ENVIRONMENTAL ASSESSMENT

REDUCING MAMMAL DAMAGE IN THE STATE OF NORTH CAROLINA

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

In Consultation With:

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

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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
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLIR	Forward Looking Infrared
FPL	Feline Panleukopenia
FR	Federal Register
FY	Fiscal Year
GnRH	Gonadotropin-releasing Hormone
IC	Intracardiac
IV	Intravenous
MOU	Memorandum of Understanding
NASS	National Agricultural Statistic Service
NCAC	North Carolina Administrative Code
NCDACS	North Carolina Department of Agriculture and Consumer Services
NCWRC	North Carolina Wildlife Resources Commission
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWRC	National Wildlife Research Center
ORV	Oral Rabies Vaccination
PEP	Post - Exposure Prophylaxis
PL	Public Law
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 North 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 several mammal species. WS has or could receive requests for assistance associated with bobcats (*Lynx rufus*), coyotes (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), raccoons (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), river otters (*Lontra canadensis*), woodchucks (*Marmota monax*), American mink (*Neovison vison*), feral swine (*Sus scrofa*), feral cats (*Felis domesticus*), feral dogs (*Canis familiaris*), gray squirrels (*Sciurus carolinensus*), Eastern cottontails (*Sylvilagus floridanus*), black bears (*Ursus americanus*), and white-tailed deer (*Odocoileus virginianus*).

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 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[2] 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 North 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 North Carolina Wildlife Resources Commission (NCWRC). In addition to those mammal species listed previously, WS also receives requests to address damage and threats of damage associated with beaver (*Castor canadensis*), muskrats (*Ondatra zibethicus*), and nutria (*Myocastor coypus*). Activities conducted by WS to alleviate damage or threats of damage associated with beaver, muskrats, and nutria were evaluated in a separate EA (USDA 2015*a*).

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.

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

This 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 NCWRC. The NCWRC has regulatory authority to manage populations of wildlife in the State. To assist with identifying additional issues and alternatives to managing damage associated with mammals in North Carolina, WS will make this EA available to the public for review and comment prior to the issuance of a Decision[3].

WS previously developed an EA that addressed WS' activities to manage damage associated with mammals in the State (USDA 2012). In addition, the WS program in North Carolina developed an EA to address damage associated with white-tailed deer in the State (USDA 2005*a*). This new 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, the NCWRC, and other entities; (4) inform the public; and (5) document the environmental consequences of the alternatives to comply with the NEPA. This EA will re-evaluate activities conducted under the previous EAs to address the new need for action and the associated affected environment. Therefore, the analysis and the outcome of the Decision issued for this EA will supersede the previous EA that addresses mammal damage management (USDA 2012) and the EA that addressed white-tailed deer damage management (USDA 2005*a*).

1.2 NEED FOR ACTION

Some species of animals 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 animals. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety.

Animals can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard animals as providing economic, recreational, and aesthetic benefits. Knowing that animals exist in the natural environment provides a positive benefit to some people. However, activities associated with animals 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 animals. When addressing damage or threats of damage caused by animals, animal damage management professionals must consider not only the needs of those directly affected by animals damage but a range of environmental, sociocultural, and economic considerations as well.

Resolving animal damage problems requires consideration of both sociological and biological carrying capacities. The acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for animals 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 animals 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 an animal 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

[3]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.

associated damage. This damage threshold determines the animal acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of animals, in many cases the acceptance capacity is lower. Once the animal 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 animals and can be an integral component of animal management (The Wildlife Society 2015). 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 an animal or animals is actual damage requiring assistance (*i.e.*, has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the aesthetic value of property and other situations where the behavior of an animal or animals was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with mammals in North Carolina arises from requests for assistance[4] 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. WS has provided technical assistance to those persons requesting assistance with resolving damage or the threat of damage. Table 1.1 lists WS' technical assistance projects involving mammal damage or threats of damage to those four major resource types in North Carolina from the federal fiscal year[5] (FY) 2010 through FY 2014.

