethally removed annually to alleviate damage or threats of damage is currently unknown.

From FY 2009 through FY 2014, the WS program in South Carolina intentionally live-captured and released two gray fox based on requests for assistance. No lethal removal of gray fox occurred by WS between FY 2009 and FY 2014. In anticipation of additional efforts, WS could intentionally remove up to 50 gray fox annually under the proposed action to address requests to alleviate damage and threats of damage. WS could also lethally remove gray fox unintentionally during activities that target other animals. However, the cumulative removal (intentional and unintentional) of gray fox by WS would not exceed 50 gray fox annually in South Carolina. Using the lowest population estimate of 21,000 fox, the removal of 50 gray fox by WS would represent 0.2% of the population.

If the average number of gray fox harvested annually by trappers were representative of future harvest levels, the cumulative removal of gray fox (*i.e.*, WS' removal of 50 gray fox and the harvest of 1,675 gray fox annually) would represent 8.2% of a statewide population estimated at 21,000 gray fox. The highest annual harvest of gray fox by trappers in the State occurred in 2004 when trappers harvested 2,513 gray fox. If WS lethally removed 50 gray fox and the annual harvest reached 2,513 gray fox, the cumulative removal would represent 12.2% of the estimated statewide population.

Since the statewide population of gray fox is likely higher than 21,000 fox, WS' removal of gray fox and the cumulative removal of fox would represent a lower percentage of the actual statewide population. Like other mammal species addressed in this EA, the unlimited harvest allowed by the SCDNR during the hunting and trapping seasons provides an indication that gray fox populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely.

RED FOX POPULATION INFORMATION AND EFFECTS ANALYSIS

The red fox is a typically proportioned member of the dog family. The bushy and unusually long tail, pointed ears, slender muzzle, and slanted eyes coupled with its small dog size and typical reddish coloration, make the red fox instantly recognizable to most people. This species is also the most common and well-known species in the genus *Vulpes*, which includes about 10 other species worldwide (Honacki et al. 1982). Typically, black-tipped ears, black cheek patches, white throat parts, a lighter underside, and black "*leg stockings*" are found on most red fox. The white tip of the tail (which is much more prominent in North American fox than elsewhere) can be used to distinguish brownish fox pups from similarly colored coyote pups, which lack a white tail tip (Voigt 1987).

In North America, the red fox weighs about 3.5 to 7 kg (7.7 to 15.4 lbs), with males averaging about one kg (2.2 lbs) heavier than females. Generally, adult fox measure 100 to 110 cm (39 to 43 inches) from the tip of the nose to the tip of the tail. Juveniles in their first autumn are similar in size to adults (Voigt 1987). Red fox occur throughout most of North America. They are found throughout most of the United States with the exception of a few isolated areas. Prehistoric fossil records suggest that the red fox may not have inhabited much of the United States; however, they were plentiful in many parts of Canada. Voigt (1987) has suggested climatic factors, interbreeding with the introduced European red fox,

extirpation of the gray and red wolf, and clearing of land for agriculture has possibly contributed to the present-day expansion and range of this species in North America.

Red fox are adaptable to most habitats within their range, but usually prefer open country with moderate cover. Some of the highest fox densities reported are in the north-central United States and occur where woodlands are interspersed with farmlands. Red fox have also demonstrated their adaptability by establishing breeding populations in many urban areas of the United States, Canada, and Europe (Phillips and Schmidt 1994). In many areas, competition with other canids and the availability of suitable year-round food resources limit fox survival. Habitat determines the availability of year-round food resources and the presence or absence of other canids. Because those two factors strongly influence red fox survival, habitat limits fox numbers but seldom limits distribution (Voigt 1987).

Red fox mate from January through March and produce litters of one to 10 kits after a gestation period of 51 to 53 days. They rear young in a maternity den usually in sparse ground cover on a slight rise, with a good view of all approaches (National Audubon Society 2000). Fox commonly use enlarged dens of other animals, such as woodchuck or badger dens, as maternity dens. Juvenile fox are able to breed before reaching a year old, but in areas of high red fox densities, most yearlings do not produce pups (Harris 1979, Voigt and MacDonald 1984, Voigt 1987). Gier (1968) reported average litter sizes of 4.8 to 5.1 in years with low rodent numbers, but litters of 5.8 to 6.2 during years with high rodent numbers. Litter sizes of one to 19 pups have been reported (National Audubon Society 2000). Offspring disperse from the denning area during the fall and establish breeding areas in vacant territories, sometimes dispersing considerable distances. Red fox are generally solitary animals as adults, except when mating (Phillips and Schmidt 1994). Rabies and distemper are associated with this species.

The red fox is a skilled nonspecific predator, foraging on a variety of prey. It is also an efficient scavenger, and in parts of the world, garbage and carrion are extremely important to its diet (Voigt 1987). They are opportunists, feeding mostly on rabbits, mice, bird eggs, insects, and native fruit. They usually kill animals smaller than a rabbit, although fawns, pigs, kids, lambs, and poultry are sometimes taken (Phillips and Schmidt 1994). They also feed on squirrels, woodchucks, crayfish, and even grasses (National Audubon Society 2000).

Population densities are difficult to determine because of the secretive and elusive nature of fox. Estimates are prone to error even in open areas with good visibility. Methods used to estimate numbers have included aerial surveys, questionnaires to rural residents and mail carriers, scent post surveys, intensive ground searches, and indices derived from hunting and trapping harvest (Voigt 1987). Home ranges for red fox in the eastern United States are usually from 500 to 2,000 ha (1,235 to 4,940 acres) in rural settings, such as farmland (Voigt and Tinline 1980), but such sizes may not apply among fox populations in urban settings. In Great Britain, where food is abundant in many urban areas, densities as high as 30 fox per km^2 (78 per mi^2) have been reported (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986), while in southern Ontario, densities of about 1 fox per km^2 (2.6 per mi^2) occur during spring. This includes both pups and adults. In small areas of the best habitat, three times as many fox have been observed (Voigt 1987). However, those densities rarely occur extensively because of the dispersion of unsuitable habitat, high mortality, or from competition with coyotes (Voigt and Earle 1983). Cyclical changes in fox numbers occur routinely and complicate density estimates as well as management. Those cycles can occur because of changes in prey availability, or disease outbreaks, especially rabies, among red fox. For fox populations to remain relatively stable, mortality and reproduction must balance approximately.

Red fox occur statewide in South Carolina; however, the statewide population and density estimates for South Carolina are currently unknown. Given that red foxes are distributed through all rural habitats, the cumulative area of these classifications in South Carolina is about 70,632 km^2 (27,271 mi^2) (see Table

4.2). If red fox only occupied 50% of those land classifications in the State and the density of red fox in the State was 2.6 red fox per square mile, the statewide population could be estimated at 35,500 red fox. The estimate would be based on one red fox occupying each home range and home ranges not overlapping.

Similar to gray fox, people can harvest red fox during annual hunting and trapping seasons in the State. There is no limit to the number of fox that people can harvest daily and no possession limit during the length of the season for red fox. Table 4.1 shows the number of red fox that people harvested annually in the State during the trapping season. Between 2003 and 2012, trappers have harvested an average of 585 red fox per year in the State. The number of red fox harvested annually in the State during the hunting season is currently unknown. People could also lethally remove red fox to alleviate damage and threats of damage. However, the number of fox lethally removed annually in the State to alleviate damage or threats of damage is also currently unknown.

During direct operational assistance projects, WS lethally removed six red fox from FY 2009 through FY 2014. In anticipation of additional efforts, WS could intentionally remove up to 50 red fox annually under the proposed action to address requests to alleviate damage and threats of damage. WS could also lethally remove red fox unintentionally during activities that target other animals. However, the cumulative removal (intentional and unintentional) of red fox by WS would not exceed 50 red fox annually in South Carolina. Using the population estimate of 35,500 fox, the removal of 50 red fox by WS would represent 0.1% of the population.

If the average number of red fox harvested annually by trappers were representative of future harvest levels, the cumulative removal of red fox (*i.e.*, WS' removal of 50 red fox and the harvest of 585 red fox annually) would represent 1.8% of a statewide population estimated at 35,500 red fox. The highest annual harvest of red fox by trappers in the State occurred in 2003 when trappers harvested 723 red fox. If WS lethally removed 50 red fox and the annual harvest reached 723 red fox, the cumulative removal would represent 2.2% of the estimated statewide population.

Although exact population and density estimates for red fox in South Carolina are not available, the unlimited harvest allowed by the SCDNR for the species during hunting and trapping seasons indicates the species is not at risk of overharvesting. The proposed lethal removal of red fox would be a small component of the overall harvest of red fox in the State. The overall removal would be of low magnitude when compared to the statewide population and the number of fox harvested during the annual hunting and trapping seasons.

BOBCAT POPULATION INFORMATION AND EFFECTS ANALYSIS

The bobcat is a medium-sized member of the North American cat family, and some people may mistake them for a large bob-tailed domestic cat. This species is actually two to three times larger than most domestic cats and appears more muscular and fuller in body. Bobcats are capable of hunting and killing prey that range from the size of a mouse to that of a deer. Rabbits, tree squirrels, ground squirrels, woodrats, porcupines, pocket gophers, and woodchucks comprise most of their diet. Bobcats also prey upon opossum, raccoon, grouse, wild turkey, and other ground nesting birds. Occasionally, insects and reptiles can be part of a bobcat's diet. They also resort to scavenging. They are opportunistic predators, and may feed on livestock and domestic animals such as poultry, sheep, goats, house cats, small dogs, exotic birds and game animals, and rarely, calves (Virchow and Hogeland 1994). McCord and Cardoza (1982) reported the cottontail rabbit to be the principal prey of bobcats throughout their range.

Ruell et al. (2009) reported bobcat densities ranged from 0.65 to 1.09 bobcats per square mile (0.25 to 0.42 bobcats per km^2) in coastal southern California in both large open habitat and in habitat surrounded

by human development. Lawhead (1984) reported bobcat densities of 0.66 per square mile (0.26 bobcats per km^2) in Arizona with a preference for riparian habitat. Bobcats in southern Illinois were reported to have a population density of 0.70 bobcats per square mile (0.27 bobcats per km^2) (Nielsen and Woolf 2001), while Anderson (1987) provided population density estimates of 0.13 to 0.26 bobcats per square mile (0.05 to 0.10 bobcats per km^2). Bobcats reach densities of about one per 0.7 km^2 (1 per ¼ mi^2) on some islands in the Gulf Coast of the southeastern United States. Densities vary from about one per 1.3 km^2 (1 per ½ mi^2) in coastal plains to about one cat per 10.7 km^2 (1 per 4 mi^2) in portions of the Appalachian foothills. Mid-Atlantic and Midwestern states usually have scarce populations of bobcats (Virchow and Hogeland 1994). Populations are stable in many northern states and reviving in other states where intensive trapping formerly decimated the species (National Audubon Society 2000). Rates of natural mortality reported for adult bobcats in protected populations appear to be quite low. Crowe (1975) estimated a 3% mortality rate in a protected population, based on a study of bobcats by Bailey (1972) in southeastern Idaho. Causes of natural mortality for adult bobcats include starvation (Hamilton 1982), disease and predation (Lembeck 1978), and injuries inflicted by prey (Fuller et al. 1985). Bobcats occur statewide in South Carolina in suitable habitat.

The statewide bobcat population is currently unknown and density information for South Carolina is currently not available. Given that bobcats occur throughout all rural habitats in the State, the cumulative area of those classifications in South Carolina is about 70,632 km^2 (27,271 mi^2) (see Table 4.2). If bobcats only occupied those land classifications in the State and the density of bobcats in the State was estimated at a low of 0.13 bobcats per square mile to a high of 1.09 bobcats per square mile, the statewide population could be estimated at between approximately 3,500 and 29,700 individuals. If bobcats only occupied 50% of those land classifications in the State and the density of bobcats in the State ranged from 0.13 bobcats per square mile to 1.09 bobcats per square mile, the statewide population would range between 1,800 and 14,900 individuals. Bobcats occur in a variety of habitats, including some developed areas, so bobcats occupying only 50% of the land area of the State would be unlikely. However, similar to the other furbearing species, the analysis will evaluate bobcats occupying only 50% of certain land classifications to provide a minimum population estimate to determine the magnitude of the proposed removal by WS under a worst-case scenario.

People may harvest bobcats during annual hunting and trapping seasons in the State that the SCDNR manages. During the hunting and trapping season, the SCDNR allows people to harvest an unlimited number of bobcats during the length of the seasons (SCDNR 2014*a*). Between 2003 and 2012, trappers have harvested an average of 392 bobcats per year in the State (see Table 4.1). The number of bobcats that hunters harvest annually in the State is currently unknown. People could also lethally remove bobcats to alleviate damage in the State; however, the number of bobcats removed to alleviate damage is unknown.

From FY 2009 through FY 2014, WS intentionally removed two bobcats to reduce strike risks at an airport. In anticipation of additional efforts, WS could intentionally remove up to 25 bobcats annually under the proposed action to address requests to alleviate damage and threats of damage. WS could also lethally remove bobcats unintentionally during activities that target other animals. However, the cumulative (intentional and unintentional) removal of bobcats by WS would not exceed 25 bobcats annually in South Carolina. Using a population estimate of 3,500 bobcats, the removal of 25 bobcats by WS would represent 0.7% of the population. Using the lowest population estimate of 1,800 bobcats, the removal of 25 bobcats by WS would represent 1.4% of the population.

If the average number of bobcats harvested annually by trappers were representative of future harvest levels, the cumulative removal of bobcats (*i.e.*, WS' removal of 25 bobcats and the harvest of 392 bobcats annually) would represent 11.9% of a statewide population estimated at 3,500 bobcats and 23.2% of a population estimated at 1,800 bobcats. The highest annual harvest of bobcats by trappers in the State

occurred in 2009 when trappers harvested 494 bobcats. If WS lethally removed 25 bobcats and the annual harvest reached 494 bobcats, the cumulative removal would represent 14.8% of a statewide population estimated at 3,500 bobcats and 28.8% of a population estimated at 1,800 bobcats. The cumulative removal would represent 1.8% of a statewide population estimated at 29,700 bobcats and 3.5% of a statewide population estimated at 14,900 bobcats.

Since the statewide population of bobcats is likely higher than 29,700 bobcats, WS' removal of bobcats and the cumulative removal of bobcats would represent a lower percentage of the actual statewide population. Like other mammal species addressed in this EA, the unlimited harvest allowed by the SCDNR during the hunting and trapping seasons provides an indication that bobcat populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely.

FERAL AND FREE-RANGING CAT POPULATION INFORMATION AND EFFECTS ANALYSIS

Feral cats are domesticated cats living in the wild. They are small in stature, weighing from three to eight pounds (1.4 to 3.6 kg), standing eight to 12 inches (20 to 30.5 cm) high at the shoulder, and 14 to 24 inches (35.5 to 61 cm) long. The tail adds another 20 to 30.5 cm (8 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 (Fitzwater 1994).

Feral cats are found in commensal relationships wherever people are found. In some urban and suburban areas, cat populations equal human populations. In many suburban and eastern rural areas, feral cats are the most abundant predators. 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).

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. They are territorial and move within a home range of roughly 4 km^2 (1.5 mi^2). After several generations, feral cats can be considered wild in habits and temperament (Fitzwater 1994).

Where it has been documented, the impact of feral cats on wildlife populations in suburban and rural areas, directly by predation, and indirectly by competition for food, has been enormous (Coleman and Temple 1989). 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). American birds face an estimated 117 to 157 million exotic predators in the form of free-ranging domestic cats, which are estimated to kill at least one billion birds every year in the United States. Cats have contributed to declines and extinctions of birds worldwide, with feral cats considered one of the most important drivers of global bird extinctions (Dauphine and Cooper 2009).

Feral and free-ranging cats also pose a health and safety threat to household pets. Feral and stray cats are at increased risk of feline immunodeficiency virus, feline leukemia, feline panleukopenia virus, also known as feline distemper, and rabies. All of these diseases can be transmitted to unvaccinated pet cats allowed to free-range. The feline panleukopenia virus is highly contagious and the virus may survive in the environment for up to a year. In addition, the virus may be transmitted to indoor cats through indirect routes, such as on shoes (Berthier et al. 2000, Truyen et al. 2009). Feral and free-ranging cats serve as a reservoir for wildlife and human diseases, including cat scratch fever, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various parasites (Fitzwater 1994).

The number of feral cats in South Carolina is unknown. Feral and free-ranging cats are considered by many wildlife biologists and ornithologists to be a detriment to native wildlife species. Feral cats prey upon native wildlife species and compete with native predators for prey. Thus, removing feral cats could be considered as providing some benefit to the natural environment by eliminating predation and competition from an introduced species.

Requests for assistance received by WS involving feral cats have primarily been associated with the human safety threats that cats can pose and damage to property. During direct operational assistance projects conducted by WS from FY 2009 through FY 2014, WS lethally removed two feral cats intentionally across the State. In addition, feral and free-ranging cats were also live-captured and released by WS between FY 2009 through FY 2014. In total, one feral or free-ranging cat was intentionally live-captured and released unharmed. Between FY 2009 and FY 2014, one cat was unintentionally live-captured by WS during other damage management activities. The cat unintentionally live-captured was released unharmed.

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 the feral or 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. However, in some cases, WS may receive requests to remove feral cats lethally to alleviate damage or threats. WS could lethally remove up to 50 feral cats annually to address additional requests for assistance. WS could also remove feral cats unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of feral cats to exceed 50 cats annually. Based upon the above information, WS' limited removal of feral cats would have minimal effects on local or statewide populations in South Carolina. Some local populations may be temporarily reduced at a local site if cats were removed using non-lethal or lethal methods. In those cases where feral cats were causing damage or were creating a nuisance and complete removal of the local population could be achieved, this could be considered as providing some benefit to the natural environment since feral cats are not considered part of the native ecosystem.

FERAL AND FREE-RANGING DOG POPULATION INFORMATION AND EFFECTS ANALYSIS

Like domestic dogs, feral dogs manifest themselves 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 from domestic dogs is the degree of reliance or dependence on people, 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 traps. Domestic dogs usually wagged their tails or exhibited a calm disposition when people approached; whereas, most feral dogs showed highly aggressive behavior, growling, barking, and attempting to bite. Some dogs were intermediate in their behavior and the authors could not classify those dogs as either feral or domestic based solely on their reaction to people. Since people often pursue, shoot at, or trap feral dogs, their aggressive behavior toward people is not surprising. For example, a feral dog caught in Arkansas had numerous lead pellets imbedded under the skin, which Gipson (1983) indicated was likely a testament to the relationship between some people and feral dogs.

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 the gathering sites or den sites may be well defined. Food scraps and other evidence of concentrated activity may occur at gathering sites.

The appearance of tracks left by feral dogs varies with the size and weight of the animal. Generally, dog tracks are more round and show more prominent nail marks than those of coyotes, and they are usually larger than the tracks of fox. Since a pack of feral dogs likely consists of animals in a variety of sizes and shapes, the tracks from a pack of dogs will correspondingly vary, unlike the tracks of a group of coyotes (Green and Gipson 1994).

Feral 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 mi^2) or more (Green and Gipson 1994).

Feral dogs often occur 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 occur 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).

Like coyotes, feral dogs are opportunistic feeders. They can be efficient predators, preying on small and large animals, including domestic livestock. 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 dogs are highly adaptable, social carnivores. Gipson (1983) suggested that family groups of feral dogs are more highly organized than previously believed. Several members of a pack may share pup rearing. Survival of pups born during autumn and winter can occur, 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 the pack excluded nonresident dogs, 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. Feral dogs commonly use former fox or coyote dens (Green and Gipson 1994).