Table 1.1 – Technical assistance projects conducted by WS from FY 2010 through FY 2014

Species	Projects	Species	Projects
Bobcat	10	**American Mink**	2
Coyote	70	**Feral Swine**	33
Gray Fox	15	**Feral Cat**	3
Red Fox	17	**Feral Dog**	1
Raccoon	56	**Gray Squirrel**	5
Virginia Opossum	6	**Eastern Cottontail**	2
Striped Skunk	8	**Black Bear**	5
River Otter	10	**White-tailed Deer**	32
Woodchuck	18	**TOTAL**	**293**

[4]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.

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

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 North Carolina. WS has conducted 293 technical assistance projects (see Table 1.1) from FY 2010 through FY 2014 involving nearly 18,100 people. The species with the highest number of technical assistance projects was the coyote with 70 projects conducted between FY 2010 and FY 2014. Over 65% of the technical assistance projects conducted by WS' personnel from FY 2010 through FY 2014 involved coyotes, raccoons, feral swine, and white-tailed deer.

Table 1.2 lists those mammal species addressed in this EA and the resource types that those mammal species can cause damage to in North Carolina. Many of the mammal species can cause damage to or pose threats to a variety of resources. Most requests for assistance received by WS relate to mammal species causing damage to or posing threats of damage to property and posing threats to human safety. For example, many of those mammal species listed in Table 1.2 can occur on airport properties where those species can pose a strike risk to aircraft. When those species move across runways and taxiways during operation of the airport, aircraft strikes can occur that can cause damage to the aircraft and threaten passenger safety if a catastrophic failure of the aircraft occurs from the strike.

Table 1.2 – The resource types damaged by mammal species in North Carolina

Species	Resource[a]				Species	Resource			
	A	N	P	H		A	N	P	H
Bobcat	X	X	X		**American Mink**	X	X	X	X
Coyote	X	X	X	X	**Feral Swine**	X	X	X	X
Gray Fox	X	X	X	X	**Feral Cat**	X	X	X	X
Red Fox	X	X	X	X	**Feral Dog**	X	X	X	X
Raccoon	X	X	X	X	**Gray Squirrel**	X	X	X	X
Virginia Opossum	X	X	X	X	**Eastern Cottontail**	X	X	X	X
Striped Skunk	X	X	X	X	**Black Bear**	X		X	X
River Otter	X	X			**White-tailed Deer**	X	X	X	X
Woodchuck	X		X	X					

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

All of the species addressed in this EA can cause damage to property, including posing strike risks at airports and airbases in North Carolina or posing as attractants for other species that are strike risks. For example, high densities of cottontail rabbits at an air facility may attract raptors to the area and those raptors may pose strike risks to aircraft. Nearly all of the species can pose threats to agricultural resources or cause damage to those resources. For example, predatory mammals (*e.g.*, coyotes, bobcats, fox, and raccoons) may kill livestock. Raccoons may enter storage facilities to feed on stored animal feed and contaminate the feed with their feces. The following subsections discuss additional information regarding mammal damage to those main categories.

Need for Mammal Damage Management to Reduce Risks to Human Health and Safety

Zoonoses (*i.e.*, animal diseases transmissible to people) are often a major concern of people 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.

People 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, people request assistance because of a perceived risk to human health or safety associated with wild animals that live 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. Although animals active during the day are not necessarily acting abnormally, especially in suburban environments, WS could receive requests for assistance associated with resolving those types of risks to human safety.

Table 1.3 - Animal 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
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*	coyotes, cats, dogs	ingestion, direct contact

[†]Table 1.3 is not an exhaustive list of animal 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 animals. 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 North Carolina where the threat of disease associated with wild or feral mammal populations may include:

- Exposure of people to threats of rabies posed by skunks denning and foraging in a residential community or from companion animals coming in contact with infected skunks

- Exposure of people to threats of sarcoptic mange posed by fox denning and foraging in a residential community or from companion animals coming in contact with infected fox
- Threats of parasitic infections to people from *Giardia* spp. resulting from high feral cat populations in a park, neighborhood, shopping center, or recreation area.

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 become infected from bites of a rabid animal. Direct threats can occur from handling infected animals or from aggressive animal behavior caused by rabies. The disease effectively can be prevented in people when exposure is identified early and treated. In addition, people can vaccinate domestic animals and pets 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 the 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 animal 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, including North Carolina (USDA 2009*a*). Rabies in raccoons was virtually unknown prior to the 1950s. The first

documented case of rabies occurred in Florida where it spread slowly during the next three decades into Georgia, Alabama, and South Carolina. People likely unintentionally introduced rabies into the Mid-Atlantic States 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 2009*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 greater 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).