Feral dogs can cause damage by preying on livestock, poultry, house cats, or domestic dogs. They may also feed on fruit crops including melons, berries, grapes, and native fruit. They 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). In some locales, they may present a serious threat to deer (Lowry 1978) and other valuable wildlife (Green and Gipson 1994).

WS would primarily provide technical assistance to requesters when those requesters were seeking assistance with dogs. WS would refer most requests for assistance to a local animal control facility since requesters are often unable to determine if a dog was feral or a free-ranging pet. From FY 2009 through FY 2014, WS lethally removed seven feral dogs intentionally during damage management activities in South Carolina. In addition, WS lethally removed three feral dogs unintentionally between FY 2009 and FY 2014 during activities targeting other animals. WS has also live-captured and released 10 feral dogs intentionally during damage management activities conducted from FY 2009 through FY 2014. In addition, WS live-captured four feral dogs unintentionally between FY 2009 and FY 2014, which WS released unharmed. WS employed non-lethal harassment methods to disperse 28 dogs between FY 2009 and FY 2014. Based on previous requests for assistance and in anticipation of additional efforts, WS could lethally remove up to 50 feral dogs per year under the proposed action alternative. When receiving requests for assistance associated with feral and free-ranging dogs, the WS program in South Carolina would follow WS Directive 2.340. WS could also remove feral dogs unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of feral dogs to exceed 50 dogs annually.

In most cases, WS would employ live-capture methods to alleviate damage or threats of damage associated with dogs. Once live-captured, WS would transfer custody of the dogs to a local animal control facility. After relinquishing the 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.

Based upon the above information, WS' limited lethal removal of feral dogs should have no adverse effects on overall populations in South Carolina. Any activities involving the use of lethal methods by WS would be restricted to isolated individual sites. The use of lethal methods by WS' personnel could temporarily reduce some local populations because of removals aimed at reducing damage at a local site. In those cases where feral dogs were causing damage or posing as a nuisance and WS' personnel could achieve complete removal of the local population, the action would provide some benefit to the natural environment since feral dogs are not part of the native ecosystem.

VIRGINIA OPOSSUM POPULATION INFORMATION AND EFFECTS ANALYSIS

Opossum are the only marsupials (possess a pouch in which young are reared) found north of Mexico (Seidensticker et al. 1987). They frequent most of the eastern and central United States, except Minnesota, northern Michigan, and New England, extending west to Wyoming, Colorado, and central New Mexico (National Audubon Society 2000). They also occur in parts of the southwestern United States, California, Oregon, and Washington (Jackson 1994*b*). It is likely that human activities have aided in the range expansion of opossum (Gardner 1982). Adults range in size from less than 1 kg (2.2 lbs) to about 6 kg (13 lbs), depending on sex and time of year. They grow throughout life (Seidensticker et al. 1987). They have a broad range of pelage colors, but they are usually a "*gray*" or "*black*" phase. Their fur is grizzled white above; long white hairs cover black tipped fur below. They climb well and feed on a variety of foods, including carrion, which forms much of their diet. In addition, opossum eat insects, frogs, birds, snakes, small mammals, earthworms, and berries and other fruits; persimmons, apples, and

corn are favorite foods (National Audubon Society 2000). They use a home range of four to 20 hectares (10 to 50 acres), foraging throughout this area frequently (Jackson 1994*b*), but concentrating on a few sites where fruits abound, when they are in season (Seidensticker et al. 1987).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude (Gardner 1982). Gestation is short (average of 12.8 days) with one to 17 young born in an embryonic state that climb up the mothers belly to the marsupium (pouch), attach to teats, and begin to suckle (Gardner 1982, National Audubon Society 2000). Those young remain in the pouch for about two months. After two months, the young begin to explore outside the pouch and may travel on their mother's back with their tails grasping hers (Whitaker, Jr., and Hamilton, Jr. 1998). Opossum live for only one to two years, with as few as 8% of a population of those animals surviving into the second year in a study in Virginia conducted by Seidensticker et al. (1987). In the five-year study, Seidensticker et al. (1987) also observed a wide variation in opossum numbers in what was likely excellent habitat for the species. Those variations occurred seasonally and in different years. However, the mean density during the study was 10.1 opossum per square mile with a range of 1.3 opossum per square mile to 20.2 opossum per square mile (Seidensticker et al. 1987). This was comparable to other opossum population densities in similar habitats in Virginia. Verts (1963) found a density estimate of 10.1 opossum per square mile in farmland areas in Illinois while Wiseman and Hendrickson (1950) found a density of 6.0 opossum per square mile in mixed pasture and woodlands in Iowa. However, VanDruff (1971) found opossum densities in waterfowl nesting habitat as high as 259 opossum per square mile.

Opossum are common throughout South Carolina in appropriate habitat. Population estimates and density estimates for opossum in the State are not available. Therefore, WS will derive a population estimate based on the best available information for opossum to provide an indication of the magnitude of removal proposed by WS to alleviate damage and threats of damage. Given that opossum densities are highest in forested areas, farmlands, and wetlands, the cumulative area of those classifications in South Carolina is about 70,632 km^2 (27,271 mi^2) (see Table 4.2). If opossum only occurred on 50% of those land classifications in the State and using a mean density of 10.1 opossum per square mile found by Seidensticker et al. (1987) in Virginia, the population could be nearly 138,000 opossum. Using the range of opossum densities found by Seidensticker et al. (1987) of 1.3 opossum per square mile to 20.2 opossum per square mile and only 50% of those land classification in the State being occupied by opossum, the statewide population would range from a low of 17,700 opossum to a high of nearly 275,400 opossum.

Opossum occur in a variety of habitats, including urban areas, so opossum occupying only 50% of those land classifications in the State is unlikely since opossum can occur almost statewide. However, WS derived the estimate based on opossum occupying only 50% of the land area to provide a minimum population estimate to determine the magnitude of the proposed removal by WS to alleviate or prevent damage.

Like many of the mammal species addressed in the EA, people can harvest opossum during annual hunting and trapping seasons (SCDNR 2014*a*). During the development of the EA, people could harvest opossum with no limit on the number that people could harvest during those seasons. Table 4.1 shows the number of opossum that trappers have harvested during trapping season in the State. However, the number of opossum that hunters have harvested in the State is currently unknown. In addition, people could lethally remove opossum to alleviate damage; however, the number of opossum lethally removed in the State to alleviate damage is unknown.

As part of damage management activities conducted by WS in the State, WS lethally removed one opossum and live-captured and released one opossum intentionally between FY 2009 through FY 2014. In addition, WS lethally removed one opossum unintentionally during activities targeting other animals

between FY 2009 and FY 2014. WS also live-captured three opossum unintentionally but released those opossum unharmed. Based on previous requests for assistance received by WS and in anticipation of additional efforts, WS could lethally remove up to 100 opossum annually in the State as part of efforts to reduce or eliminate damage under the proposed action alternative. Based on a statewide population ranging from 17,700 opossum to 275,400 opossum, the lethal removal of up to 100 opossum annually by WS under the proposed action alternative would represent 0.04% to 0.6% of the estimated population. WS could also remove opossum unintentionally during other damage management activities conducted by WS; however, WS does not anticipate the cumulative lethal removal of opossum to exceed 100 opossum annually.

As shown in Table 4.1, trappers have harvested an average of 2,560 opossum per year in the State, with the highest annual harvest occurring in 2012 when trappers harvested 3,326 opossum. If the average number of opossum harvested annually by trappers were representative of future harvest levels, the cumulative removal of opossum would represent 15.0% of a statewide population estimated at 17,700 opossum. If WS lethally removed 100 opossum and the annual harvest reached 3,326 opossum, the cumulative removal would represent 19.4% of a statewide population estimated at 17,700 opossum. However, the population of opossum in the State likely exceeds 17,700 opossum and likely exceeds 275,400 opossum.

Although the actual number of opossum harvested annually in the State during the hunting season is unknown, the cumulative removal is not likely to reach a magnitude where adverse effects would occur to the opossum population. The unlimited harvest allowed by the SCDNR provides an indication that the statewide densities of opossum are sufficient that overharvest is not likely to occur. Damage management activities associated with opossum would target a single animal or localized animals at sites where their presence was causing unacceptable damage to agriculture, human health and safety, natural resources, or property. The proposed removal of opossum in the State by WS would be of low magnitude when compared to the actual statewide population estimates.

NINE-BANDED ARMADILLO POPULATION INFORMATION AND EFFECTS ANALYSIS

The nine-banded armadillo is easily recognized due to its unique appearance. An opossum-sized animal, the armadillo has a "*shell*", which is composed of ossified dermal plates covered by a leathery epidermis (Whitaker, Jr. and Hamilton, Jr. 1998). The armadillo is the only North American mammal that has heavy bony plates (National Audubon Society 2000). Female armadillos produce one litter of young per year, which are genetically identical quadruplets (National Audubon Society 2000).

Armadillo expansion in the United States appears to be limited by climate and soil types. Originally thought to occur in Central and South America, including Mexico, the nine-banded armadillo has undergone a northward and eastward expansion into the United States since the late-1800s, likely through natural dispersal from Mexico and release of captive armadillos (Layne 2003). Today, the armadillo can be found across the southern portion of the United States with additional dispersal northward and eastward in the United States likely in the future (Layne 2003). Range expansion is likely only limited by the reduced food availability and the colder temperatures experienced during the winter months.

Armadillos do not tolerate extended periods of cold weather, which may limit their expansion northward. Armadillos do not hibernate and must feed every couple of days during winter months since they do not store food nor accumulate efficient amounts of body fat to survive through the winter. The presence of snow or frozen soils limits the availability of food sources, primarily the availability of insects, during winter months. The lack of food available often causes armadillos to starve during winter months. However, in South Carolina, winter temperatures are relatively sufficient to maintain armadillo

populations, though periods of extreme cold or prolonged periods of cold temperatures may temporarily affect populations.

Armadillos occupy and exploit a variety of natural and human-modified terrestrial habitats in the United States and across their range, including those armadillos found in South Carolina. Layne (2003) summarizes the natural habitat types occupied by armadillos throughout their range as "*...pine-oak woodlands, oak-elm woodlands, pine forests, mixed pine-hardwood forests, bottomland forests, riparian woodlands, mesic hardwood forests, scrub, chaparral-mixed grass, inland and coastal prairies, salt marsh, coastal dunes, and coastal strand*." Human-modified habitats where armadillos can be found has been summarized by Layne (2003), which includes "*...pastures, parkland, cemeteries, golf courses, citrus groves, pine plantations, plant nurseries, cut-over pineland, and various croplands*." The ability of armadillos to exploit a wide variety of habitat types is likely one of the main components facilitating the range expansion of the armadillo into and across the United States (Layne 2003). Habitat suitability is likely more of a function of soil substrate rather than vegetative type due to the foraging and digging behavior of armadillos (Layne 2003).

Armadillos are opportunistic feeders and will often forage by digging and probing the soil, leaf litter, and decaying wood for invertebrates, primarily insects. One study found at least 488 different food items in the stomachs of 281 armadillos with insects and other invertebrates comprising 92% of the stomach contents (Kalmbach 1943). Armadillos are also known to forage on plant material and small vertebrates with food preferences often driven by the availability of food sources (Layne 2003).

The other limiting factor in armadillo expansion and for maintaining populations is the presence of sandy or clay soils. Armadillos are prolific diggers and damages attributed to armadillos are often associated with their digging behavior. Armadillos will dig out shelters and dig while rooting out invertebrates in the soil and leaf litter. This digging and rooting behavior are the most common complaints from resource owners in South Carolina. Damage to landscaping is the most common resource being damaged by armadillos in the State. Sandy soils are conducive to digging and armadillos can be found in those areas in South Carolina where sandy soils are present.

Population estimates for armadillos in the United States range from 30 to 50 million armadillos (Gilbert 1995). However, population estimates in South Carolina are not currently available. Therefore, a population estimate will be derived based on the best available information for armadillos to provide an indication of the magnitude of lethal removal proposed by WS to alleviate damage and threats of damage. Population densities for armadillos are reported to range from 0.004 to 1.4 armadillos per acre with an average of 0.25 armadillos per acre (Mengak 2005). Based on the natural habitat types occupied by armadillos throughout their range summarized by Layne (2003), the cumulative area of those classifications in South Carolina is about 47,900 km^2 (18,500 mi^2) (see Table 4.2). Using a population density estimated at 0.004 to 1.4 armadillos per acre and if armadillos only inhabited 25% of those land classifications in the State, the statewide population could range from approximately 11,800 armadillos to approximately 4.1 million armadillos. With an average of 0.25 armadillos per acre, the statewide population could be estimated at 740,000 armadillos. As stated previously, the actual number of armadillos in the State is currently unknown. The range of armadillos only encompassing 25% of the land area in the State was used to provide a minimum population estimate to determine the magnitude of the proposed removal by WS to alleviate or prevent damage.

Between FY 2009 through FY 2014, WS did not receive requests for direct operational assistance associated with armadillos. In anticipation of receiving requests for assistance, WS could lethally remove up to 200 armadillos annually in the State as part of efforts to alleviate and prevent damage. Given the range of population estimates in the State, the removal of 200 armadillos by WS annually would represent 1.7% of the statewide population based on a population estimated at 11,800 armadillos if the overall

population remains at least stable. Armadillos could also be lethally removed unintentionally during other damage management activities conducted by WS; however, WS does not anticipate the cumulative lethal removal of armadillos to exceed 200 armadillos annually. People can lethally remove armadillos during a continuous open hunting season in the State, which places no limits on the number of armadillos that can be harvested (SCDNR 2014*a*). However, the number of armadillos that people lethally remove in the State is unknown. Although the number of armadillos lethally removed by other entities in the State is unknown, the cumulative removal of armadillos, including the proposed removal of up to 200 armadillos annually by WS, would likely be of low magnitude when compared to the statewide population of armadillos.

WHITE-TAILED DEER POPULATION INFORMATION AND EFFECTS ANALYSIS

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. Deer are known for raising their tail while alarmed and in flight, called "*flagging*", in which the tail appears as a large, bright flash of white. This communicates danger to other deer and helps young follow their mothers in flight (National Audubon Society 2000). The range in size of white-tailed deer is extreme. White-tailed deer in the northern extremes of its range, where there is good habitat, will achieve weights of greater than 136 kg (300 lbs). By comparison, the tiny Florida Keys subspecies (*O. v. clavium*) commonly weighs less than 23 kg (50 lbs) (National Audubon Society 2000).

Male white-tailed deer are called bucks. They exhibit antlers, which are a pair of bony outgrowths of the frontal bone that normally are shed annually. The antlers begin growing in the early summer at which time they are covered with a skin that grows as the antlers do. The skin has short fine hairs called "*velvet*", containing a network of blood vessels, which nourish the growing bone beneath. By late summer, the antlers are fully developed, and the "*velvet*" is rubbed off against small saplings by the animal as the bone hardens. The antlers then serve as sexual ornaments and rival males may use them as weapons in courtship battles during the breeding season, which is called the "*rut*". After the mating season, the antlers decalcify and detach from the frontal bone within two to three days of each other, fall to the ground, and are often quickly found and gnawed on by various rodents for the calcium (National Audubon Society 2000). Antler size depends upon nutrition, age, and genetics (Craven and Hygnstrom 1994).

The white-tailed deer reproductive season varies according to geographic range. It may occur by the first two weeks in November in the north, but occurs as late as January or February in the south. Females, called "*does*", may have one to three young, or "*fawns*", after a gestation period of approximately 202 days (Craven and Hygnstrom 1994). A young doe bred for the first time will usually have only one fawn, older does two or three. The female remains near the fawns, returning to feed them only once or twice a day. Twin fawns are separated, which serves to protect them. Weaning occurs between 1 and 2 ½ months. Fawns stay with the mother until fall or winter, sometimes up to two years, but the doe generally drives off her young the previous year shortly before giving birth (National Audubon Society 2000).

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 range throughout most of the United States, except the far southwest, and inhabit the southern half of the southern tier of Canadian provinces. This species inhabits farmlands, brushy areas, forests, suburbs, and gardens. Rural areas containing a matrix of forest and agricultural crops can contain the highest deer densities (Roseberry and Woolf 1998). Biologists and resource managers in South Carolina have been challenged with managing escalating populations of deer in many urban/suburban areas and in some rural areas. As deer populations increase, there is an increasing occurrence of damage from white-tailed deer to agricultural

crops (DeVault et al. 2007), increasing incidences of Lyme disease (Fernandez 2008, Kilpatrick et al. 2014), a rise in deer-vehicle collisions (Conover et al. 1995), and a disruption in forest health, regeneration, and forest dependent species (Tilghman 1989). Additionally, white-tailed deer are ranked as one of the most hazardous species to aviation according to the percentage of strikes that caused damage from 1990 through 2013 (Dolbeer et al. 2014).

Similar to other areas of the United States, the deer population in South Carolina experienced steep declines between 1750 and 1900 from unrestricted subsistence and commercial harvest of deer, along with the clearing of land for agriculture (SCDNR 2013). By 1900, the deer population in South Carolina reached a low of approximately 20,000 deer (SCDNR 2013). Due to severe drought in the 1920s and the emergence of the cotton boll weevil, a decline in farming occurred in the State, which led to major reforestation in parts of the State by the 1970s. Reforestation and increasing timber harvest activities that followed into the 1980s created large areas of early successional habitat that is ideal for deer (SCDNR 2013). By the mid- to late 1990s, the deer population in the State was estimated at just over 1 million deer (SCDNR 2013).

Today, white-tailed deer are present statewide in South Carolina, and occupy almost all land types that contain suitable habitat. The current white-tailed deer population in South Carolina has been estimated to be approximately 750,000 deer (SCDNR 2014*b*). The authority for management of resident wildlife species, including deer, is the responsibility of the SCDNR. The SCDNR collects and compiles information on white-tailed deer population trends and harvest and uses this information to manage deer populations. The primary tool for the management of deer populations in SCDNR is through adjusting the allowed lethal removal during the deer harvest season in the State. People can harvest white-tailed deer during an annual hunting season in the State. Although the regulations often vary by county, during the development of this EA, the SCDNR allowed hunters to harvest an unlimited number of bucks and up to five antlerless deer per season in approximately two-thirds of the State. In the remainder of the State, the SCDNR allowed hunters to harvest up to five bucks and up to five antlerless deer per season.

Mortality can also occur from vehicle collisions, dogs, illegal removal, tangling in fences, disease, and other causes (Crum 2003). Annual deer mortality in South Carolina from other sources (*e.g.*, illegal removal, disease, and predation) is currently unknown. From July 1, 2011 through June 30, 2012, State Farm Mutual Automobile Insurance Company (2012) estimated 26,408 deer-vehicle collisions occurred in South Carolina.

From FY 2009 through FY 2014, WS responded to requests for assistance associated with white-tailed deer in the State. WS' personnel addressed most requests for assistance by providing technical assistance. Those persons requesting assistance reported at least $125,000 in damages, primarily from damage to gardens, golf courses, cotton crops, trees, shrubs, and threats to human safety. Between FY 2009 and FY 2014, the WS program in South Carolina lethally removed 392 deer during damage management activities, including deer that WS' personnel removed unintentionally during activities targeting other animals. In addition, WS' personnel used non-lethal methods to disperse 733 deer to alleviate damage or threats of damage in the State between FY 2009 and FY 2014.

After review of previous activities conducted by WS and in anticipation of addressing additional requests for lethal removal, WS' future lethal removal could reach 500 deer annually, including deer the WS' personnel could lethally remove unintentionally. In addition, the SCDNR and/or the SCDA could request WS' assistance with sampling and managing the spread of diseases found in free-ranging and/or captive deer populations. If a disease outbreak occurred, the SCDNR and/or the SCDA could request WS lethally remove white-tailed deer for sampling and/or to prevent further spread of diseases, including captive deer (*i.e.*, deer held in fenced enclosures). However, WS' total annual removal would not exceed 500 deer annually under the proposed action. As indicated previously, WS' personnel could also lethally remove

deer unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of deer to exceed 500 deer annually.

If requested, WS could also assist with sampling and removing deer from captive facilities where people confine deer inside a perimeter fence. The detection of a disease at a captive facility often raises concerns for the potential spread of diseases to free-ranging herds. Diseases can spread rapidly among deer inside those facilities due to their close contact with one another. Often, once a disease occurs in a confined deer herd, the SCDNR and/or the SCDA requires the removal of the entire herd to ensure the containment of the disease. Any involvement with the depopulation of deer confined inside a perimeter fence by WS would be at the request of the SCDNR and/or the SCDA. As proposed in this alternative, in those cases where the SCDNR and/or the SCDA has requested WS' assistance with the removal of a captive deer herd in South Carolina, the removal would not exceed 500 deer for purposes of disease monitoring or surveillance. Deer confined inside perimeter fences for the purposes of non-traditional farming, including confined for hunting, are not included in statewide deer population estimates. However, since removal of deer by WS for disease surveillance or monitoring could occur in free-ranging or captive herds, the potential removal of up to 500 deer for disease surveillance and monitoring by WS would be part of the impact analysis on the statewide free-ranging deer population.

From 2009 through 2014, hunters harvested over 1.3 million deer in South Carolina during the annual hunting seasons, with the highest harvest level occurring in 2009 when hunters harvested 231,703. The lowest harvest level of deer between 2009 and 2014 occurred in 2014 when 202,952 deer were harvested (SCDNR 2009, SCDNR 2010, SCDNR 2011, SCDNR 2012, SCDNR 2013, SCDNR 2015*b*). If WS' removal reached 500 deer during the highest harvest of deer in the State that occurred in 2009, WS' removal of 500 deer would have represented 0.2% of the harvest. If WS' removal reached 500 deer during the lowest harvest total of deer in the State that occurred in 2014, WS' removal of 500 deer would have represented 0.3% of the total harvest.

As stated previously, the SCDNR has estimated the deer population in South Carolina at 750,000 deer. The total deer mortality in the State in 2011 was an estimated 252,866 deer, based on harvest and vehicle collision data. If the deer population estimate provided by the SCDNR included recruitment of deer born that year, then the removal of deer from all known sources in 2011 would represent 33.7% of the deer population, if the deer population remained at least stable. If WS had lethally removed 500 deer in 2011, the total mortality of deer would be approximately 253,366 deer. When combined with the total known mortality in the State during 2011, WS' removal of up to 500 deer would have raised total mortality to 33.8% of the population. If WS had lethally removed 500 deer in 2011, WS' removal would have represented an increase of 0.1% when compared to the total mortality in 2011 if no removal by WS had occurred (*i.e.*, 33.7% without removal by WS compared to 33.8% if WS' removal had been 500 deer in 2011).

With oversight of the SCDNR, the magnitude of removal of deer by WS annually to resolve damage and threats would be low. The SCDNR has determined that there is no evidence to suggest that human mediated mortality resulting from regulated harvest and damage management, including removal by WS, would be detrimental to the survival of the white-tailed deer population in the state of South Carolina (C. Ruth, SCDNR, pers. comm. 2014).

The EPA officially registered GonaCon™ in 2009 for use in reducing fertility in female white-tailed deer. According to the label, only WS' personnel, state wildlife management agency personnel, or individuals working under their authority can use the reproductive inhibitor. Additionally, in order for WS to use GonaCon™, the CUDPR must register the product and the SCDNR must approve the use to manage local deer populations. The reproductive inhibitor GonaCon™ is currently not available for use in South

Carolina. However, if GonaCon™ becomes available to manage deer in the State, WS' personnel could consider the inhibitor as part of an integrated approach to managing damage.

Population management from the use of reproductive inhibitors to induce a decline in a localized deer population occurs through a reduction in the recruitment of fawns into the population by limiting reproductive output of adults. A reduction in the population occurs when the number of deer recruited into the population cannot replace those individuals that die from other causes each year, which equates to a net loss in the number of individuals in the population and a reduction in the overall population. Although not generally considered a lethal method since no direct removal occurs, reproductive inhibitors can result in the reduction of a target species' population. WS' use of GonaCon™ would target a local deer population identified as causing damage or threatening human safety. Although a reduction in a local deer population would likely occur from constant use of GonaCon™, the actual reduction in the local population annually would be difficult to derive prior to the initiation of the use of the vaccine.

One of the difficulties in calculating and analyzing any actual reduction that could occur from the use of the vaccine in a targeted population prior to application of the vaccine is the variability in the response of deer to the vaccine. Previous studies on GonaCon™ as a reproductive inhibitor have shown variability in the immune response of deer to the vaccine (Miller et al. 2000). Not all deer injected with GonaCon™ develop sufficient antibodies to neutralize the Gonadotropin-releasing Hormone (GnRH) produced in the body. Those deer continue to enter into a reproductive state and produce fawns even after vaccination. WS cannot predict beforehand the number of deer that do not develop sufficient antibodies after the initial vaccination. In one study, 88% of the deer vaccinated with GonaCon™ did not produce fawns the following reproductive season while 12% of the deer injected with GonaCon™ produced fawns (Gionfriddo et al. 2009). The year following the initial vaccination, the number of deer that were vaccinated the first year that did not produce fawns declined to 47% while the number of deer producing fawns increased to 53% (Gionfriddo et al. 2009) demonstrating the diminishing results that are likely over time if deer are not provided a booster shot periodically.

Since the effects of GonaCon™ appear to be reversible if deer do not receive a booster shot periodically, WS' personnel could maintain the reduction in a local population of deer from the use of GonaCon™ at appropriate levels where damages or threats were resolved by increasing or decreasing the number of deer receiving booster injections. Although a localized reduction in the local deer populations would likely occur from the use of GonaCon™, the extent of the reduction would be variable. For example, the vaccine may not prevent all deer from entering into a non-reproductive state and those deer that were initially in a non-reproductive state from the vaccine often become reproductively active in subsequent years as the antibody levels neutralizing the GnRH hormone diminish over time. Therefore, the actual decline in the number of deer in a localized population achieved from the use of GonaCon™ would be difficult to predict prior to the use of the reproductive inhibitor. However, since the decline would occur through attrition over time and since the ability of the inhibitor to prevent reproduction diminishes with time, the actual decline in a localized population would be gradual and WS' personnel and other entities could monitor the decline. In addition, a full reversal of the reduction in a local deer population could occur if deer no longer received vaccinations or booster shots and other conditions (*e.g.*, food, disease) were favorable for population growth.

Turner et al. (1993) noted that although contraception in white-tailed deer can limit population growth, it would not reduce the number of deer in excess of the desired level in many circumstances. Turner et al. (1993) further contended that initial population reductions by various other means may be necessary to achieve management goals, and that reproduction control would be one facet of an integrated program. Although immunocontraceptive technology has been effective in laboratories, pens, and in island field applications, it has not been effective in reducing populations of free-ranging white-tailed deer over large geographical areas.

The magnitude of WS' activities to alleviate damage and threats associated with deer in the State would be low with the oversight and permitting of WS' activities occurring by the SCDNR. If removal by WS had reached 500 deer during 2014 when the lowest known deer harvest occurred in the State, WS' removal would have represented 0.3% of the statewide harvest. In 2011, if WS' removal had reached 500 deer, the total known mortality would have increased only 0.1% when compared to total known mortality if WS had not removed 500 deer. Based on the deer population estimate, removal of up to 500 deer by WS would have represented 0.1% of the estimated population. WS would annually report to the SCDNR and monitor removal to ensure WS' activities do not adversely affect the deer population. The permitting of all WS' removal by the SCDNR would ensure WS' removal would meet the objectives of the statewide wildlife management plan.

ADDITIONAL TARGET SPECIES

WS may lethal remove additional target species in small numbers, in addition to the mammal species analyzed previously. Those additional species would typically be feral animals. For example, WS could receive a request to remove fallow deer for disease testing that have escaped from a hunting enclosure. Additional species that entities could request WS to provide assistance with include feral burros, feral cattle, feral goats, feral horses, fallow deer, and other non-native mammals that, on occasion, could cause damage or pose threats of damage. While WS does not currently expect to lethally remove any of those species, the SCDNR and/or the SCDA could request WS' assistance with unique situations where a small number of those mammals have escaped or were released. Those occasions could include the accidental release of feral animals onto airport properties or animals that have escaped from fenced enclosures. In addition, the SCDNR and/or the SCDA could request WS' assistance as part of an incident response, such as the accidental release of domestic or exotic mammals from vehicle wrecks. There may also be additional need for removing other mammal species in the event of an animal disease outbreak to limit the spread of the disease. As part of the proposed program, WS could provide assistance, upon request, involving exotic and domestic mammals not specifically listed in this EA in emergencies to alleviate threats to human health and safety. Any lethal removal requested would target specific individual mammals and removal would not reach a magnitude where adverse effects would occur to a species' population based on the limited scope of the removal. In most cases, the removal would be limited to a few individuals and removal would likely occur by other entities in the absence of WS' involvement.

WILDLIFE DISEASE SURVEILLANCE AND MONITORING

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen if it is introduced. Effective implementation of a surveillance system would facilitate planning and execution at regional and state levels, and coordination of surveillance data for risk assessment. It would also facilitate partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups.

Under disease sampling strategies that could be implemented to detect or monitor diseases in the United States, WS' implementation of those sampling strategies would not adversely affect mammal populations in the State. Sampling strategies that could be employed involve sampling live-captured mammals that could be released on site after sampling occurs. The sampling (*e.g.*, drawing blood, swabbing nasal cavities, collecting fecal samples) and the subsequent release of live-captured mammals would not result in adverse effects since those mammals would be released unharmed on site. In addition, the sampling of mammals that were sick, dying, or harvested by hunters would not result in the additive lethal removal of mammals that would not have already occurred in the absence of disease sampling. Therefore, the sampling of mammals for diseases would not adversely affect the populations of any of the mammals

addressed in this EA nor would sampling mammals result in any lethal removal of mammals that would not have already occurred in the absence of disease sampling (*e.g.*, hunter harvest).

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Mammal populations in the State would not be directly impacted by WS from a program implementing technical assistance only. However, persons experiencing damage or threats from mammals may implement methods based on WS' recommendations. Under a technical assistance only alternative, WS would recommend and demonstrate for use both non-lethal and lethal methods legally available for use to resolve mammal damage. Methods and techniques recommended would be based on WS' Decision Model using information provided from the requester or from a site visit. Requesters may implement WS' recommendations, implement other actions, seek assistance from other entities, or take no further action. However, those people requesting assistance would likely be those people that would implement damage abatement methods in the absence of WS' recommendations.

Under a technical assistance only alternative, those persons experiencing threats or damage associated with mammals in the State could lethally remove mammals or request assistance from other entities despite WS' lack of direct involvement in the management action. Therefore, under this alternative, the number of mammals lethally removed annually would likely be similar to the other alternatives since removal could occur through authorization by the SCDNR, removal of non-regulated mammal species could occur without the need for authorization from the SCDNR, and removal would continue to occur during the harvest season for those species. WS' participation in a management action would not be additive to an action that would occur in the absence of WS' participation.

With the oversight of the SCDNR, it is unlikely that mammal populations would be adversely impacted by implementation of this alternative. Under this alternative, WS would not be directly involved with damage management actions and therefore, direct operational assistance could be provided by other entities, such as the SCDNR, private entities, and/or municipal authorities. If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal removal, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not conduct damage management activities in the State. WS would have no direct involvement with any aspect of addressing damage caused by mammals and would provide no technical assistance. No removal of mammals by WS would occur under this alternative. Mammals could continue to be lethally removed to resolve damage and/or threats occurring through authorization by the SCDNR, during the regulated hunting or trapping seasons, or in the case of non-regulated species, removal could occur anytime using legally available methods. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Local mammal populations could decline, stay the same, or increase depending on actions taken by those persons experiencing mammal damage. Some resource/property owners may take illegal, unsafe, or environmentally harmful action against local populations of mammals out of frustration or ignorance. While WS would provide no assistance under this alternative, other individuals or entities could conduct lethal damage management resulting in lethal removal levels similar to the proposed action.

Since mammals could still be removed under this alternative, the potential effects on the populations of those mammal species in the State would be similar to the other alternatives for this issue. WS' involvement would not be additive to removal that could occur since the cooperator requesting WS' assistance could conduct mammal damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with mammals could occur by other entities despite WS' lack of involvement under this alternative.

Issue 2 - Effects of Mammal Damage Management Activities on Non-target Wildlife Species Populations, Including T&E Species

As discussed previously, a concern is often raised about the potential impacts to non-target species, including T&E species, from the use of methods to resolve damage caused by mammals. The potential effects on the populations of non-target wildlife species, including T&E species, are analyzed below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

The potential for adverse effects to non-targets occurs from the employment of methods to address mammal damage. Under the proposed action, WS could provide both technical assistance and direct operational assistance to those people requesting assistance. The risks to non-targets from the use of non-lethal methods as part of an integrated direct operational assistance program would be similar to those risks to non-targets discussed in the other alternatives.

Personnel from WS would be experienced with managing wildlife damage and would be trained in the employment of methods, which would allow WS' employees to use the WS Decision Model to select the most appropriate methods to address damage caused by targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that were as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. SOPs to prevent and reduce any potential adverse effects on non-targets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize non-target exposure to methods during program activities, the potential for WS to disperse or lethally remove non-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that were not the primary reason the exclusion was erected; therefore, non-target species excluded from areas may potentially be adversely affected if the area excluded was large enough. The use of auditory and visual dispersal methods to reduce damage or threats caused by mammals would also likely disperse non-targets in the immediate area the methods were employed. Therefore, non-targets may be permanently dispersed from an area while employing non-lethal dispersal techniques. However, like target species, the potential impacts on non-target species would likely be temporary with target and non-target species often returning after the cessation of dispersal methods.

Non-lethal methods that use auditory and visual stimuli to reduce or prevent damage would be intended to elicit fright responses in wildlife. When employing those methods to disperse or harass target species, any non-targets near methods when employed would also likely be dispersed from the area. Similarly, any exclusionary device constructed to prevent access by target species could also exclude access to some non-target species. The persistent use of non-lethal methods would likely result in the dispersal or abandonment of those areas where non-lethal methods were employed of both target and non-target species. Therefore, any use of non-lethal methods would likely elicit a similar response from both non-

target and target species. Although non-lethal methods do not result in the lethal removal of non-targets, the use of non-lethal methods could restrict or prevent access of non-targets to beneficial resources. However, non-lethal methods would not be employed over large geographical areas and those methods would not be applied at such intensity levels that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species were unharmed. Overall, the use of non-lethal methods would not adversely affect populations of wildlife since those methods would often be temporary.

Other non-lethal methods available for use under this alternative would include live traps, nets, repellents, immobilizing drugs, and reproductive inhibitors. Live traps and nets restrain wildlife once captured; therefore, those methods would be considered live-capture methods. Live traps would have the potential to capture non-target species. Trap and net placement in areas where target species were active and the use of target-specific attractants would likely minimize the capture of non-targets. If traps and nets were attended to appropriately, any non-targets captured could be released on site unharmed.

Chemical repellents would also be available to reduce mammal damage. Since FY 2009, WS has not used repellents to reduce mammal damage in the State. However, WS may recommend or employ commercially available repellents when providing technical assistance and direct operational assistance. Under this alternative, WS' personnel would recommend or use only those repellents registered with the EPA pursuant to the FIFRA, and registered with the CUDPR. The active ingredients in many commercially available repellents are naturally occurring substances (*e.g.*, capsaicin, whole egg solids), which are often used in food preparation (EPA 2001). When used according to label instructions, most repellents would be regarded as safe since 1) they are not toxic to animals, if ingested; 2) there is normally little to no contact between animals and the active ingredient, and 3) the active ingredients are found in the environment and degrade quickly (EPA 2001). Therefore, the use and recommendation of repellents would not have negative impacts on non-target species when used according to label requirements. Most repellents for mammals pose a very low risk to non-targets when exposed to or when ingested.

WS could employ immobilizing drugs to handle and transport target mammal species. Immobilizing drugs would be applied directly to target animals through hand injection or by projectile (*e.g.*, dart gun). WS would make reasonable efforts to retrieve projectiles containing immobilizing drugs if misses occurred or if the projectile detached from target animals. Therefore, no direct effects to non-target animals would be likely since identification would occur prior to application. Animals anesthetized using immobilizing drugs recover once the drug has been fully metabolized. Therefore, non-targets that may consume animals that recover are unlikely to receive a dosage that would cause any impairment. When using immobilizing drugs to handle or transport target animals, WS would monitor anesthetized animals until that animal recovers sufficiently to leave the site.

Exposure of non-target wildlife to Gonacon™ could occur primarily from secondary hazards associated with wildlife consuming deer that have been injected with Gonacon™. Since Gonacon™ would be applied directly to deer through hand injection after the animal was live-captured and restrained, the risk of directly exposing non-target wildlife to Gonacon™ while being administered to deer would be nearly non-existent. Several factors inherent with Gonacon™ reduce risks to non-target wildlife from direct consumption of deer injected with the vaccine (EPA 2009). The vaccine itself and the antibodies produced by the deer in response to the vaccine are both proteins which if consumed would be broken down by stomach acids and enzymes (EPA 2009, USDA 2010*b*). The EPA determined that the potential risks to non-target wildlife from the vaccine and the antibodies produced by deer in response to the vaccine "*...are not expected to exceed the Agency's concern levels*" (EPA 2009).

Potential impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal removal would occur. Non-lethal methods would be available under all the alternatives analyzed; however, the use of Gonacon™ would be restricted to use by the SCDNR or persons under their supervision under Alternative 2 and Alternative 3, if registered. WS' involvement in the use of or recommendation of non-lethal methods would ensure the potential impacts to non-targets were considered under WS' Decision Model. Potential impacts to non-targets under this alternative from the use of and/or the recommendation of non-lethal methods are likely to be low.

WS could also employ and/or recommend lethal methods under the proposed action alternative to alleviate damage, when those methods were deemed appropriate for use using the WS Decision Model. Lethal methods available for use to manage damage caused by mammals under this alternative would include the recommendation of harvest during hunting and/or trapping seasons, shooting, body-gripping traps, cable restraints, fumigants, rodenticides, euthanasia chemicals, and euthanasia after live-capture. Available methods and the application of those methods to resolve mammal damage is further discussed in Appendix B.

The use of firearms would essentially be selective for target species since animals would be identified prior to application; therefore, no adverse effects would be anticipated from use of this method. Similarly, the use of euthanasia methods would not result in non-target removal since identification would occur prior to euthanizing an animal.

When using fumigants, burrows and dens would be observed for the presence of non-targets before the use of fumigants. If non-target activity (*e.g*., tracks, scat) were observed, the fumigation of those burrows or dens would not occur. Since non-targets are known to occur in burrows or dens, some risks of unintentional removal of non-targets does exist from the use of fumigants. For example, burrows of woodchucks can be used by a variety of non-target species such as the Eastern cottontail, striped skunk, raccoon, red fox, coyote, white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), and short-tailed shrew (*Blarina brevicauda*) (Hamilton 1934, Grizzell 1955, Dolbeer et al. 1991).