In an effort to halt the westward spread of the raccoon variant of the rabies virus and to limit the spread of the canine variant from Texas, WS began participating in the distribution of ORV baits (fishmeal polymer containing Raboral V-RG® vaccine [Merial, Athens, Georgia, USA]). Currently, WS participates in the distribution of ORV baits and the surveillance of wildlife rabies vectors in 26 states, including North Carolina. ORV baits were first distributed by WS in North Carolina during the fall of 2003. A total of 98,629 baits were distributed (69,317 by air and 29,312 by hand) across a 1,202 km^2 area which included portions of Catoosa, Chattooga, and Walker Counties, and all of Dade County, in the northwest corner of North Carolina. North Carolina expanded its baiting program in 2004 by 302 km^2 to include larger portions of Walker and Catoosa Counties. Since the inception of the program in the fall of 2003, 385,644 ORV baits have been distributed in North Carolina. In FY 2010, as part of a surveillance of rabies vectors in North Carolina, WS collected 324 samples from target wildlife species. Of the 324 samples, 57 were tested with only 10 samples testing positive to the southeast raccoon rabies variant. WS' participation in the ORV program is further addressed in a separate EA (USDA 2009*a*) but will be addressed in this EA to evaluate potential cumulative effects of activities proposed in this EA and the

capturing and releasing of target animals during surveillance activities associated with the ORV program (USDA 2009*a*)[6].

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.

Lyme disease is a zoonotic disease caused by the bacterium *Borrelia burgdorferi* that infected blacklegged ticks (*Ixodes scapularis*) can transmit to people through bites. The preferred hosts of the adult blacklegged tick are deer; however, the ticks do not acquire the bacterium *Borrelia burgdorferi* from deer but from infected rodents as the ticks develop through their life cycle. Limited information is known about the relationship between white-tailed deer and the spread of Lyme disease-carrying deer ticks. Some research has shown a correlation between infected ticks, deer numbers, and Lyme disease cases (Magnarelli et al. 1984, Deblinger et al. 1993). Although deer are implicated in the spread of deer ticks that vector Lyme disease, researchers have found varying conclusions on the relationship between deer densities and deer tick densities. Reducing deer densities in isolated environments, such as islands and peninsulas, have been shown to have a positive effect on reducing the disbursement and abundance of deer tick nymphs (Deblinger et al. 1993, Kilpatrick et al. 2014). Additionally, reduced deer densities in those isolated environments has been shown to correspond with a reduction in tick infection rates, and a reduction in the reported cases of human Lyme disease (Kilpatrick et al. 2014). However, this same relationship is uncertain in landscapes that are more open. In addition, increasing research suggests that the Lyme disease emergence and risk is highly correlated with fluctuations in the abundance of small-mammal host that infect the majority of ticks (Levi et al. 2012).

In the United States, the CDC (2015) reported 27,203 confirmed cases of Lyme disease during 2013. Between 2004 and 2013, the CDC (2015) reports 397 confirmed cases of Lyme disease in North Carolina, with 39 confirmed cases occurring during 2013 and 141 probable cases.

In 1986, another serious tick-borne zoonosis, human ehrlichiosis, was discovered in the United States (McQuiston et al. 1999). Two distinct forms of the illness may affect humans: human monocytic ehrlichiosis (HME) and human granulocytic ehrlichiosis (HGE) (McQuiston et al. 1999, Lockhart et al. 1997). The bacterial agents that cause ehrlichiosis are transmitted to humans by infected ticks that acquire the agents from feeding on infected animal reservoirs (McQuiston et al. 1999). Ehrlichiosis in humans may result in fever, headache, myalgia, nausea, and occasionally death (McQuiston et al. 1999, Little et al. 1998). HME is the type of ehrlichiosis predominantly found in the southeastern, south-central, and mid-Atlantic United States. White-tailed deer are major hosts for *Amblyomma americanum*, the tick that transmits HME, and deer have been identified as a reservoir for HME (Little et al. 1998, Lockhart et al. 1997).

Chronic wasting disease (CWD) is a neurological disease found only in cervids (members of the deer family) in North America, including white-tailed deer. The disease is a transmissible spongiform encephalopathy characterized by spongy degeneration of brain tissue, which results in emaciation,

[6]The supplemental EA addressing WS' participation in an ORV distribution and surveillance program contains the analyses for distribution of ORV baits and for surveillance activities conducted in North Carolina. The analyses contained in this EA do not reflect WS' actions for capturing and releasing target animals during surveillance activities associated with the ORV program since those actions are addressed in the referenced ORV EA.

abnormal behavior, loss of bodily functions, and ultimately death. Since 1999, the NCWRC has collected tissue samples from captive and wild deer across the state for testing. Despite extensive testing, no samples have tested positive for CWD in North Carolina. In 2002, concerned about the rapid spread of CWD in other states, the NCWRC began implementing stronger regulations for captive deer and elk herds the State. New requirements included tagging of animals, minimum fence heights and restrictions on the importation and transportation of deer and elk. The tighter controls enable the NCWRC to track captive animals better and to reduce the risk of disease spreading if an animal became infected (NCWRC 2006, NCWRC 2014). The introduction of CWD into North Carolina could have adverse biological, economical, and sociological ramifications (NCWRC 2006, NCWRC 2014). Therefore, the NCWRC developed a CWD response plan "*…to prevent introduction or spread of CWD into North Carolina or to increase the likelihood of disease detection should it already occur*" (NCWRC 2006)[7]. If requested, the WS program in North Carolina could provide assistance with collecting deer samples as part of the response plan.

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. Most professional wildlife biologists consider feral cats and dogs to be non-native species that can 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, exposure of companion animals to a wide range of zoonoses can occur. Companion animals could bring those zoonoses into the home where direct contact between the companion animal and people increases the likelihood of disease transmission. Free-ranging animals that people consider 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, occur 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 cats, despite a trap, neuter, and release effort (AVMA 2004).

[7]The NCWRC is currently revising the CWD response plan (NCWRC 2014)

A study in France determined that stray cats serve as major reservoirs for the bacterium *Bartonella* spp. Consequently, stray cats and their fleas (*C. felis*) are the only known vectors for infecting house bound cats and people with this bacterium. The flea does not infect people, but fleabites can often infect pet cats. 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).

Feral swine can pose a threat to human safety from disease transmission, from aggressive behavior, and from vehicles and aircraft striking swine. Feral swine are potential reservoirs for at least 30 viral and bacterial diseases (Samuel et al. 2001, Williams and Barker 2001, Davidson 2006) and 37 parasites (Forrester 1992) that are transmissible to people. Brucellosis, salmonellosis, toxoplasmosis, trichinosis, tuberculosis, and tularemia are some of the common diseases that feral swine could carry that are also known to infect people (Hubalek et al. 2002, Seward et al. 2004, Stevens 2010). In addition, feral swine can pose risks to domestic livestock through the potential transmission of diseases between feral swine populations and domestic livestock where interactions may occur.

Public awareness and the health risks associated with zoonoses have increased in recent years; however, disease transmission directly from animals to people is uncommon. The infrequency of such transmission does not diminish the concerns of those people fearful of exposure requesting assistance since disease transmission could occur. This EA briefly addresses some of the more commonly known zoonotic diseases associated with mammals. 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. Those zoonotic diseases remain a concern and continue to pose threats to human safety where people encounter mammals.

Limited information and understanding of disease transmission from animals 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 animal 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. WS actively attempts to educate the public about the risks associated with disease transmission from animals 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 animals, especially from predatory animals. 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 animal species thrive in urban habitat due to the availability of food, water, and shelter. Many people enjoy animals to the point of purchasing food specifically for feeding animals 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 animal species that are adaptable to those habitats. Often the only limiting factor of animal species in and around areas inhabited by people is the prevalence of disease. Overabundant animals 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 animals 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.

Black bears occasionally threaten human health and safety. Herrero (1985) documented 500 injuries to people resulting from encounters with black bears from 1960 to 1980. Of those injuries, 90% were considered minor (*e.g.*, minor bites, scratches, and bruises) by Herrero (1985). People reported 23 fatalities from 1900 to 1980 due to black bear attacks. Of those fatalities, 90% were likely associated with habituated, food-conditioned bears. The number of bear attacks is low considering the geographic overlap of human and black bear populations.