Fumigants would be used in active burrows or dens only, which would minimize risk to non-targets. Dolbeer et al. (1991) found a total of one cottontail rabbit and three mice (*Permyscus* spp.) in three of the 97 woodchuck burrows treated with gas cartridges during the late summer. During 2,064 trap nights at 86 woodchuck burrow entrances targeting small mammals, Swihart and Picone (1995) captured 99 individuals of four small mammal species, which included short-tailed shrews, meadow voles (*Microtus pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), and white-footed mice. Risks to non-targets can be minimized by treating only burrows that appear to be active (Dolbeer et al. 1991). There are no secondary poisoning risks involved with the use of gas cartridges as the gas produced dissipates into the atmosphere shortly after activation. Primary risks to non-targets would be minimized by treating only active burrows or dens, by covering entrances of burrows or dens, and by following the pesticide label. Although non-targets could be present in burrows or dens, even after WS' conducts site investigations, the risks would be relatively low and unintentional removal from the use of fumigants would be limited.

Zinc phosphide is a toxicant used to kill rodents, lagomorphs, and nutria. Zinc phosphide is two to 15 times more toxic to rodents than to carnivores (Hill and Carpenter 1982). Secondary risks appear to be minimal to predators and scavengers that scavenge carcasses of animals killed with zinc phosphide (Tietjen 1976, Hegdal and Gatz 1977, Hegdal et al. 1980, Hill and Carpenter 1982, Johnson and Fagerstone 1994). Risks would be minimal since 90% of the zinc phosphide ingested by rodents is

detoxified in the digestive tract (Hegdal et al. 1980) and 99% of the zinc phosphide residues occur in the digestive tracts, with none occurring in the muscle. In addition, the amount of zinc phosphide required to kill target rodents is not enough to kill most other predatory animals that consume tissue (Johnson and Fagerstone 1994).

In addition, zinc phosphide has a strong emetic action (*i.e.*, causes vomiting) and most non-target animals in research tests regurgitated bait or tissues contaminated with zinc phosphide without succumbing to the toxicant (Hegdal and Gatz 1977, Hegdal et al. 1980, Johnson and Fagerstone 1994). Furthermore, predators tend to eviscerate zinc phosphide-poisoned rodents before eating them or otherwise avoid the digestive tract and generally do not eat the stomach and intestines (Hegdal et al. 1980, Johnson and Fagerstone 1994). Although zinc phosphide baits have a strong, pungent, phosphorous-like odor (garlic like), this characteristic seems to attract rodents, particularly rats, and apparently makes the bait unattractive to some other animals. Many birds appear capable of distinguishing treated from untreated baits and they prefer untreated grain when given a choice (Siegfried 1968, Johnson and Fagerstone 1994). Birds appear particularly susceptible to the emetic effects of zinc phosphide, which would tend to offer an extra degree of protection against bird species dying from the consumption of grain treated with zinc phosphide or, for scavenging bird species, from eating poisoned rodents. Use of rolled oats instead of whole grain also appears to reduce bird acceptance of bait. Uresk et al. (1988) reported on the effects of zinc phosphide on six non-target rodent populations. Uresk et al. (1988) determined that no differences were observed from pretreatment until after treatment in populations of eastern cottontail rabbits and white-tailed jackrabbits (*Lepus townsendii*). However, primary consumption of bait by non-target wildlife could occur and potentially cause mortality. Uresk et al. (1988) reported a 79% reduction in deer mouse populations in areas treated with zinc phosphide; however, the effect was not statistically significant because of high variability in densities and the reduction was not long-term (Deisch et al. 1990).

Ramey et al. (2000) reported that five weeks after treatment, no ring-necked pheasants (*Phasianus colchicus*) had been killed because of zinc phosphide baiting. In addition, Hegdal and Gatz (1977) determined that zinc phosphide did not affect non-target populations and more radio-tracked animals were killed by predators than died from zinc phosphide intoxication (Hegdal and Gatz 1977, Ramey et al. 2000). Tietjen (1976) observed horned larks (*Eremophila alpestris*) and mourning doves (*Zenaida macroura*) on zinc phosphide-treated prairie dog colonies, but observations after treatment did not locate any sick or dead birds, a finding similar to Apa et al. (1991). Uresk et al. (1988) reported that ground feeding birds showed no difference in numbers between control and treated sites. Apa et al. (1991) further states that zinc phosphide was not consumed by horned larks because: 1) poisoned grain remaining for their consumption was low (*i.e.*, bait was accepted by prairie dogs before larks could consume it), 2) birds have an aversion to black-colored foods, and 3) birds have a negative sensory response to zinc phosphide.

Reduced impacts on birds associated with the use of zinc phosphide have also been reported by Tietjen and Matschke (1982). Deisch et al. (1989) reported on the effect zinc phosphide has on invertebrates. Deisch et al. (1989) determined that zinc phosphide bait reduced ant densities; however, spider mites, crickets, wolf spiders, ground beetles, darkling beetles, and dung beetles were not affected. Wolf spiders and ground beetles showed increases after one year on zinc phosphide treated areas (Deisch 1986). Generally, direct long-term impacts from rodenticide treatments were minimal for the population of insects that were sampled (Deisch et al. 1989). Long-term effects were not directly related to rodenticides, but more to habitat changes (Deisch 1986) as vegetative cover and prey diversity increased without prairie dogs grazing and clipping the vegetation (Deisch et al. 1989). In addition, zinc phosphide treated baits would be placed underground or used in bait stations. The application of baits below ground or in bait stations would limit the direct exposure risks by most non-target species.

Use of zinc phosphide on various types of fruit, vegetable, or cereal baits (*e.g.*, apples, carrots, sweet potatoes, oats, barley) has proven to be effective at suppressing target wildlife populations. All chemicals that could be used by WS would be registered under the FIFRA and administered by the EPA and the CUDPR. Specific bait applications would be designed to minimize non-target hazards. WS' personnel that use chemical methods would be certified as pesticide applicators by the CUDPR and would be required to adhere to all certification requirements set forth in the FIFRA and the South Carolina pesticide control laws and regulations. No chemicals would be used on federal or private lands without authorization from the land management agency or property owner/manager.

While every precaution would be taken to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by mammals, the use of such methods could result in the incidental lethal removal of unintended species. The unintentional removal and capture of wildlife species during damage management activities conducted under the proposed action alternative would primarily be associated with the use of body-gripping traps and cable restraints and in some situations, with live-capture methods, such as foothold traps and cage traps.

Table 4.3 shows the number of non-targets lethally removed unintentionally by WS from FY 2009 through FY 2014 while conducting activities to alleviate damage associated with those target species addressed in this EA. The capture and limited lethal removal that could occur as part of the ORV program and trapping activities are further addressed in the ORV program EA (USDA 2010*a*).

Table 4.3 – WS' lethal removal of non-targets by method in South Carolina, FY 2009 – FY 2014

Species	Method of Lethal Removal			Total
	Body Grip	Foothold	Neck Snare	
Opossum	0	1	0	**1**
River Otter	1	0	0	**1**
Cottontail Rabbit	0	0	1	**1**
Raccoon	0	1	3	**4**

In total, WS lethal removed seven non-targets unintentionally during damage management activities conducted from FY 2009 through FY 2014, which is an average of one non-target lethally removed annually by WS. The species with the highest level of lethal removal were raccoons, which WS' employees lethally removed unintentionally during activities targeting coyotes. WS has lethally removed four raccoons as non-targets from FY 2009 through FY 2014. The lethal removal of non-targets could result in declines in the number of individuals in a population; however, as was discussed previously, the lethal removal of non-targets by WS during damage management activities would be of low magnitude when compared to the actual statewide population of those species. The previous non-targets lethally removed unintentionally by WS are representative of non-targets that WS could lethally remove under the proposed action alternative. WS could lethally remove additional species of non-targets unintentionally; however, the removal of individuals from any species would not be likely to increase substantively above the number of non-targets removed annually by WS during previous damage management activities.

In addition, those species lethally removed or live-captured previously are also target species in this EA and the level of removal analyzed for each of those species under Issue 1 included the unintentional removal that could occur by WS or the unintentional removal was evaluated as part of the cumulative analysis. Therefore, the lethal removal of those species was evaluated cumulatively under Issue 1, including removal that could occur when a species was considered a target or non-target. WS would continue to monitor activities, including non-target removal, to ensure the annual removal of non-targets does not result in adverse effects to a species' population. Hunters and/or trappers can harvest those species lethally removed as non-targets previously by WS in the State during annual harvest seasons.

Table 4.4 shows those non-targets live-captured and released unharmed by WS from FY 2009 through FY 2014. As shown in Table 4.4, most non-targets captured by WS during damage management activities are live-captured and subsequently released unharmed. The primary species live-captured are opossums and feral dogs. Non-targets released have been primarily live-captured during activities targeting coyotes.

Table 4.4 – Non-targets live-captured and released by WS in South Carolina, FY 2009 – FY 2014

Species	Method of Live-Capture		Total
	Foothold[†]	Neck Snare[†]	
Feral Cat	1	0	**1**
Feral Dog	0	3	**3**
Opossum	3	0	**3**
Raccoons	1	0	**1**

[†]WS' personnel would release animals captured in body grip, foothold, or neck snares by the tail or other extremities if they are unharmed and can be released safely.

WS would monitor the removal of non-target species to ensure program activities or methodologies used in mammal damage management would not adversely affect non-targets. Methods available to resolve and prevent mammal damage or threats when employed by trained, knowledgeable personnel would be selective for target species. WS would report to the SCDNR any non-target removal to ensure removal by WS was considered as part of management objectives established for those species by the SCDNR. The potential for adverse effects to occur with non-targets would be similar to the other alternatives and would be considered minimal to non-existent based on previous non-target removal.

As discussed previously, the use of non-lethal methods to address damage or threats would generally be regarded as having no effect on a species' population since those individuals addressed using non-lethal methods would be unharmed and no actual reduction in the number of individuals in a species' population occurs. Similarly, the live-capture and release of non-targets would generally be regarded as having no adverse effects on a species' population since those individuals would be released unharmed and no actual reduction in the number of individuals in a population occurs. Therefore, the live-capture and subsequent releasing of non-targets during damage management activities conducted under the proposed action alternative would not result in declines in the number of individuals in a species' population.

While every precaution would be taken to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by mammals, the use of such methods could result in the incidental removal of unintended species. Those occurrences would be rare and should not affect the overall populations of any species under the proposed action.

T&E SPECIES EFFECTS

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 minimization measures. Chapter 3 describes those SOPs that WS would implement to avoid effects on T&E species.

Although exact population estimates for target mammal species are not available, target mammal species can occur statewide in South Carolina. Therefore, damage or threats of damage caused by target mammal species could occur statewide in South Carolina wherever target mammal species occur. However, WS would only conduct activities to alleviate or prevent damage when a landowner or manager requests such assistance and only on properties where WS and a cooperating entity sign a Memorandum of Understanding, work initiation document, or another comparable document. Therefore, WS has defined

the action area as the State of South Carolina, which encompasses the known areas occupied by all of the T&E species listed within the State.

During the development of this EA, WS reviewed the current list of species designated as threatened or endangered in South Carolina as determined by the USFWS and the National Marine Fisheries Service. WS conducted a review of potential impacts of activities on each of the listed species. The evaluation took into consideration the direct and indirect effects of available methods. WS reviewed the status, critical habitats designations, and current known locations of all T&E species listed as threatened or endangered within South Carolina. In addition, WS reviewed the methods available to manage damage, the use patterns of those methods, and the areas where previous requests for assistance associated with target mammal species have occurred within the State.

For several species listed within the State, 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 (see Table 4.5). In addition, WS has made a "*no effect*" determination for several species currently listed in the State based on those methods currently available and based on current life history information for those species (see Table 4.5).

Table 4.5 - List of threatened or endangered species in South Carolina and WS' determination

Common Name	Scientific Name	Status[†]	Determination[‡]
Animals			
Invertebrates			
Carolina Heelsplitter	*Lasmigona decorata*	E[*]	MANLAA
Reptiles			
Green Sea Turtle	*Chelonia mydas*	T	MANLAA
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	MANLAA
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	MANLAA
Leatherback Sea Turtle	*Dermochelys coriacea*	E	MANLAA
Loggerhead Sea Turtle	*Caretta caretta*	T[*]	MANLAA
Bog Turtle	*Clemmys muhlenbergii*	T	MANLAA
Amphibian			
Frosted Flatwoods Salamander	*Ambystoma cingulatum*	T[*]	MANLAA
Fish			
Shortnose Sturgeon	*Acipenser brevirostrum*	E	NE
Smalltooth Sawfish	*Pristis pectinata*	E	NE
Mammals			
West Indian Manatee	*Trichechus manatus*	E	NE
Finback Whale	*Balaenoptera physalus*	E	NE
Humpback Whale	*Megaptera novaeangliae*	E	NE
North Atlantic Right Whale	*Eubalaena glacialis*	E	NE
Red Wolf	*Canis rufus*	E	NE
Birds			
Piping Plover	*Charadrius melodus*	T[*]	NE
Bachman's Warbler	*Vermivora bachmanii*	E	NE
Red-cockaded Woodpecker	*Picoides borealis*	E	MANLAA
Kirtland's Warbler	*Setophaga kirtlandii*	E	NE
Wood Stork	*Mycteria americana*	T	NE
Red Knot	*Calidris canutus rufa*	T	NE
Roseate Tern	*Sterna dougallii dougallii*	T	NE

Plants			
American Chaffseed	*Schwalbea americana*	E	NE
Bunched Arrowhead	*Sagittaria fasciculata*	E	NE
Canby's Dropwort	*Oxypolis canbyi*	E	NE
Pondberry	*Lindera melissifolia*	E	NE
White Fringeless Orchid	*Platanthera integrilabia*	C	NE
Dwarf-flowered Heartleaf	*Hexastylis naniflora*	T	NE
Harperella	*Ptilimnium nodosum*	E	NE
Little Ampianthus	*Amphianthus pusillus*	T	NE
Miccosukee Gooseberry	*Ribes echinellum*	T	NE
Michaux's sumac	*Rhus michauxii*	E	NE
Mountain Sweet Pitcher-plant	*Sarracenia rubra jonesii*	E	NE
Persistent Trillium	*Trillium persistens*	E	NE
Relict Trillium	*Trillium reliquum*	E	NE
Rough-leaved Loosestrife	*Lysimachia asperulaefolia*	E	NE
Schweinitz's Sunflower	*Helianthus schweinitzii*	E	NE
Seabeach Amaranth	*Amaranthus pumilus*	T	NE
Small Whorled Pogonia	*Isotria medeoloides*	T	NE
Smooth Coneflower	*Echinacea laevigata*	E	NE
Swamp Pink	*Helonias bullata*	T	NE
White Irisette	*Sisyrinchium dichotomum*	E	NE
Rock Gnome Lichen	*Gymnoderma lineare*	E	NE
Black Spored Quillwort	*Isoetes melanospora*	E	NE

†T=Threatened; E=Endangered; C=Candidate; P=Proposed

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

*Species with critical habitat designated within South Carolina

WS based the effects determination for each species on several considerations, including the use pattern of methods, the locations and habitats where WS was likely to use methods, and the known geographical extent of the species. The following discussion provides the rationale for WS' effects determination for each species.

Carolina Heelsplitter – This freshwater mussel species occurs in creeks, streams, and rivers along the slate-belt portion of the piedmont areas of North Carolina and South Carolina. In South Carolina, populations were only known to occur in small stretches of the Lynches River in Chesterfield, Lancaster, and Kershaw Counties; Flat Creek and Grills Creek in Lancaster County; Turkey Creek in Edgefield and McCormick Counties; Mountain Creek and Beaverdam Creek in Edgefield County; and Cuffytown creek in Greenwood and McCormick Counties (USFWS 1996). The USFWS (2009) stated, "*Several small mammal species are known to feed on mussels including muskrat, otter, raccoon, mink…"* and "[w]*hile predation is not thought to be a significant threat to a healthy mussel population, it could limit the recovery of endangered mussel species or contribute to the local extirpation of mussel populations already depleted by other factors*". Based on the use patterns of methods, the proposed activities would have no direct effect on the status of the heelsplitter. However, removing mammalian predators near areas where heelsplitters occur could provide some benefit by reducing predation. In addition, the methods that would be available to resolve damage caused by mammals do not result in major ground disturbances, siltation, pollution, or stream alterations; therefore, the proposed action alternative would have no effect on any critical habitat designated for the heelsplitter in the State.

Green Sea Turtle - Like the other sea turtles, the green sea turtle is a marine species that could be found along the coastal waters of the State. Based on the use patterns of methods, the proposed activities would

have no direct effect on the status of the green sea turtle. Nesting is not known to occur on coastal beaches of the continental United States; however, if nesting were to occur along the beaches in the State, removing mammalian predators near nesting areas could provide some benefit by reducing predation on eggs and young turtles.

Hawksbill Sea Turtle - The hawksbill sea turtle is another marine species that could occur along the coastal waters and could nest along the beach areas of the State. However, nesting is not known to occur along the coastal beaches of the State. Since methods and activities conducted under the proposed activities would not involve marine environments, the proposed activities would have no direct effect on the status of the Hawksbill sea turtle. If nesting were to occur along the beaches in the State, removing mammalian predators near nesting areas could provide some benefit by reducing predation on eggs and young turtles.

Kemp's Ridley Sea Turtle - This sea turtle is a marine species that could be found along the coastal waters of South Carolina. Based on the use patterns of methods available to alleviate mammal damage, the proposed activities would have no direct effect on sea turtles. Predation of sea turtle nests by mammalian predators, such as raccoons, coyotes, or fox, could occur if nesting occurs along the coastal beaches of the State. If nesting were to occur along the beaches in the State, removing mammalian predators near nesting areas could provide some benefit by reducing predation on eggs and young turtles.

Leatherback Sea Turtle - This marine species has been observed nesting along the gulf coast states from Texas to Georgia; however, the sea turtle currently only consistently nests along the Florida coast. Similar to the other sea turtles, the proposed activities would not directly affect the sea turtle; however, the removal of mammalian predators by WS could reduce predation on nests, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing nest predation, which would warrant a not likely to adversely affect determination.

Loggerhead Sea Turtle - The loggerhead sea turtle is a marine species that could be found along the coastal areas of the State. The proposed activities would not result in any detrimental impacts to the status of the loggerhead sea turtle. The removal of mammalian predators in areas where sea turtles nest could result in reduced predation on eggs and young, which could be beneficial to the status of sea turtles. Therefore, WS has concluded the proposed activities may affect the loggerhead sea turtle but would have no adverse effect on the status of the species based on the potential for beneficial effects from the removal of mammal predators from areas where nesting could occur in the State.

Bog Turtle – The USFWS lists bog turtles found in the northern portion of their range as a threatened species. The USFWS lists those bog turtles in the southern portion of their range, including those turtles found in South Carolina, as threatened due to the similarity of appearance with the turtles from the northern portion of their range. In the southern portion of the their range, bog turtles occur in the Appalachian Mountains from southern Virginia to northern Georgia, with populations occurring in Greenville and Pickens Counties, South Carolina. The USFWS allows the incidental take of bog turtles in the southern portion of their range, including South Carolina, from otherwise lawful activities (see 62 FR 59605-59623; 50 CFR 17.42(f)). No incidental take of bog turtles has occurred previously by WS in the State when targeting mammal species. WS does not expect incidental take to occur during activities to alleviate mammalian damage in the State given the limited range of the bog turtle in the State and the use patterns of methods available. Removing mammalian predators could reduce predation rates on bog turtles, which could provide some benefit to the species.

Frosted Flatwoods Salamander – The frosted flatwoods salamander likely occurs in Beaufort, Berkeley, Charleston, Jasper, and Orangeburg Counties in the State. Flatwoods salamanders occur in longleaf pine-slash pine flatwoods with breeding occurring in isolated, seasonal ponds. The primary threat to the

salamander is loss and degradation of both its terrestrial habitat and breeding habitat. In addition, fire suppression may be a primary reason for continued habitat degradation (see 74 FR 6700-6774). The proposed activities would not directly affect the frosted flatwoods salamander; however, the removal of mammalian predators by WS could reduce predation risks, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation, which would warrant a not likely to adversely affect determination. In addition, the proposed activities would not result in habitat destruction or draining of ponds; therefore, WS has determined the proposed activities would have no effect on critical habitat designated in the State.

Shortnose Sturgeon – The shortnose sturgeon is a fish species that occurs in large coastal rivers of eastern North America. Based on the use patterns of the methods available to address damage or threats of damage associated with mammals, WS has determined the proposed action would have no effect on the status of the shortnose sturgeon.

Smalltooth sawfish - The smalltooth sawfish historically has occurred in the shallow coastal waters of the Gulf of Mexico from Texas to Florida and the shallow coastal areas along the Atlantic Ocean from Florida to New York. WS' activities to resolve damage or threats associated with mammals do not cause major disturbances to habitat or the introduction of pollutants into the waters where sawfish are known to occur. Current populations of smalltooth sawfish are only known to occur off the southern coasts of Florida (National Marine Fisheries Service 2009). Based on the current known range of the smalltooth sawfish being restricted to peninsular Florida, WS' mammal management activities conducted pursuant to the EA would have no effect on the smalltooth sawfish.

West Indian Manatee - Manatees are an aquatic species occasionally found in larger drainages that empty into large saltwater bays and lakes or the Gulf of Mexico. WS does not conduct damage management activities in those types of environments; therefore, WS has determined that activities under the proposed action alternative would have no effect on this species, including any designated critical habitat.

Whales – The finback whale, the humpback whale, and the north Atlantic right whale are marine species that could occur along the coastal waters of South Carolina. WS would not conduct mammal management activities in marine environments; therefore, activities would have no effect on those whale species.

Red Wolf – The only wild red wolf population occurs in northeastern North Carolina along the Albemarle Peninsula, which the USFWS has designated as a non-essential experimental population. Based on the known range of the red wolf, WS had determined the proposed action alternative would have no effect on the status of the red wolf.

Piping Plover – The piping plover winters along the coast and prefers tidal flats for feeding and sandy beaches for roosting. Critical habitat for this plover includes the coastal areas of Beaufort, Charleston, Colleton, Georgetown, Horry, and Jasper Counties. The proposed activities would not directly affect the piping plover; however, the removal of mammalian predators by WS could reduce predation risks, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation, which would warrant a not likely to adversely affect determination. In addition, the proposed activities would not result in habitat destruction; therefore, WS has determined the proposed activities would have no effect on critical habitat designated in the State.

Bachman's Warbler - The Bachman's warbler has not been officially documented in the United States since 1962 and was last documented on wintering grounds in Cuba in 1984 (USFWS 2007). Although unconfirmed reports of Bachman's warblers have occurred since 1962 in the United States and

uncertainty on the status of the species remains, the species is likely extinct (USFWS 2007). Based on the rarity of occurrences and the preferred habitat of the Bachman's warbler being palustrine forested wetlands with a dense understory, WS' activities would have no effect on the Bachman's warbler in the State.

Red-cockaded Woodpecker - This species requires open stands of mature pine trees, primarily longleaf pine, for nest cavity construction. The proposed activities would not directly affect the red-cockaded woodpecker. The removal of mammals to alleviate damage or threats of damage could also reduce predation risks, thus providing positive benefits to the species; therefore, WS has determined that the proposed action could be beneficial and not likely to adversely affect the status of this species in the State.

Kirtland's warbler – The Kirtland's warbler is an endangered species that nests in young jack pine stands in the Great Lakes region of the United States and Canada. During the migration periods, Kirtland's warbler may occur along the coastal areas of the southeastern United States as they move toward their wintering grounds in the Bahamas. Based on the use patterns of the methods available to alleviate damage and the areas where damage management activities could occur in relationship to areas where warblers are likely to occur during their migration, WS has concluded the proposed action would have no effect on the status of the Kirtland's warbler.

Wood stork - Storks utilize freshwater and estuarine wetlands, primarily nesting in cypress or mangrove swamps. They feed in freshwater marshes, tidal creeks, and tidal pools. The proposed activities do not result in habitat destruction or modifications of habitat. Based on the habitat preferences of wood storks and the activities where damage management activities could occur, WS has determined the proposed activities would have no effect on the status of wood storks in the State, including any designated critical habitat.

Red knot - The USFWS has listed the red knot as a threatened species. During the breeding season, red knots occur in the extreme northern artic region. Red knots winter primarily in intertidal marine habitats, especially near coastal inlets, estuaries, and bays. In South Carolina, red knots occur in marine habitats along the coast (Baker et al. 2013). Primary food sources include invertebrates, especially bivalves and crustaceans. Based on the use patterns of the methods available to alleviate damage and the areas where damage management activities could occur in relationship to areas where red knots are likely to occur, WS has concluded the proposed action would have no effect on the status of the red knot.

Roseate Tern – Roseate terns present in the State would primarily occur during the migration periods as terns disperse from breeding areas to wintering areas. No known breeding colonies of terns occur in South Carolina. Terns primarily migrate far from land across the open ocean but are occasional observed along the coasts. Based on the migration patterns of terns, WS has determined the proposed action alternative would have no effect on the status of the roseate tern.

Plants – Based on the use patterns of the methods available and the current known locations of the plant species listed as endangered, threatened, or a candidate species in the State, WS has concluded the proposed action alternative would have no effect on the status of any of the plant species. Methods do not cause major ground disturbance or cause habitat destruction.

Based on a review of those T&E species listed in the State during the development of the EA, WS determined that activities conducted pursuant to the proposed action would not likely adversely affect those species listed in the State by the USFWS and the National Marine Fisheries Service nor their critical habitats. As part of the development of the EA, WS consulted with the USFWS under Section 7 of the ESA. The USFWS concurred with WS' determination that activities conducted pursuant to the proposed

action would not likely adversely affect those species currently listed in the State or their critical habitats (T. McCoy, USFWS pers. comm. 2015).

State Listed Species – The current list of State listed species designated as endangered or threatened as determined by the SCDNR were obtained and reviewed during the development of the EA (see Appendix D). Based on the review of species listed in the State, WS has determined that the proposed activities would not adversely affect those species currently listed by the State. The SCDNR has concurred with WS' determination for State listed species (E. Cope, SCDNR pers. comm. 2015).

State-listed species are separated into three categories: Highest Conservation Need, High Conservation Need and Moderate Conservation Need. Identification of priority rankings was accomplished by considering the data available for the criteria presented Figure 1.

Figure 1. Criteria used for determination of priority by SCDNR

- State and federal protection status: endangered, threatened, rare or special concern
- South Carolina Natural Heritage Program state rank: S1 through S5
- Degree of exploitation/harvest: high, medium or low
- Availability of past or current funding to address species challenges
- Feasibility measure: the likelihood that conservation activities in South Carolina can make a difference for this species
- Knowledge of the species' population status: status mostly known, slightly known or unknown
- Knowledge of species' distribution in the state: distribution mostly known, slightly known or unknown
- Knowledge of limiting factors affecting the species: limiting factors mostly known, slightly known or unknown
- Population status (trend): population decreasing, stable or increasing

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Under a technical assistance alternative, WS would have no direct impact on non-target species, including T&E species. Methods recommended or provided through loaning of equipment could be employed by those persons requesting assistance. Recommendations would be based on WS' Decision Model using information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize non-target impacts associated with the methods being recommended or loaned. Methods recommended could include non-lethal and lethal methods as deemed appropriate by WS' Decision Model and as permitted by laws and regulations.

The potential impacts to non-targets under this alternative would be variable and based on several factors. If methods were employed, as recommended by WS, the potential impacts to non-targets would likely be similar to the proposed action. If recommended methods and techniques were not followed or if other methods were employed that were not recommended, the potential impacts on non-target species, including T&E species would likely be higher compared to the proposed action.

The potential impacts of harassment and exclusion methods on non-target species would be similar to those described under the proposed action. Harassment and exclusion methods would be easily obtainable and simple to employ. Since identification of targets would occur when employing shooting

as a method, the potential impacts to non-target species would likely be low under this alternative but would be based on the knowledge and experience of the person to identify the target species correctly.

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

If requesters were provided technical assistance but do not implement any of the recommended actions and conducted no further action, the potential to remove non-targets would be lower when compared to the proposed action. If those persons requesting assistance implement recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-targets would be similar to the proposed action. If WS made recommendations on the use of methods to alleviate damage but those methods were not implemented as recommended by WS or if those methods recommended by WS were used inappropriately, the potential for lethal removal of non-targets would likely increase under a technical assistance only alternative. Therefore, the potential impacts to non-targets, including T&E species, would be variable under a technical assistance only alternative.

If non-lethal methods recommended by WS under this alternative were deemed ineffective by those people requesting assistance, lethal methods could be employed by those people experiencing damage. Those people requesting assistance would likely be those persons that would use lethal methods since a damage threshold had been met for that individual requester that triggered seeking assistance to reduce damage. The potential impacts on non-targets by those persons experiencing damage would be highly variable. People whose mammal damage problems were not effectively resolved by non-lethal control methods would likely resort to other means of legal or illegal lethal control. This could result in less experienced people implementing control methods and could lead to greater removal of non-target wildlife than the proposed action. When those persons experiencing damage caused by wildlife reach a level where assistance does not adequately reduce damage or where no assistance is available, people have resorted to using chemical toxicants that are illegal for use on the intended target species. The illegal use of methods often results in loss of both target and non-target wildlife (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003). The use of illegal toxicants by those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate removal of wildlife species.

The ability to reduce negative effects caused by mammals to wildlife species and their habitats, including T&E species, would be variable under this alternative. The ability to reduce risks would be based upon the skills and abilities of the person implementing damage management actions. It would be expected that this alternative would have a greater chance of reducing damage than Alternative 3 since WS would be available to provide information and advice on appropriately employing methods and reducing the risk of non-target removal.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be directly involved with damage management activities in the State. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. Mammals would continue to be lethally removed when authorized by the SCDNR, removal would continue to occur during the regulated harvest seasons, and some mammal species could continue to be removed without the need for authorization from the SCDNR. Risks to non-targets 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, state, and private entities. Although some risks could occur from those people that implement mammal damage management 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 negative effects caused by mammals to other wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative.

Issue 3 - Effects of Mammal Damage Management Activities on Human Health and Safety

A common concern is the potential adverse effects that methods available could have on human health and safety. The threats to human safety of methods available under the alternatives are evaluated below by each of the alternatives.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

The cooperator requesting assistance would be made aware through a MOU, work initiation document, or a similar document that those methods agreed upon could potentially be used on property owned or managed by the cooperator. Therefore, the cooperator would be made aware of the possible use of those methods on property they own or manage to identify any risks to human safety associated with the use of those methods. Cooperators would be made aware by signing a MOU, work initiation document, or another similar document, which would assist WS and the cooperating entity with identifying any risks to human safety associated with methods at a particular location.

Under the proposed action, WS could use or recommend those methods discussed in Appendix B singularly or in combination to resolve and prevent damage associated with mammals in the State. WS would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Non-lethal and lethal methods could be used under the proposed action. WS would continue to provide technical assistance and/or direct operational assistance to those persons seeking assistance with managing damage or threats from mammals. Risks to human safety from technical assistance conducted by WS would be similar to those risks addressed under Alternative 2. Those non-lethal methods that could be used as part of an integrated approach to managing damage that would be available for use by WS as part of direct operational assistance, would be similar to those risks associated with the use of those methods under the other alternatives.

Lethal methods available under the proposed action would include the use of euthanasia chemicals, body-gripping traps, cable restraints, the recommendation of harvest during hunting and/or trapping seasons, fumigants, rodenticides, and shooting. In addition, target mammal species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. Those lethal methods available under the proposed action alternative or similar products would also be available under the other alternatives. None of the lethal methods available would be restricted to use by WS only. Euthanasia chemicals would not be available to the public but those mammals live-captured could be killed using other methods.

WS' employees who conduct activities to manage damage caused by mammals would be knowledgeable in the use of those methods available, the wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by mammals.

When employing lethal methods, WS' employees would consider risks to human safety when employing those methods based on location and method. For example, risks to human safety from the use of methods would likely be lower in rural areas that are less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property could be controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at public parks or near other public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety would increase. Activities would generally be conducted when human activity was minimal (*e.g.*, early mornings, at night) or in areas where human activities was minimal (*e.g.*, in areas closed to the public).

The use of live-capture traps, restraining devices (*e.g.*, foothold traps, some cable restraints), and body gripping traps have been identified as a potential issue. Live-capture traps available for mammals would typically be walk-in style traps where mammals enter but are unable to exit. Live-traps, restraining devices, and body-gripping traps would typically be set in situations where human activity was minimal to ensure public safety. Those methods rarely cause serious injury and would only be triggered through direct activation of the device. Therefore, human safety concerns associated with live traps, restraining devices, and body-gripping traps used to capture wildlife, including mammals, would require direct contact to cause bodily harm. Therefore, if left undisturbed, risks to human safety would be minimal. Signs warning of the use of those tools in the area could be posted for public view at access points to increase awareness that those devices were being used and to avoid the area, especially pet owners.

Other live-capture devices, such as cannon nets, pose minor safety hazards to the public since activation of the device would occur by trained personnel after target species were observed in the capture area of the net. Lasers also pose minimal risks to the public since application would occur directly to target species by trained personnel, which would limit the exposure of the public to misuse of the method.

Safety issues related to the misuse of firearms and the potential human hazards associated with the use of firearms were issues identified. To help ensure the safe use of firearms and to increase awareness of those risks, WS' employees who use firearms during official duties would be required to attend an approved firearm safety training course and to remain certified for firearm use must attend a safety training course in accordance with WS Directive 2.615. As a condition of employment, WS' employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC § 922(g)(9)). A safety assessment based on site evaluations, coordination with cooperating and local agencies (if applicable), and consultation with cooperators would be conducted before firearms were deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues were considered before firearms would be deemed appropriate for use. The use of all methods, including firearms, would be agreed upon with the cooperator to ensure the safe use of those methods. The security of firearms would also occur pursuant to WS Directive 2.615.

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods could include immobilizing drugs, euthanasia chemicals, reproductive inhibitors, fumigants, rodenticides, and repellents.

The use of immobilizing drugs would only be administered to mammals that have been live-captured using other methods or administered through injection using a projectile (*e.g.*, dart gun). Immobilizing

drugs used to sedate wildlife would be used to temporarily handle and transport animals to lessen the distress of the animal from the experience. Drug delivery would likely occur on site with close monitoring of the animal to ensure proper care of the animal. Immobilizing drugs would be reversible with a full recovery of sedated animals occurring. Drugs used in capturing and handling wildlife that would be available include ketamine, a mixture of ketamine/xylazine, and Telazol. A list and description of immobilizing drugs available for use under the identified alternatives can be found in Appendix B.

If mammals were immobilized for sampling or translocation and released, risks could occur to human safety if harvest and consumption occurred. SOPs employed by WS to reduce risks are discussed in Chapter 3 and in Appendix B. SOPs that would be part of the activities conducted include:

- All immobilizing drugs used in capturing and handling wildlife would be under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and WS.
- As determined on a state-level basis by those veterinary authorities (as allowed by AMDUCA), wildlife hazard management programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to the hunting or trapping season for the target species. This practice would avoid release of animals that may be consumed by hunters and/or trappers prior to the end of established withdrawal periods for the particular drugs used. Ear tagging or other marking of animals drugged and released to alert hunters and trappers that they should contact state officials before consuming the animal.
- Most animals administered immobilizing drugs would be released well before hunting/trapping seasons, which would give the drug time to metabolize completely out of the animals' systems before they might be harvested and consumed by people. In some instances, animals collected for control purposes would be euthanized when they were captured within a certain specified time period prior to the legal hunting or trapping season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems.

Meeting the requirements of the AMDUCA should prevent any adverse effects to human health with regard to this issue.

Euthanizing chemicals would be administered under similar circumstances to immobilizing drugs and would be administered to animals live-captured using other methods. Euthanasia chemicals would include sodium pentobarbital, potassium chloride, and Beuthanasia-D. Euthanized animals would be disposed of in accordance with WS Directive 2.515; therefore, would not be available for harvest and consumption. Euthanasia of target animals would occur in the absence of the public to minimize risks, whenever possible.

The recommendation of repellents or the use of those repellents registered for use to disperse mammals in the State could occur under the proposed action as part of an integrated approach to managing mammal damage. Those chemical repellents that would be available to recommend for use or that could be directly used by WS under this alternative would also likely be available under any of the alternatives. Therefore, risks to human safety from the recommendation of repellents or the direct use of repellents would be similar across all the alternatives. Risks to human safety associated with the use of repellents by WS or the recommendation of repellents by WS is addressed under the technical assistance only alternative (Alternative 2). Risks to human safety would be similar across all the alternatives. WS' involvement, either through recommending the use of repellents or the direct use of repellents, would ensure that label requirements of those repellents were discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using those chemical methods. Therefore, the risks to human safety associated with the recommendation of or direct use of repellents could be lessened through WS' participation.

Gas cartridges would be ignited and placed inside of burrows or dens with the entrance covered by dirt, which traps carbon monoxide inside the burrow. The carbon monoxide would dissipate into the atmosphere and be diluted by the air (EPA 1991). WS would follow label instructions when employing gas cartridges. Therefore, no risks to human safety would occur from the use of gas cartridges.

The recommendation of various rodenticides or the use of those rodenticides registered for use to manage rodents in the State could occur under the proposed action as part of an integrated approach to managing damage. Those rodenticides that would be available for use by WS or could be recommended by WS under this alternative would also likely be available under any of the alternatives. Therefore, risks to human safety from the recommendation of rodenticides or the direct use of rodenticides would be similar across all the alternatives. WS' involvement, either through recommending the use of rodenticides or their direct use, would ensure that label requirements of these rodenticides would be discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using those chemical methods. Therefore, the risks to human safety associated with the recommendation of or direct use of rodenticides could be lessened through WS' participation.

Due to the classification of GonaCon™ as a restricted-use pesticide by the EPA, this product would be restricted to use by federal or state agencies that have successfully completed the requirements of the CUDPR for the purchase and application of restricted-use pesticides. Risks to human safety would be limited primarily to the actual applicator due to the necessity to capture and inject GonaCon™ into each animal to be vaccinated. During the development of this EA, GonaCon™ was not registered for use in South Carolina; therefore, GonaCon™ would not be available for use within the State. However, this product could be registered for use in South Carolina and could be administered by SCDNR or their agents under any of the alternatives.

Risks to human safety from the use of GonaCon™ would be minimal and would occur primarily to those persons injecting the deer through accidental self-injection or those persons handling syringes. To reduce the risks of accidental exposure through self-injection, the label of GonaCon™ requires the use of long sleeved shirts, long pants, gloves, socks, and shoes. In addition, injection would only occur after deer had been properly restrained to minimize accidental injection during application to the deer. The label also requires that children be absent from the area during application of the vaccine as well as a warning to women that accidental self-injection could cause infertility.