Although attacks on people associated with those species addressed in this EA occurs rarely, requests for assistance to lessen the threat of possible attacks could occur from people in North Carolina. Often, animals exhibiting threatening behavior or a loss of apprehension to the presence of people is a direct result and indication of an animal inflicted with a disease. Therefore, requests for assistance could occur from a desire to reduce the threat of disease transmission and/or from fear of aggressive behavior from an animal that is less apprehensive of people or induced as a symptom of disease.

Burrowing by woodchucks may sometimes threaten earthen dams as they form networks of burrows, which can weaken such structures, causing erosion and failure. Such incidents can threaten the safety and lives of people living downstream from the dam. For that reason, managers of such sites are concerned with preventing excessive burrowing by animals at dam sites.

Need for Mammal Damage Management to Protect Agricultural Resources

Bobcats, coyotes, gray fox, red fox, raccoons, opossum, skunks, river otters, mink, feral swine, feral cats, feral dogs, and black bears can cause losses or injury to crops (*e.g.*, corn), 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 animals 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. Feral swine accounted for 3% or $18.5 million in damages to field crops (NASS 2002).

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 nearly $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 while feral dogs represented 9.9% of the cattle losses associated with animal predation. 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 North Carolina, the NASS (2011) reported that animal predators killed 1,400 cattle and 4,000 calves during 2010. Animal predation represented 16.4% of all cattle and calf losses in the State during 2010, resulting in an economic loss in North Carolina of an estimated $2.4 million in 2010 (NASS 2011). Of those cattle reported as lost due to animal predation in the State, respondents suspected coyotes as the cause of the loss for 26.1% of the adult cattle losses and 63.7% of the calf losses. North Carolina cattle producers reported using a number of non-lethal methods to reduce losses due to predators. Guard animals were the primary non-lethal method employed by livestock producers in the State during 2010 with 64% of respondents reporting the use of guard animals (NASS 2011). The use of exclusion fencing was reported by 26.2% of respondents in North Carolina (NASS 2011). The NASS (2011) reported no losses to cattle from bobcat predation in North Carolina. However, cattle producers in the United States indicated mountain lions and bobcats[8] caused 8.6% of the cattle and calf losses attributed to animal predators in 2010 (NASS 2011). Bobcats can also prey on other livestock, such as chickens and domestic waterfowl.

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 can 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 is severe. Similar damage can occur in nurseries that grow landscape ornamentals and shrubs.

River otters and, to a lesser extent, bears and 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, Teutsch et al. 1979). 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 (FPL) infection, feline calicivirus infection, feline reovirus infection, and feline syncytium-forming virus infection (Gillespie and Scott 1973). Of the four feline diseases, FPL is likely the most serious. Reif (1976) found that during the acute stages of FPL, fleas were vectors of this disease to other cats. FPL infection is cyclic in nature, being more prevalent in the July to September period.

Agricultural damage and threats caused by feral swine can occur to a variety of crops, livestock, and other agricultural resources (Beach 1993, Seward et al. 2004, West et al. 2009, Hamrick et al. 2011). Damage

[8]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.

occurs from direct consumption of agricultural resources and from trampling, rooting, and/or wallowing that are common activities of feral swine (Beach 1993). Rooting is a common activity of feral swine where they overturn sod and soil in the search for food (West et al. 2009, Stevens 2010, Hamrick et al. 2011). Feral swine also wallow in water and mud to regulate body temperature and to ward off skin parasites.

Damage and threats to livestock associated with feral swine occurs from predation on livestock and the risks associated with disease transfer from feral swine to domestic livestock (West et al. 2009, Hamrick et al. 2011). Feral swine can also cause damage to other agricultural resources. For example, feral swine can cause damage to pastures and land used for hay by rooting and wallowing, can cause damage to ponds and water sources for livestock, and can cause damage from the consumption of livestock feed. Feral swine feeding activities in agricultural crops can also lead to increased erosion from the removal of vegetation that leaves the soil bare along with the overturning of soil caused by rooting.