In addition, human exposure could occur through consumption of deer that were treated with GonaCon™. As was discussed previously, the vaccine and the antibodies produced in response to the vaccine are amino acid proteins that if consumed would be broken down by stomach acids and enzymes, posing no risks to human safety. The vaccine would only be used in localized areas where deer populations have exceeded the biological or social carrying capacity. Those areas would likely be places where hunting was prohibited or restricted (*e.g.*, in public parks); therefore, the consumption of deer would be unlikely in those areas where the vaccine would be used since hunting would be prohibited or restricted. Deer injected with the vaccine must also be marked for identification, which would allow for placement of warnings to people that could harvest and consume a treated deer. Based on the use pattern of GonaCon™ and the chemical make-up of the vaccine and the antibodies, the risks to human safety from the use of the vaccine would be extremely low and would occur primarily to the handler (EPA 2009).

The recommendation by WS that mammals be harvested during the regulated hunting and/or trapping season that are established by the SCDNR would not increase risks to human safety above those risks already inherent with hunting or trapping those species. Recommendations of allowing hunting and/or trapping on property owned or managed by a cooperator to reduce mammal populations, which could then

reduce damage or threats, would not increase risks to human safety. Safety requirements established by the SCDNR for the regulated hunting and trapping season would further minimize risks associated with hunting and trapping. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized populations of mammals would not increase those risks.

No adverse effects to human safety have occurred from WS' use of methods to alleviate mammal damage in the State from FY 2009 through FY 2014. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, would be considered low. Based on the use patterns of methods available to address damage caused by mammals, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Under this alternative, WS would be restricted to making recommendations on the use of methods and the demonstration of methods to resolve damage. WS would only provide technical assistance to those people requesting assistance with mammal damage and threats. Although hazards to human safety from non-lethal methods exist, those methods are generally regarded as safe when used by trained individuals who are experienced in their use. Risks to human safety associated with non-chemical methods, such as resource management methods (*e.g*., crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, and cage traps, could be considered low based on their use profile for alleviating damage associated with wildlife. Although some risk of fire and bodily harm exists from the use of pyrotechnics and propane cannons, when used appropriately and in consideration of those risks, those methods could be used with a high degree of safety.

Under a technical assistance only alternative, the availability of GonaCon™, immobilizing drugs, euthanasia chemicals, and aircraft to those persons experiencing damage or other entities would be limited. Personnel with the SCDNR or their designated agents could use GonaCon™ under this alternative, if registered. Immobilizing drugs and euthanasia chemicals used in capturing and handling wildlife could be administered under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and other entities, such as the SCDNR. Without access to immobilizing drugs or euthanizing chemicals, those persons capturing mammals using live-traps or other live-capture methods would be responsible for euthanizing or handling live-captured captive animals. Since the availability of immobilizing drugs and euthanizing chemicals would be limited under this alternative, a gunshot would likely be the primary method of euthanasia. The use of aircraft, primarily the use of firearms from an aircraft, would require a permit from the SCDNR.

If cannon nets were recommended, persons employing nets would be present at the site during application to ensure the safety of the public and operators. Although some fire and explosion hazards exist with rocket nets during ignition and storage of the explosive charges, safety precautions associated with the use of the method, when adhered to, would pose minimal risks to human safety and would primarily occur to the handler. Nets would not be recommended in areas where public activity was high, which would further reduce the risks to the public. Nets would be recommended for use in areas where public access was restricted whenever possible to reduce risks to human safety. Overall, nets would pose minimal risks to the public.

The use of chemical methods that are considered non-lethal could be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage damage caused by mammals in the State. Most repellents require ingestion of the chemical to achieve the desired effects on target species. Repellents that require ingestion are intended to discourage foraging on vulnerable resources and to disperse mammals from areas where the repellents were applied. 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.

The recommended use of chemical methods that were considered lethal would also be available under this alternative. Lethal chemicals available would consist primarily of those Ready-To-Use toxicants targeting rodents that were available at local hardware stores for use in managing old world rodents. Those toxicants would require no special certification to use and they would generally be considered safe when their use occurred in accordance with label directions. Additional lethal chemicals would be available through WS' recommendation to contact private sector wildlife control operators that have received CUDPR certification for use of restricted-use pesticides. While those chemicals may not be available to individual landowners, using a private sector wildlife control operator, similar chemical use, and mammal damage control could be achieved.

The recommendation by WS that mammals be harvested during the regulated hunting and/or trapping season, which would be established by the SCDNR, would not increase risks to human safety above those risks already inherent with hunting and trapping mammals. Recommendations of allowing hunting or trapping on property owned or managed by a cooperator to reduce local mammal populations that could then reduce mammal damage or threats would not increase risks to human safety. Safety requirements established by the SCDNR for the regulated hunting and trapping season would further minimize risks associated with those activities. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized mammal populations would not increase those risks.

The recommendation of shooting with firearms as a method of direct lethal removal could occur under this alternative. Safety issues do arise related to misusing firearms and the potential human hazards associated with firearms use when employed to reduce damage and threats. When used appropriately and with consideration for human safety, risks associated with firearms would be minimal. If firearms were employed inappropriately or without regard to human safety, serious injuries could occur. Under this alternative, recommendations of the use of firearms by WS would include human safety considerations. Since the use of firearms to alleviate mammal damage would be available under any of the alternatives and the use of firearms by those persons experiencing mammal damage could occur whether WS was consulted or contacted, the risks to human safety from the use of firearms would be similar among all the alternatives.

If non-chemical methods were employed according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to the proposed action. If methods were employed without guidance from WS or applied inappropriately, the risks to human safety could increase. The extent of the increased risk would be unknown and variable. Non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

The cooperator requesting assistance would also be made aware of threats to human safety associated with the use of those methods. SOPs for methods are discussed in Chapter 3 of this EA. Risks to human safety from activities and methods recommended under this alternative would be similar to the other alternatives since the same methods would be available. If misused or applied inappropriately, any of the methods available to alleviate mammal damage could threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety. The recommendation of methods by WS to people requesting assistance and the pattern of use recommended by WS would comply with Executive Order 12898 and Executive Order 13045.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under the no involvement by WS alternative, WS would not be involved with any aspect of managing damage associated with mammals in the State, including technical assistance. Due to the lack of involvement in managing damage caused by mammals, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damages associated with mammals from conducting damage management activities in the absence of WS' assistance. The direct burden of implementing permitted methods would be placed on those people experiencing damage or would require those people to seek assistance from other entities.

Similar to the technical assistance only alternative, GonaCon™, immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability under this alternative to the public. However, fumigants, most rodenticides, and repellents would continue to be available to those persons with the appropriate pesticide applicators license. Since most methods available to resolve or prevent mammal damage or threats would be available to anyone, the threats to human safety from the use of those methods would be similar between the alternatives. However, methods employed by those persons not experienced in the use of methods or were not trained in their proper use, could increase threats to human safety. Overall, the methods available to the public, when applied correctly and appropriately, would pose minimal risks to human safety.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

Another concern often raised is the potential impact the alternatives could have on the aesthetic value that people often regard for mammals. The effects of the alternatives on this issue are analyzed below by alternative.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

Under the proposed action, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of mammals to resolve damage and threats. In some instances where mammals were dispersed or removed, the ability of interested persons to observe and enjoy those mammals would likely temporarily decline.

Even the use of exclusionary devices can lead to the dispersal of wildlife if the resource being damaged was acting as an attractant. Thus, once the attractant was removed or made unavailable, the wildlife would likely disperse to other areas where resources would be more vulnerable.

The use of lethal methods would result in temporary declines in local populations resulting from the removal of mammals to address or prevent damage and threats. The goal under the proposed action would be to respond to requests for assistance and to manage those mammals responsible for the resulting damage. Therefore, the ability to view and enjoy mammals would remain if a reasonable effort were made to locate mammals outside the area in which damage management activities were occurring. In most cases, the mammals removed by WS could be removed by the person experiencing damage or removed by other entities if no assistance was provided by WS.

All activities would be conducted where a request for assistance was received and only after the cooperator and WS had signed a MOU, work initiation document, or similar document. Some aesthetic value would be gained by the removal of some mammal species and the return of a more natural

environment, including the return of native wildlife and plant species that may be suppressed or displaced by high mammal densities.

Since those mammals that could be removed by WS under this alternative could be removed by other entities, WS' involvement in removing those mammals would not likely be additive to the number of mammals that could be removed in the absence of WS' involvement. Other entities could remove mammals when the SCDNR authorizes the removal, without the need for a permit if the species was unregulated, or during the regulated hunting or trapping seasons.

WS' removal of mammals from FY 2009 through FY 2014 has been of low magnitude compared to the total mortality and populations of those species. WS' activities would not likely be additive to the mammals that could be lethally removed in the absence of WS' involvement. Although mammals removed by WS would no longer be present for viewing or enjoying, those mammals would likely be removed by the property owner or manager if WS were not involved in the action. Removal by the property owner or manager could occur under a permit, during the regulated hunting and trapping seasons, or if the mammals were unregulated, removal could occur without the need for a permit. Given the limited removal proposed by WS under this alternative when compared to the known sources of mortality of mammals and the population estimates of those species, WS' mammal damage management activities conducted pursuant to the proposed action would not adversely affect the aesthetic value of mammals. The impact on the aesthetic value of mammals and the ability of the public to view and enjoy mammals under the proposed action would be similar to the other alternatives and would likely be low.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

If those persons seeking assistance from WS were those persons likely to conduct damage management activities in the absence of WS' involvement, then technical assistance provided by WS would not adversely affect the aesthetic value of mammals in the State similar to Alternative 1. Mammals could be lethally removed under this alternative by those entities experiencing mammal damage or threats, which could result in localized reductions in the presence of mammals at the location where damage was occurring. The presence of mammals where damage was occurring could be reduced where damage management activities were conducted under any of the alternatives. Even the recommendation of non-lethal methods would likely result in the dispersal of mammals from the area if those non-lethal methods recommended by WS were employed by those persons receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of mammals since any activities conducted to alleviate mammal damage could occur in the absence of WS' participation in the action, either directly or indirectly.

Under this alternative, the effects on the aesthetic values of mammals would be similar to those addressed in the proposed action. When people seek assistance with managing damage from either WS or another entity, the damage level has often reached an unacceptable threshold for that particular person. Therefore, in the case of mammal damage, the social acceptance level of those mammals causing damage has reached a level where assistance has been requested and those persons would likely apply methods or seek those entities that would apply those methods based on recommendations provided by WS or by other entities. Based on those recommendations, methods could be employed by the requester that could result in the dispersal and/or removal of mammals responsible for damage or threatening safety. If those mammals causing damage were dispersed or removed by those persons experiencing damage based on recommendations by WS or other entities, the potential effects on the aesthetic value of those mammals would be similar to the proposed action alternative. In addition, those persons could contact other entities to provide direct assistance with dispersing or removing those mammals causing damage.

The potential impacts on aesthetics from a technical assistance program would only be lower than the proposed action if those individuals experiencing damage were not as diligent in employing those methods as WS would be if conducting an operational program or if no further action was taken by the requester. If those persons experiencing damage abandoned the use of those methods or conducted no further actions, then mammals would likely remain in the area and available for viewing and enjoying for those persons interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities could occur would not be such that mammals would be dispersed or removed from such large areas that opportunities to view and enjoy mammals would be severely limited.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under the no mammal damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of mammals in the State. Those people experiencing damage or threats from mammals would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. Mammals could continue to be dispersed and lethally removed under this alternative in the State. Lethal removal could continue to occur when permitted by the SCDNR through the issuance of permits, removal could occur during the regulated harvest season, and in the case of non-regulated species, removal could occur any time without the need for a permit.

Since mammals would continue to be lethally removed under this alternative, despite WS' lack of involvement, the ability to view and enjoy mammals would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of mammals dispersed or removed since WS' has no authority to regulate removal or the harassment of mammals in the State. The SCDNR, with management authority over mammals, could continue to adjust all removal levels based on population objectives for those mammal species in the State. Therefore, the number of mammals lethally removed annually through hunting and under permits would be regulated and adjusted by the SCDNR.

Those people experiencing damage or threats could continue to use those methods they feel appropriate to resolve mammal damage or threats, including lethal removal or could seek the direct assistance of other entities. Therefore, WS' involvement in managing damage would not be additive to the mammals that could be dispersed or removed. The impacts to the aesthetic value of mammals would be similar to the other alternatives.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised is concerns about the humaneness of methods available under the alternatives for resolving mammal damage and threats. The issues of method humaneness relating to the alternatives are discussed below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

Under the proposed action, WS would integrate methods using WS' Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, non-lethal methods would be used by WS that were generally regarded as humane. Non-lethal methods that would be available include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), translocation, exclusion devices, frightening devices, reproductive inhibitors, cage traps, foothold traps, nets, immobilizing drugs, and repellents.

As discussed previously, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

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 non-lethal 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. With 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, agencies are challenged with conducting activities and employing methods that are perceived 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 methods have been stereotyped as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. For instance, a cage trap would generally be considered by most members of the public as "*humane*", since the animal would be alive and generally unharmed. Yet, without proper care, live-captured wildlife in a cage trap could be treated inhumanely if not attended to 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. Overall, the use of resource management methods, harassment methods, and exclusion devices would be regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

Although some issues of humaneness could occur from the use of cage traps, foothold traps, reproductive inhibitors, translocation, immobilizing drugs, nets, and repellents, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of wildlife. Concerns from the use of those non-lethal methods would be from injuries to animals restrained in traps and from the stress of the animal while being restrained or during the application of the method. 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 appropriate action to alleviate conditions that cause pain or distress in animals.

If mammals were to be live-captured by WS, WS' personnel would be present on-site during capture events or WS' personnel would check capture devices at least once in a 24-hour period to ensure WS' personnel addressed mammals captured in a timely manner and to prevent injury. Although stress could occur to animals restrained in a trap, timely attention to live-captured animals would alleviate suffering. Stress would likely be temporary.

Under the proposed action, WS' personnel could use lethal methods to alleviate or prevent mammal damage and threats, when requested. Lethal methods would include shooting, body-gripping traps, cable restraints, gas cartridges, zinc phosphide, euthanasia chemicals, and the recommendation of harvest during hunting and/or trapping seasons. In addition, WS' personnel could euthanize target animals that an employee live-captures using non-lethal methods. WS' use of lethal methods under the proposed action would follow those required by WS' directives (see WS Directive 2.430, WS Directive 2.505).

The euthanasia methods that WS is considering for use under the proposed action for animal live-captured are carbon dioxide, carbon monoxide, gunshot, and barbiturates or potassium chloride in conjunction with general anesthesia. The AVMA considers those methods as acceptable for euthanasia and the use of those methods would meet the definition of euthanasia (AVMA 2013). The use of carbon dioxide, carbon monoxide, barbiturates, and potassium chloride for euthanasia would occur after the animal had been live-captured and would occur away from public view. 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 2013). WS' personnel that employ firearms to address mammal damage or threats to human safety would be aware of the proper placement of shots to ensure a timely and quick death.

An issue when dealing with some of the target species is the use of foothold traps to create submersion sets and the humaneness of drowning. Muskrats and river otters are the only target species addressed in this EA where the best management practices for trapping include traps for submersion sets (Association of Fish and Wildlife Agencies 2014*a*, Association of Fish and Wildlife Agencies 2014*b*). WS' personnel would only use submersion sets for muskrats and river otter and would not use submersion sets for the other target species addressed in this EA. In addition, the WS program in South Carolina has not specifically used submersion sets to target muskrats and river otters in the State. If WS receives requests for assistance associated with muskrats and river otters, WS' personnel would rarely, if ever, use submersion sets. There is considerable debate and disagreement among animal interest groups, veterinarians, wildlife professionals, fur trappers, and nuisance wildlife agents on this issue. The debate centers on an uncertainty as to whether the drowning animals are rapidly rendered unconscious by high levels of carbon dioxide (CO_2) and therefore, insensitive to distress and pain (Ludders et al. 1999). The inhalation of carbon dioxide at concentrations of 7.5% can increase the pain threshold and higher concentrations can have a rapid anesthetic effect on animals (AVMA 2013). For comparison, room air contains approximately 0.04% carbon dioxide (AVMA 2007).

The AVMA identifies drowning as an unacceptable method of euthanasia and does not meet the definition of euthanasia (Beaver et al. 2001, AVMA 2007, AVMA 2013). Ludders et al. (1999) concluded animals that drowned were distressed because of the presence of high levels of the stress related hormones epinephrine and norepinephrine that were present in their bloodstreams. Ludders et al. (1999) showed death during drowning occurred from hypoxia and anoxia; thus, animals experienced hypoxemia. Ludders et al. (1999) reported carbon dioxide narcosis did not occur in drowning animals until the mercury levels in the arterial blood of animals exceeded 95 millimeters. Therefore, Ludders et al. (1999) also concluded drowning did not meet the definition of euthanasia based on animals not dying rapidly from carbon dioxide narcosis.

The use of submersion trap sets has been a traditional wildlife management technique in trapping aquatic mammals, such as muskrats and otters (Ludders et al 1999). In some situations, submersion trap sets may be the most appropriate and efficient method available to capture otter and muskrat. For example, a submersion set, using a foothold trap, may be practical to prevent the animals from injuring themselves while restrained, or from escaping. Animals that drown die relatively quickly (*e.g.*, within minutes) versus the possible stress of being restrained and harassed by people, dogs, and other wildlife before being euthanized. Submersion sets make the captured animal, along with the trap, less visible and prevents injury from the trapped animal (*e.g.*, bites and scratches) to people who may otherwise approach a restrained animal. Furthermore, the sight of dead animals may offend some people. Drowning places the dead animal out of public view. Some sites may be unsuitable for body-gripping traps or snares because of unstable banks, deep water, or a marsh with a soft bottom, but those sites would be suitable for foothold traps.

Given the short time period of a drowning event, the possible analgesic effect of CO_2 buildup, the minimal if any pain or distress on drowning animals, the AVMA acceptance of a minimum of pain and distress during euthanasia, and the acceptance of catching and drowning muskrats and otters approved by International Humane Trapping Standards (Fur Institute of Canada 2000), WS concludes that drowning, though rarely used by WS, would be acceptable. WS recognizes some people would disagree.

Research and development by WS has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products were found practical, a certain amount of animal suffering could occur when some methods were used in situations where non-lethal damage management methods were not practical or effective. As stated previously, research suggests that some methods, such as restraint in foothold traps or changes in the blood chemistry of trapped animals, indicate "*stress*" (Kreeger et al. 1990). However, such 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).

Personnel from WS would be experienced and professional in their use of management methods. Consequently, management methods would be implemented in the most humane manner possible. Many of the methods discussed in Appendix B to alleviate mammal damage and/or threats in the State could be used under any of the alternatives by those persons experiencing damage regardless of WS' direct involvement. The only methods that would not be available to those people experiencing damage associated with mammals would be reproductive inhibitors, immobilizing drugs, and euthanasia chemicals. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives since those methods could be employed by other entities 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. SOPs that would be incorporated into WS' activities to ensure methods were used by WS as humanely as possible are listed in Chapter 3.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

The issue of humaneness of methods under this alternative would be similar to the humaneness issues discussed under the proposed action. This similarity would be derived from WS' recommendation of methods that some people may consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods. Therefore, by recommending methods and thus a requester employing those methods, the issue of humaneness would be similar to the proposed action. Under Alternative 2, WS would recommend the use of euthanasia methods pursuant to WS Directive 2.505. However, the person requesting assistance would determine what methods to use to euthanize or kill a live-captured animal under Alternative 2.

WS would instruct and demonstrate the proper use and placement of methodologies to increase effectiveness in capturing target mammal species and to ensure methods were used in such a way as to minimize pain and suffering. However, the efficacy of methods employed by a cooperator would be based on the skill and knowledge of the requester in resolving the threat to safety or damage situation despite WS' demonstration. Therefore, a lack of understanding of the behavior of mammals or improperly identifying the damage caused by mammals along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of being perceived as inhumane. In those situations, the potential for pain and suffering would likely be regarded as greater than discussed in the proposed action.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of mammal damage management in South Carolina. Those people experiencing damage or threats associated with mammals could continue to use those methods legally available. Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods.

The humaneness of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the 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 mammals. Under Alternative 3, euthanasia or killing of live-captured animals would also be determined by those persons employing methods to live-captured wildlife.

Issue 6 - Effects of Mammal Damage Management Activities on the Regulated Harvest of Mammals

The populations of several of the mammal species addressed in this assessment are sufficient to allow for annual harvest seasons that typically occur during the fall. Hunting and trapping seasons are established by the SCDNR. Those species addressed in this EA that have established hunting and/or trapping seasons include muskrat, gray squirrel, raccoon, river otter, coyote, gray fox, red fox, bobcat, opossum, nine-banded armadillo, and white-tailed deer. For many mammal species considered harvestable during hunting and/or trapping seasons, the estimated number of mammals harvested during the season could be reported by the SCDNR in published reports.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (No Action/Proposed Action)

The magnitude of lethal removal addressed in the proposed action would be low when compared to the mortality of those species from all known sources. When WS' proposed removal of mammals was included as part of the known mortality of those species and compared to the estimated populations, the impact on those species' populations was below the level of removal required to lower population levels.

With oversight of mammal populations by the SCDNR, the number of mammals that WS could remove annually would not limit the ability of those persons interested to harvest those mammal species during the regulated season. All removal by WS would be reported to the SCDNR annually to ensure removal by WS could be incorporated into population management objectives established for mammal populations. Based on the limited removal proposed by WS and the oversight by the SCDNR, WS' removal of mammals annually would have no effect on the ability of those persons interested to harvest mammals during the regulated harvest season.

Alternative 2 – Mammal Damage Management by WS through Technical Assistance Only

Under the technical assistance only alternative, WS would have no direct impact on mammal populations in the State. If WS recommended the use of non-lethal methods and those non-lethal methods were employed by those persons experiencing damage, mammals would likely be dispersed from the damage area to areas outside the damage area, which could serve to move those mammals from those less accessible areas to places accessible to hunters. Although WS could recommend lethal methods under a technical assistance only alternative, the use of those methods could only occur after the property owner

or manager received a permit from the SCDNR or when considered a non-regulated species, could be removed at any time using legally available methods. Lethal removal could also occur during the annual hunting and trapping season in areas where those activities were permitted. WS' recommendation of lethal methods could lead to an increase in the use of those methods. However, the number of animals that people are authorized to remove and the allowed harvest levels during the regulated hunting/trapping seasons would be determined by the SCDNR. Therefore, WS' recommendation of the use of lethal methods under this alternative would not limit the ability of those persons interested in harvesting mammals during the regulated season since the SCDNR determines the number of mammals that may be lethally removed during the hunting/trapping season and under permits.

Alternative 3 – No Mammal Damage Management Conducted by WS

WS would have no impact on the ability to harvest mammals under this alternative. WS would not be involved with any aspect of mammal damage management. The SCDNR would continue to regulate populations through adjustments of the allowed removal during the regulated harvest season and the continued use of permits.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

Cumulative impacts, as defined by the CEQ (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.

Under Alternative 1 and Alternative 2, WS would address damage associated with mammals either by providing technical assistance only (Alternative 2) or by providing technical assistance and direct operational assistance (Alternative 1) in the State. WS would be the primary federal agency conducting direct operational assistance in the State under Alternative 1. However, other federal, state, and private entities could also be conducting mammal damage management in the State.

WS does not normally conduct direct damage management activities concurrently with such agencies or other entities in the same area, but may conduct damage management activities at adjacent sites within the same period. In addition, commercial companies may conduct damage management activities in the same area. The potential cumulative impacts could occur from either WS' damage management program activities over time or from the aggregate effects of those activities combined with the activities of other agencies and private entities. Through ongoing coordination and collaboration between WS and the SCDNR, activities of each agency and the removal of mammals would be available. Damage management activities in the State would be monitored to evaluate and analyze activities to ensure they were within the scope of analysis of this EA.

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur because of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

Issue 1 - Effects of Mammal Damage Management Activities on Target Mammal Populations

The issue of the effects on target mammal species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats. As part of an integrated methods approach to

managing damage and threats, WS could apply both lethal and non-lethal methods when requested by those persons experiencing damage.

Non-lethal methods could disperse or otherwise make an area unattractive to mammals causing damage; thereby, reducing the presence of mammals at the site and potentially the immediate area around the site where non-lethal methods were employed. WS' employees would give non-lethal methods priority when addressing requests for assistance (see WS Directive 2.101). However, WS would not necessarily employ non-lethal methods to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance had already attempted to disperse mammals using non-lethal harassment methods, WS would not necessarily employ those methods again during direct operational assistance since those methods had already been proven to be ineffective in that particular situation. WS and other entities could use non-lethal methods to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from an area resulting in a reduction in the presence of those mammals at the site where WS or another entity employed those methods. However, mammals responsible for causing damage or threats would likely disperse to other areas with minimal impacts occurring to those species' populations. WS would not employ non-lethal methods over large geographical areas or apply those methods at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. WS and most people generally regard non-lethal methods as having minimal impacts on overall populations of wildlife since individuals of those species would be unharmed. Therefore, the use of non-lethal methods would not have cumulative effects on mammal populations in the State.

WS' employees could employ lethal methods to resolve damage associated with those target mammal species identified by WS as responsible for causing damage or threats to human safety. However, lethal removal by WS would only occur after receiving a request for such assistance and only after the SCDNR authorized WS to use lethal methods, when required. Therefore, the use of lethal methods could result in local reductions in the number of target animals in the area where damage or threats were occurring since WS would remove those target individuals from the population. WS would often employ lethal methods to reinforce non-lethal methods and to remove mammals that have been identified as causing damage or posing a threat to human safety. The use of lethal methods could therefore result in local reductions of mammals in the area where damage or threats were occurring. The number of mammals removed from a species' population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed.

WS would maintain ongoing contact with the SCDNR to ensure activities were within management objectives for those species. WS would submit annual activity reports to the SCDNR. The SCDNR would have the opportunity to monitor the total removal of mammals from all sources and could factor in survival rates from predation, disease, and other mortality data.

WS would monitor removal by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal was below the level that would cause undesired adverse effects to the viability of native species populations. This EA analyzed the potential cumulative impacts on the populations of target mammal species from the implementation of the proposed action alternative in Section 4.1.

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on mammal populations when targeting those species responsible for damage at the levels addressed in this EA. 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 would not be limited to:

- Natural mortality of mammals
- Mortality through vehicle strikes, aircraft strikes, and illegal harvest
- Human-induced mortality of mammals 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 mammal populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage would be constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. WS would use the Decision Model to evaluate the damage occurring, including other affected elements and the dynamics of the damaging species, to determine appropriate strategies to minimize effects on environmental elements. The Model would allow WS to implement damage management actions and to monitor those actions to adjust/cease damage management actions, which would allow WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative effects on target species (Slate et al. 1992).

With management authority over mammal populations in the State, the SCDNR could adjust removal levels, including the removal by WS, to ensure population objectives for mammals were achieved. Consultation and reporting of removal by WS would ensure the SCDNR had the opportunity to consider any activities WS conducts.

WS' removal of mammals in South Carolina from FY 2009 through FY 2014 was of a low magnitude when compared to the total known removal of those species and the populations of those species. The SCDNR could consider all known removal when determining population objectives for mammals and could adjust the number of mammals that could be harvested during the regulated harvest season and the number of mammals removed for damage management purposes to achieve the population objectives. Any removal of regulated mammal species by WS would occur at the discretion of the SCDNR. Any mammal population declines or increases would be the collective objective for mammal populations established by the SCDNR through the regulation of lethal removal. Therefore, the cumulative removal of mammals annually or over time by WS would occur at the desire of the SCDNR as part of management objectives for mammals in the State. No cumulative adverse effects on target and non-target wildlife would be expected from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on wildlife

WS would conduct damage management activities associated with mammals only at the request of a cooperator to reduce damage that was occurring or to prevent damage from occurring and only after methods to be used were agreed upon by all parties involved. WS would monitor activities to ensure any potential impacts were identified and addressed. WS would work closely with resource agencies to ensure damage management activities would not adversely affect mammal populations and that WS' activities were considered as part of management goals established by those agencies. Historically, WS' activities to manage damage caused by mammals in South Carolina have not reached a magnitude that would cause adverse effects to mammal populations in the State.

SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on mammals, and have been tailored to respond to changes in wildlife populations that could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alteration of activities would be defined through SOPs, and implementation would be insured through monitoring, in accordance with the WS Decision Model (see WS Directive 2.201; Slate et al. 1992).

Issue 2 - Effects of Mammal Damage Management Activities on Non-target Wildlife Species Populations, Including T&E Species

Potential effects on non-target species from conducting mammal damage management arise from the use of non-lethal and lethal methods to alleviate or prevent those damages. The use of non-lethal methods during activities to reduce or prevent damage caused by mammals has the potential to exclude, disperse, or capture non-target wildlife. However, the effects of non-lethal methods are often temporary and often do not involve the removal (killing) of non-target wildlife species. When using exclusion devices and/or repellents, both target and non-target wildlife can be prevented from accessing the resource being damaged. Since exclusion and repellents do not involve lethal removal, cumulative impacts on non-target species from the use of exclusionary methods or repellents would not occur but would likely disperse those individuals to other areas. Exclusionary methods and repellents can require constant maintenance to ensure effectiveness. Therefore, the use of exclusionary devices and repellents would be somewhat limited to small, high-value areas and not used to the extent that non-targets would be excluded from large areas that would cumulatively impact populations from the inability to access a resource, such as potential food sources, denning, or fawning sites. The use of visual and auditory harassment and dispersion methods would generally be temporary with non-target species returning after the cessation of those activities. Dispersal and harassment do not involve the removal (killing) of non-target species and similar to exclusionary methods would not be used to the extent or at a constant level that would prevent non-targets from accessing critical resources that would threaten survival of a population.

The use of lethal methods or those methods used to live-capture target species followed by euthanasia also have the potential to affect non-target wildlife through the removal (killing) or capture of non-target species. Capture methods used are often methods that would be set to confine or restrain target wildlife after being triggered by a target individual. Capture methods would be employed in such a manner as to minimize the threat to non-target species by placement in those areas frequently used by target wildlife, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-targets from capture. Most methods described in Appendix B are methods that would be employed to confine or restrain wildlife that would be subsequently euthanized using humane methods. With all live-capture devices, non-target wildlife captured could be released on site if determined to be able to survive following release. SOPs are intended to ensure removal of non-target wildlife was minimal during the use of methods to capture target wildlife.

The use of firearms and euthanasia methods would essentially be selective for target species since identification of an individual would be made prior to the application of the method. Euthanasia methods would be applied through direct application to target wildlife. Therefore, the use of those methods would not affect non-target species.

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according with WS' Directives and relevant federal, state, and local regulations. Chemical methods available for use under the proposed action would include repellents, reproductive inhibitors, rodenticides, fumigants, immobilizing drugs, and

euthanasia chemicals, which are described in Appendix B. Except for repellents that would be applied directly to the affected resource and reproductive inhibitors that would be applied directly to target animals, those chemical methods available for use would be employed using baits that were highly attractive to target species, used in known burrow/den sites, and/or used in areas where exposure to non-targets would be minimal. The use of those methods often requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to product labels, which would ensure that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals would also ensure non-target hazards would be minimal.

Repellents may be used or recommended by the WS program in South Carolina to manage mammal damage. The active ingredients in numerous commercial repellents are capsaicin, pepper oil, and carnivore urine. Characteristics of these chemicals and potential use patterns indicate that no cumulative impacts related to environmental fate would be expected from their use in WS' programs in South Carolina when used according to label requirements.

When using rodenticides, as required by WS' SOPs and applicable pesticide labels, all potential bait sites would be pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets were observed feeding on the pre-bait, the areas would be abandoned and no baiting would occur at those locations. Once sites were baited, sites would be monitored to further observe for non-target feeding activity. If non-targets were observed feeding on bait, those sites would be abandoned. WS would retrieve all dead target species to the extent possible following treatment to minimize any secondary hazards associated with or perceived to be associated with scavengers feeding on target species carcasses. When using rodenticides, appropriate bait stations would be utilized and inspected as required by the applicable label.

The amount of chemicals used or stored by WS would be minimal to ensure human safety. All label requirements of repellents and toxicants would be followed to minimize non-target hazards. Based on this information, WS' use of chemical methods, as part of the proposed action, would not have cumulative impacts on non-targets.

The methods described in Appendix B have a high level of selectivity and could be employed using SOPs to ensure minimal impacts to non-target species. Those species lethally removed as unintentional non-targets were included in analysis as target species in this EA. The cumulative removal of those species, including target and non-target removal were evaluated in Chapter 4 of this EA. The unintentional removal of wildlife would likely be limited and would not reach a magnitude where adverse effects would occur.

Based on the methods available to resolve mammal damage and/or threats, WS does not anticipate the number of non-targets lethally removed to reach a magnitude where declines in those species' populations would occur. Therefore, removal under the proposed action of non-targets would not cumulatively affect non-target species. WS' has reviewed the T&E species listed by the SCDNR, the USFWS, and the National Marine Fisheries Service, and has determined that damage management activities proposed by WS would not likely adversely affect T&E species. Cumulative impacts would be minimal on non-targets from any of the alternatives discussed.

Issue 3 - Effects of Mammal Damage Management Activities on Human Health and Safety

Non-chemical methods described in Appendix B would be used within a limited period, would not be residual, and do not possess properties capable of inducing cumulative effects on human health and safety. Non-chemical methods would be used after careful consideration of the safety of those persons employing methods and to the public. When possible, capture methods would be employed where human

activity was minimal to ensure the safety of the public. Capture methods also require direct contact to trigger ensuring that those methods, when left undisturbed, would have no effect on human safety. All methods would be agreed upon by the requesting entities, which would be made aware of the safety issues of those methods when entering into a MOU, work initiation document, or another comparable document between WS and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or remove wildlife. Firearms used to alleviate or prevent damage, though hazards do exist, would be employed to ensure the safety of employees and the public.

Personnel employing non-chemical methods would continue to be trained to be proficient in the use of those methods to ensure the safety of the applicator and to the public. Based on the use patterns of non-chemical methods, those methods would not cumulatively affect human safety.

Repellents to disperse mammals from areas of application would be available. Repellents must be registered with the EPA according to the FIFRA and registered with the CUDPR. Many of the repellents currently available for use have active ingredients that are naturally occurring and are generally regarded as safe. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and applicator. When repellents were applied according to label requirements, no effects to human safety would be expected. Similarly, fumigants and rodenticides must also be registered for use with the EPA and the CUDPR. Given the use patterns of repellents, rodenticides, and fumigants, no cumulative effects would occur to human safety.

WS has received no reports or documented any effects to human safety from WS' mammal damage management activities conducted from FY 2009 through FY 2014. No cumulative effects from the use of those methods discussed in Appendix B would be expected given the use patterns of those methods for resolving mammal damage in the State.

Issue 4 - Effects of Mammal Damage Management Activities on the Aesthetic Value of Mammals

The activities of WS would result in the removal of mammals from those areas where damage or threats were occurring. Therefore, the aesthetic value of mammals in those areas where damage management activities were being conducted would be reduced. However, for some people, the aesthetic value of a more natural environment would be gained by reducing mammal densities, including the return of native species that may be suppressed or dispersed by non-native species.

Some people experience a decrease in aesthetic enjoyment of wildlife because they feel that overabundant species are objectionable and interfere with their enjoyment of wildlife in general. Continued increases in numbers of individuals or the continued presence of mammals may lead to further degradation of some people's enjoyment of any wildlife or the natural environment. The actions of WS could positively affect the aesthetic enjoyment of wildlife for those people that were being adversely affected by the target species identified in this EA.

Mammal population objectives would be established and enforced by the SCDNR by regulating harvest during the statewide hunting and trapping seasons after consideration of other known mortality factors. Therefore, WS would have no direct impact on the status of mammal populations since removal by WS would occur at the discretion of the SCDNR. Since those persons seeking assistance could remove mammals from areas where damage was occurring when permitted by the SCDNR, WS' involvement would have no effect on the aesthetic value of mammals in the area where damage was occurring. When damage caused by mammals has occurred, any removal of mammals by the property or resource owner would likely occur whether WS was involved with taking the mammals or not.

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, Archer 1999, Ross and Baron-Sorensen 1998, Meyers 2000). Similar observations were 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 who lose companion animals, or animals for which they may have developed a bond and affection, are observed to 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 a similar meaningfulness by establishing an association with new individual animals or through other relational activities (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).

Some mammals with which people have established affectionate bonds may be removed from some project sites by WS. However, 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 animals. In addition, human behavior processes usually result in individuals ultimately returning to normalcy after experiencing the loss of association with a wild animal that might be removed from a specific location. WS' activities would not be expected to have any cumulative effects on this element of the human environment.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

WS would continue to seek new methods and ways to improve current technology to improve the humaneness of methods used to manage damage caused by wildlife. Cooperation with individuals and organizations involved in animal welfare continues to be an agency priority for the purpose of evaluating strategies and defining research aimed at developing humane methods.

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked at least once a day in accordance with South Carolina laws and regulations to ensure any wildlife confined or restrained were addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured mammals would be applied according to WS' directives. Shooting would occur in some situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of mammals removed by this method.

WS would employ methods as humanely as possible by applying SOPs to minimize pain and that allow wildlife captured to be addressed in a timely manner to minimize distress. Through the establishment of SOPs that guide WS in the use of methods to address damage and threats associated with mammals in the State, the cumulative impacts on the issue of method humaneness would be minimal. All methods would be evaluated to ensure SOPs were adequate and that wildlife captured were addressed in a timely manner to minimize distress.

Issue 6 - Effects of Mammal Damage Management Activities on the Regulated Harvest of Mammals

As discussed in this EA, the magnitude of WS' mammal removal for damage management purposes from FY 2009 through FY 2014 was low when compared to the total removal of mammals and when compared to the estimated statewide populations of those species. Since all removal of mammals is regulated by the SCDNR, removal by WS that could occur annually and cumulatively would occur pursuant to mammal population objectives established in the State. WS' removal of mammals (combined removal) annually to alleviate damage would be a minor component to the known removal that occurs annually during the harvest seasons for most mammal species.

The populations of several mammal species are sufficient to allow for annual harvest seasons that typically occur during the fall. Hunting and trapping seasons are established by the SCDNR. Those species addressed in this EA that have established harvest seasons include armadillo, muskrat, gray squirrel, raccoon, river otter, coyote, gray fox, bobcat, red fox, opossum, and white-tailed deer.

With oversight of mammal removal, the SCDNR maintains the ability to regulate removal by WS to meet management objectives for mammals in the State. Therefore, the cumulative removal of mammals would be considered as part of the SCDNR objectives for mammal populations in the State.

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS/REVIEWERS

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APPENDIX A
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APPENDIX B

METHODS AVAILABLE FOR RESOLVING OR PREVENTING MAMMAL DAMAGE IN SOUTH CAROLINA

The most effective approach to resolving wildlife damage problems would be to integrate the use of several methods, either simultaneously or sequentially. An adaptive plan would integrate and apply practical methods of prevention and reduce damage by animals while minimizing harmful effects of damage reduction measures on people, other species, and the environment. An adaptive plan may incorporate resource management, physical exclusion and deterrents, and population management, or any combination of these, depending on the characteristics of specific damage problems.