In addition, feral swine also damage pastures, land used for hay, and sod farms through rooting and wallowing activities (Beach 1993, West et al. 2009, Stevens 2010, Hamrick et al. 2011). Rooting activities can also lead to increased erosion and soil loss. Wallowing and rooting activities in watering areas for livestock can result in severely muddied water, algal blooms, oxygen depletion, bank erosion, and reduction in fish viability (Beach 1993). Since feral swine often travel in family groups, damage from rooting and wallowing can be extensive often encompassing several acres.

Additional risks associated with feral swine are the potential for disease transmission from feral swine to domestic livestock, especially to domestic swine. Feral swine are potential reservoirs for several diseases that are known to be transmissible between feral swine and domestic livestock (Wood and Barrett 1979, Corn et al. 1986, Beach 1993, Davidson 2006). Corn et al. (1986) found feral swine tested in Texas were positive for pseudorabies, brucellosis, and leptospirosis. A study in Oklahoma found samples from feral swine tested positive for antibodies of porcine parvovirus, swine influenza, and porcine reproductive and respiratory syndrome virus (Saliki et al. 1998). Porcine reproductive and respiratory syndrome is a highly infectious virus that causes reproductive failure and respiratory disease in swine (USDA 2009*b*). The total cost of productivity losses due to porcine reproductive and respiratory syndrome in the domestic swine herd in the United States was estimated at $664 million annually during 2011 and represented an increase from the $560 million annual cost estimated in 2005 (Holtkamp et al. 2013).

Pseudorabies is a viral disease associated with an extremely contagious herpes virus that can have negative effects on reproduction in domestic swine. An economic analysis estimated that the annual cost of pseudorabies to pork producers in the United States at more than $30 million annually in lost production as well as testing and vaccination costs (USDA 2008). Brucellosis is a bacterial disease that can also have negative effects on reproduction of swine.

Cholera, trichinosis, and African swine fever are additional diseases that can be transmitted between livestock and feral swine. Disease transmission is likely to occur where domestic livestock and feral swine have a common interface, such as at water sources and livestock feeding areas. Although several diseases carried by swine are also transmissible to other livestock, the primary concern is the potential transmission of diseases from feral swine to domestic swine. Many of the diseases associated with feral swine also negatively affect the health and marketability of domestic swine that can lead to economic losses to the livestock producer. A disease outbreak not only has negative economic implications to the individual livestock producer but an outbreak also could cause economic losses that can negatively affect the statewide swine industry. The WS program in North Carolina could conduct disease surveillance in the feral swine population as part of the National Wildlife Disease Surveillance Program.

The United States is one of the world's largest producers of pork and is the second largest exporter of pork. Pork production in the United States accounts for about 10% of the total world supply. The retail value of pork sold to consumers exceeds $30 billion annually. In addition, the pork industry supports more than 600,000 jobs (USDA 2008).

Although the source of livestock disease outbreaks can be difficult to identify, a risk of transmission and the spreading of diseases to domestic swine and other livestock exists wherever feral swine and domestic livestock interact (Witmer et al. 2003). In addition to large-scale commercial operations, small-scale "*backyard*" swine operations where domestic swine could interact with feral swine are also at risk (Saliki et al. 1998). With the large number of domestic swine in the State, the potential exists for severe economic losses to occur because of the transmission of infectious diseases between feral and domestic swine.

In addition to the potential for disease transmission, feral swine can also kill livestock. Feral swine can kill calves, kids (goats), lambs, and poultry (West et al. 2009, Stevens 2010). Predation occurs primarily on young livestock but feral swine can also kill weakened or injured livestock. Feral swine predation on livestock occurs rarely and the WS program in North Carolina has not received requests for assistance with managing predation on livestock associated with feral swine. However, if feral swine populations continue to increase in the State, WS could receive requests for assistance to address localized predation by feral swine. Since feral swine so thoroughly consume young prey, there is often little evidence remaining to suggest that a birthing and subsequent predation occurred. If a landowner is not alert to the possibility of feral swine predation, it is easy to overlook this as a cause for low production. Frequently, even when predation is considered, feral swine often escape suspicion because people generally underestimate their capabilities as a predator (Beach 1993).