In selecting damage management techniques for specific damage situations, consideration would be given to the responsible species and the magnitude, geographic extent, duration and frequency, and likelihood of wildlife damage. Consideration would also be given to the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, 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. Those factors would be evaluated in formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to the WS program in South Carolina relative to the management or reduction of damage from mammals. Various federal, state, and local statutes and regulations and 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. The following methods could be recommended or used by the WS program in South Carolina. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

Non-chemical Wildlife Damage Management Methods

Non-chemical management methods consist primarily of tools or devices used to repel, capture, or kill a particular animal or local population of wildlife to alleviate damage and conflicts. Methods may be non-lethal (*e.g.*, fencing, frightening devices) or lethal (*e.g.*, firearms, body gripping traps). If WS' personnel apply those methods, a MOU, work initiation document, or another similar document must be signed by the landowner or administrator authorizing the use of each damage management method. Non-chemical methods used or recommended by WS could include:

Exclusion pertains to preventing access to resources through fencing 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 mammal species that dig, including fox, feral cats, and striped skunks. Areas such as airports, yards or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and gnawing of valuable trees and to prevent the entry of mammals into buildings through existing holes or gaps. Construction of concrete spillways may reduce or prevent damage to dams by burrowing aquatic rodent species. Riprap can also be used on dams and levees to deter muskrat, woodchuck and other burrowing rodents. Exclusion and one-way devices such as netting or nylon window screening can be used to exclude animals from a building or an enclosed structure. Electric fences of various constructions have been used effectively to reduce damage to various crops by deer, raccoons, and other species (Boggess 1994, Craven and Hygnstrom 1994).

Cultural Methods and Habitat Management includes the application of practices that seek to minimize exposure of the protected resource to damaging animals through processes other than exclusion. They may include animal husbandry practices such as employing guard dogs, herders, shed lambing, carcass removal, or pasture selection. Strategies may also include minimizing cover where damaging mammals might hide, manipulating the surrounding environment through barriers or fences to deter animals from entering a protected area, or planting lure crops on fringes of protected crops.

Some mammals that cause damage are attracted to homes by the presence of garbage or pet food left outside and unprotected. Removal or sealing of garbage in tight trash receptacles, and elimination of all pet foods from outside areas can reduce the presence of unwanted mammals. If raccoons are a problem, making trash and garbage unavailable, and removing all pet food from outside during nighttime hours can reduce their presence. Altering how bird feeders are hung and constructing mounting poles for the feeders that cannot be climbed by tree squirrels or chipmunks can reduce the presence of localized populations along with their associated damage.

Supplemental feeding is sometimes used to reduce damage by wildlife, such as lure crops. Food is provided so that the animal causing damage would consume it rather than the resource being protected. In feeding programs, target wildlife would be offered an alternative food source with a higher appeal with the intention of luring them from feeding on affected resources.

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. Those techniques are usually aimed at causing target animals to respond by fleeing from the site or remaining at a distance. They usually employ extreme noise or visual stimuli. Unfortunately, many of these techniques are only effective for a short time before wildlife habituate to them (Conover 1982). Devices used to modify behavior in mammals include electronic guards (siren strobe-light devices), propane exploders, pyrotechnics, laser lights, human effigies, effigies of predators, and the noise associated with the discharge of a firearm.

Live Capture and Translocation can be accomplished using hand capture, hand nets, catch poles, cage traps, suitcase type traps, cable restraints, or with foothold traps to capture some mammal species for the purpose of translocating them for release in other areas. WS could employ those methods in South Carolina when the target animal(s) can legally be translocated or can be captured and handled with relative safety by WS' personnel. Live capture and handling of mammals poses an additional level of human health and safety threat if target animals are aggressive, large, or extremely sensitive to the close proximity of people. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. The AVMA, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission, particularly for small mammals, such as raccoons or skunks (CDC 1990). Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise in South Carolina due to the risk of disease transmission. High population densities of some animals may make this a poor wildlife management strategy for those species. Translocation would be evaluated by WS on a case-by-case basis. Translocation would only occur with the prior authorization of the SCDNR.

Trapping can utilize a number of devices, including nets, foothold traps, cage-type traps, body-gripping traps, foot snares, and neck/body snares. Those techniques would be implemented by WS' personnel because of the technical training required to use such devices.

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 were present and when animals were 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 were present. Nets are used to live-capture target individuals and if any non-targets 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). Nets are not generally available to the public.

Cannon 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 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 or compressed air. Only personnel trained in the safe handling of explosive charges would 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 nets require personnel to be present at the site continually to monitor for feeding. Similar to drop nets, cannon nets can be used to capture multiple animals during a single application. Similar to drop nets, injury rates for cannons nets appear to be correlated with the number of animals captured during a single application of the net (Haulton et al. 2001). Non-targets incidentally captured can be released on site unharmed. Cannon nets would generally not be available for use by the public and would not be available for use by the public under Alternative 2 and Alternative 3 except by the SCDNR or other natural resource agencies. A permit may be required from the SCDNR to use cannon nets.

Foothold Traps can be effectively used to capture a variety of mammals. Foothold traps can be placed beside or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target 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 non-target animals since animals are captured alive. The use of foothold traps requires more skill than some methods. Foothold traps would generally be available for use by the public and other state or federal agencies.

Cable Restraints are typically made of wire or cable, and can be set to capture an animal by the neck, body, or foot. Cable restraints may be used as either lethal or live-capture devices depending on how or where they are set. Cable restraints set to capture an animal by the neck are usually lethal but stops can be attached to the cable to increase the probability of a live capture depending on the trap check interval. Snares positioned to capture the animal around the body

can be a useful live-capture device, but are more often used as a lethal control technique. Snares can incorporate a breakaway feature to release non-target wildlife and livestock where the target animal is smaller than potential non-targets (Phillips 1996). Snares can be effectively used wherever a target animal moves through a restricted travel lane (*e.g.*, under fences or trails through vegetation). When an animal moves forward into the loop formed by the cable, the noose tightens and the animal is held. Snares must be set in locations where the likelihood of capturing non-target animals is minimized.

The foot or leg snare can be set as a spring-powered non-lethal device, activated when an animal places its foot on the trigger or pan. In some situations, using snares to capture wildlife is impractical due to the behavior or morphology of the animal, or the location of many wildlife conflicts. In general, cable restraints would be available to all entities to alleviate damage.

Cage traps come in a variety of styles to live-capture animals. The most commonly known cage traps are box traps. 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.

The disadvantages of using cage traps are: 1) some individual target animals may avoid cage traps; 2) some non-target 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 traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions; 4) some animals will fight to escape and may become injured; and 5) the expense of purchasing traps.

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 monitoring devices could be employed when using cage traps, 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 non-targets would be restrained. By reducing the amount of time targets and non-targets are restrained, pain and stress can be minimized and captured wildlife can be addressed in a timely manner, which could allow non-targets to be released unharmed.

Body-grip Traps are designed to cause the quick death of the animal that activates the trap. Body-grip traps include 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 to 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. Spring-powered harpoon traps are used to control damage caused by surface-tunneling moles. Soil is pressed down in an active tunnel and the trap is placed at that point. When the mole reopens the tunnel, it triggers the trap. Two variations of scissor like traps are also used in tunnels for moles. Safety hazards and risks to

people are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to non-target animals. Selectivity of body-grip traps can be enhanced by placement, trap size, trigger configurations, and baits. When using body-grip traps, risks of non-target capture can be minimized by using recessed sets (placing trap inside a cubby, cage, or burrow), restricting openings, or by elevating traps. Choosing appropriately sized traps for the target species can also exclude non-targets by preventing larger non-targets from entering and triggering the trap. The trigger configurations of traps can be modified to minimize non-target capture. For example, offsetting the trigger can allow non-targets to pass through conibear traps without capture. Body-grip traps would be available for use by all entities.

Shooting with firearms is 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 or aircraft, 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 nocturnal mammals, such as deer. Spotlights may or may not be covered with a red 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 (FLIR) devices can also be used to detect and shoot mammals at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and FLIR equipment aid in locating wildlife at night when wildlife may be more active. Night vision and FLIR equipment could be used during surveys and in combination with shooting to remove target mammals at night. WS' personnel most often use this technology to target mammals 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 FLIR equipment allow for the identification of target species during night activities, which reduces the risks to non-targets and reduces human safety risks. Night vision equipment and FLIR devices only aid in the identification of wildlife and are not actual methods of lethal removal. The use of FLIR and night vision equipment to remove target mammals would increase the selectivity of direct management activities by targeting those mammals most likely responsible for causing damage or posing threats.

Denning is the practice of locating coyote or fox dens and killing the young, adults or both to stop an ongoing predation problem or prevent future depredation of livestock. Coyote and red fox depredations on livestock often increase in the spring and early summer due to the increased food requirements associated with feeding and rearing litters of pups. Removal of pups will often stop depredations even if the adults are not taken (Till 1992). Pups are typically euthanized in the den using a registered gas fumigant cartridge or by digging out the den and euthanizing the pups with sodium pentobarbital (see discussion of gas cartridges and sodium pentobarbital under *Chemical Wildlife Damage Management Methods*).

Hunting/Trapping is sometimes recommended by WS to resource owners. WS could recommend resource owners consider legal hunting and trapping as an option for reducing mammal damage.

Although legal hunting/trapping is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some populations of mammals.

Aerial Surveying is a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of wildlife. WS uses aerial surveying throughout the United States to monitor damages and/or populations of coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, mountain lions, white-tailed deer, pronghorn antelope, elk, big-horn sheep, and wild horses but any wildlife species big 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 state laws. Pilots and aircraft must also be certified under established WS program procedures and policies.

Aerial Telemetry is used in research projects studying the movements of various wildlife species. Biologists will frequently place radio-transmitting collars on selected individuals of a species and then monitor their movements over a specified period. Whenever possible, the biologist attempts 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 state laws.

Chemical Wildlife Damage Management Methods

All pesticides used by WS would be registered under the FIFRA and administered by the EPA and the CUDPR. All WS personnel in South Carolina who apply restricted-use pesticides would be certified pesticide applicators by CUDPR and have specific training by WS for pesticide application. The EPA and the CUDPR require pesticide applicators to adhere to all certification requirements set forth in the FIFRA. Pharmaceutical drugs, including those used in wildlife capture and handling, are administrated by the United States Food and Drug Administration and/or the United States Drug Enforcement Administration.

Chemicals would not be used by WS on public or private lands without authorization from the land management agency or property owner or manager. The following chemical methods have been proven to be selective and effective in reducing damage by mammals.

GonaCon™ was developed by scientists with the NWRC as a reproductive inhibitor. GonaCon™ is a new single dose immunocontraceptive vaccine. Recent studies have demonstrated the efficacy of this single-shot GnRH vaccine on California ground squirrels, Norway rats, feral cats and dogs, feral swine, wild horses, and white-tailed deer. Infertility among treated female swine and white-tailed deer has been documented for up to two years without requiring a booster vaccination (Miller et al. 2000). This vaccine overcomes one of the major obstacles of previous two dose vaccines since target wildlife need to be captured only once for vaccination instead of twice. A single-injection vaccine would be much more practical as a field delivery system for use on free-ranging animals.

GonaCon™ was officially registered by the EPA in 2009 for use in reducing fertility in female white-tailed deer under EPA registration number 56228-40. GonaCon™ is registered as a restricted-use pesticide available for use by WS' personnel and personnel of a state wildlife management agency or persons under their authority. Additionally, in order for GonaCon™ to be used in any given state, the product must also be registered with the state and approved for use by the appropriate state agency responsible for managing wildlife. GonaCon™, when injected into the body, elicits an immune response

that neutralizes the GnRH hormone being produced naturally by deer. The GnRH hormone in deer stimulates the production of other sexual hormones, which leads to the body reaching a reproductive state. The vaccine neutralizes the GnRH hormone being produced, which then prevents the production of other sexual hormones in the deer vaccinated; thereby, preventing the body of the deer from entering into a reproductive state (USDA 2010*b*).

Ketamine (Ketamine HCl) is a dissociative anesthetic that is used to capture wildlife, primarily mammals, birds, and reptiles. It is used to eliminate pain, calm 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.

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.

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 (Johnson et al. 2001). This reduces heat production from muscle tension, but can lead to lower body temperatures when working in cold conditions.

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (AVMA 2013). Sodium pentobarbital would only be administered after target animals were live-captured and properly immobilized to allow for direct injection. There are United States Drug Enforcement Administration restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified WS' personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with United States Drug Enforcement Administration and state regulations. All animals euthanized using sodium pentobarbital and all of its dilutions (*e.g.* Beuthanasia-D, Fatal-Plus) are disposed of immediately through incineration or deep burial to prevent secondary poisoning of scavenging animals and introduction of these chemicals to non-target animals.

Potassium Chloride used in conjunction with prior general anesthesia is used as a euthanasia agent for animals, and is considered acceptable and humane by the AVMA (2013). Animals that have been euthanized with this chemical experience cardiac arrest followed by death, and are not toxic to predators or scavengers.

Beuthanasia®-D combines pentobarbital with another substance to hasten cardiac arrest. Intravenous (IV) and intracardiac (IC) are the only acceptable routes of injection. As with pure sodium pentobarbital, IC injections with Beuthanasia®-D are only acceptable for animals that are unconscious or deeply anesthetized. With other injection routes, there are concerns that the cardiotoxic properties may cause cardiac arrest before the animal is fully unconscious. It is a Schedule III drug, which means it can be obtained directly from the manufacturer by anyone with a United States Drug Enforcement Administration registration. However, Schedule III drugs are subject to the same security and record-keeping requirements as Schedule II drugs.

Fatal-Plus® combines pentobarbital with other substances to hasten cardiac arrest. IV is the preferred route of injection; however, IC is acceptable as part of the two-step procedure used by WS. Animals are first anesthetized and sedated using a combination of ketamine/xylazine and once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered. Like Beuthanasia®-D, it is a Schedule III drug requiring a United States Drug Enforcement Administration registration for purchase and is subject to the security and record-keeping requirements of Schedule II drugs.

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. This method is approved as a euthanizing agent by the AVMA. 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.

Zinc phosphide is an inorganic compound used to control rats, mice, voles, ground squirrels, prairie dogs, nutria, muskrats, feral rabbits, and gophers. Zinc phosphide is a heavy, finely ground gray-black powder that is partially insoluble in water and alcohol. When exposed to moisture, it decomposes slowly and releases phosphine gas (PH_3). When zinc phosphide treated bait encounters acids in the stomach, phosphine (PH_3) gas is released, which may account in a large part for observed toxicity. Animals that ingest lethal amounts of bait usually succumb overnight with terminal symptoms of convulsions, paralysis, coma, and death from asphyxia. If death is prolonged for several days, intoxication that occurs is similar to intoxication with yellow phosphorous, in which the liver is heavily damaged. Prolonged exposure to phosphine can produce chronic phosphorous poisoning.

Although zinc phosphide baits have a strong, pungent, phosphorous-like odor (garlic like), this characteristic seems to attract rodents, particularly rats, and apparently makes the bait unattractive to some other animals. For many uses of zinc phosphide formulated on grain or grain-based baits, pre-baiting is recommended or necessary for achieving good bait acceptance. Primary toxicity risks to non-target species from the direct consumption of treated bait can be minimized by using bait stations to prevent access by non-target species such as birds.

Because zinc phosphide is not stored in muscle or other tissues of poisoned animals, there is no secondary poisoning with this rodenticide. The bait however, remains toxic up to several days in the gut of the dead rodent. Other animals can be poisoned if they eat enough of the gut content of rodents recently killed with zinc phosphide.

Repellents are usually naturally occurring substances or chemicals formulated to be distasteful or to elicit pain or discomfort for target animals when they are smelled, tasted, or contacted. Only a few repellents are commercially available for mammals, and are registered for only a few species. Repellents would not be available for many species that may present damage problems, such as some predators or furbearing species. Repellents are variably effective and depend largely on the resource to be protected, time and

length of application, and sensitivity of the species causing damage. Again, acceptable levels of damage control would usually not be realized unless repellents were used in conjunction with other techniques.

Gas cartridges (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are often used to treat dens or burrows of coyotes, fox, or woodchucks. When ignited, the cartridge burns in the den of an animal and produces large amounts of carbon monoxide, a colorless, odorless, and tasteless, poisonous gas. The combination of oxygen depletion and carbon monoxide exposure kills the animals in the burrow or den. Sodium nitrate is the principle active chemical in gas cartridges and is a naturally occurring substance. Although stable under dry conditions, it is readily soluble in water and likely to be highly mobile in soils. In addition, dissolved nitrate is very mobile, moving quickly through the vadose zone to the underlying water table (Bouwer 1989). However, burning sodium nitrate, as in the use of a gas cartridge as a fumigant in a rodent burrow, is believed to produce mostly simple organic and inorganic gases, using all of the available sodium nitrate. In addition, the human health drinking water tolerance level for this chemical is 10 mg / L, a relatively large amount, according to EPA Quality Criteria for Water (EPA 1986, Wallace 1987). The gas, along with other components of the cartridge, are likely to form oxides of nitrogen, carbon, phosphorus, and sulfur. Those products are environmentally non-persistent because they are likely to be metabolized by soil microorganisms or they enter their respective elemental cycles. In rodent cartridges, sodium nitrate is combined with seven additional ingredients: sulfur, charcoal, red phosphorus, mineral oil, sawdust, and two inert ingredients. None of the additional ingredients in this formulation is likely to accumulate in soil, based on their degradation into simpler elements by burning the gas cartridge. Sodium nitrate is not expected to accumulate in soils between applications, nor does it accumulate in the tissues of target animals (EPA 1991). The EPA stated sodium nitrates "*...as currently registered for use as pesticides, do not present any unreasonable adverse effects to humans*" (EPA 1991).

APPENDIX C

STATE LISTED THREATENED AND ENDANGERED SPECIES

The following species of resident wildlife are designated as state-listed endangered species:

Animals

Scientific Name	Common Name	Status
Acipenser brevirostrum	Shortnose Sturgeon	SE-Endangered
Ambystoma cingulatum	Flatwoods Salamander	SE-Endangered
Caretta caretta	Loggerhead	ST-Threatened
Charadrius wilsonia	Wilson's Plover	ST-Threatened
Clemmys guttata	Spotted Turtle	ST-Threatened
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	SE-Endangered
Elanoides forficatus	American Swallow-tailed Kite	SE-Endangered
Elassoma boehlkei	Carolina Pygmy Sunfish	ST-Threatened
Etheostoma collis	Carolina Darter	ST - 1976
Eumeces anthracinus pluvialis	Southern Coal Skink	ST-Threatened
Falco peregrinus anatum	American Peregrine Falcon	SE-Endangered
Glyptemys muhlenbergii	Bog Turtle	ST-Threatened
Gopherus polyphemus	Gopher Tortoise	SE-Endangered
Haliaeetus leucocephalus	Bald Eagle	SE-Endangered
Hyla andersonii	Pine Barrens Treefrog	ST-Threatened
Mycteria Americana	Wood Stork	SE-Endangered
Myotis leibii	Eastern Small-footed Myotis	ST-Threatened
Myotis sodalist	Indiana Myotis	SE-Endangered
Picoides borealis	Red-cockaded Woodpecker	SE-Endangered
Plethodon websteri	Webster's Salamander	SE-Endangered
Pseudobranchus striatus	Dwarf Siren	ST-Threatened
Puma concolor couguar	Eastern Cougar	SE-Endangered
Rana capito	Gopher Frog	SE-Endangered
Sterna antillarum	Least Tern	ST-Threatened
Thryomanes bewickii	Bewick's Wren	ST-Threatened
Trichechus manatus	Florida Manatee	SE-Endangered
Vermivora bachmanii	Bachman's Warbler	SE-Endangered
Lasmigona decorate	Carolina Heelsplitter	SE-Endangered