According to technical assistance requests received by WS, agricultural crops lost to deer depredation have included, but are not limited to, snap beans, sweet corn, leafy vegetables, tomatoes, peppers, and apples. WS also received requests for assistance associated with grain crops, including corn (silage and grain), soybeans, wheat, and oats. In a North Carolina survey, 92% of farms that produce soybeans reported damage associated with deer. Similarly, 92% of farms that produce cotton in the State reported deer damage. Agriculture producers identified deer damage at 75% of farms producing peanuts and 60% of farms producing wheat (NASS 2009).

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

- Coyotes attacking and killing calves, lambs, chickens, and emus
- Raccoons and striped skunks 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 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 or habitats in general. Examples of natural resources in North Carolina could include 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. Those mammal species addressed in this EA can also cause damage to natural resources.

Some of the target mammal species addressed in this EA can 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, skunks, feral swine, feral cats, coyotes, or fox. While predation is not generally a threat to a healthy animal population, it could limit the recovery of threatened or endangered species or contribute to the local extirpation of populations already depleted by other factors. Massey (1971) and Massey and Atwood (1981) found that predators could prevent federally endangered least terns (*Sterna antillarum*) from nesting or cause them to abandon previously occupied sites. In another study, mammalian predators adversely affected the nesting success of least terns on sandbars and sandpits (Kirsch 1996).

Raccoons, coyotes, fox, feral swine, and skunks 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 loggerhead sea turtles (*Caretta caretta*), green sea turtles (*Chelonia mydas*), leatherback sea turtles (*Dermochelys coriacea*), and Kemp's Ridley sea turtles (*Lepidochelys kempii*) (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 North 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 (*e.g*., see 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 predation tolerances listed in the recovery plan for 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 mallards (*Anas platyrhynchos*) (Figley and VanDruff 1982) and young brown pelicans (*Pelecanus occidentalis*) (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, "*cats often kill common* [bird] *species such as Northern 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 with the selection of prey based more on availability than abundance. Pearson (1971) found that cats were serious predators of California voles (*Microtus californicus*) and that the greatest pressure on voles occurred when vole numbers were lowest.

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. Domesticated cats preyed on few rats of reproductive size or age. 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 requires the use of chemical methods (*e.g.*, poisons). Jackson (1951) found that feral and free-ranging cats in urban areas of Baltimore, Maryland were insignificant predators of Norway rats (*Rattus norvegicus*). 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 may 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 (*Peromyscus* spp.) and harvest mice (*Reithrodontomys megalotis*) trapped were in the no-cat area; whereas, 79% of the house mice (*Mus musculus*), 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).

Feral swine compete with over 100 species of native wildlife for important and limited natural food supplies. Some species including quail, turkey, endangered sea turtles, and shorebirds are at risk of predation by nest destruction and the consuming of eggs. Feral swine cause damage to natural areas such as parks and wildlife management areas. Those sites suffer erosion and local loss of critical ground plants and roots, as well as destruction of seedlings because of feral swine feeding and rooting (Barrett and Birmingham 1994). Many state and federal natural resource managers are now in the process of controlling feral swine because of their known impact to endangered plants and animals (Thompson 1977).

Feral swine can feed on many smaller animals (some threatened or endangered), disrupt ecosystems via rooting, and feed on rare and endangered plants. Many experts in the fields of botany and herpetology have observed declines in some rare species of plants, reptiles, amphibians, and soil invertebrates (Singer et al. 1982) in areas inhabited by feral swine. Feral swine can also disturb large areas of vegetation and soils through rooting, and swine inhabiting coastal, upland, and wetland ecosystems can uproot, damage, and feed on rare native species of plants and animals. Swine can disrupt natural vegetative communities, eliminate rare plants and animals, alter species composition within a forest, including both canopy and low growing species (Lipscomb 1989, Frost 1993), increase water turbidity in streams and wetlands (reducing water quality and impacting native fish), and increase soil erosion and alter nutrient cycling (Singer et al. 1982, DeBenedetti 1986).

One of the more important seasonal food resources used by feral swine is wild fruit and nut crops, especially oak mast (Wood and Roark 1980). Mast crops, such as beechnut (*Fagus* spp.), acorns (*Quercus* spp.), and hickory nuts (*Carya* spp.), are an important food source for deer, turkey, black bear, and squirrels (Knee 2011). Oak mast is an important food source for white-tailed deer and wild turkey (*Meleagris gallopavo*). Each adult feral swine can consume up to 1,300 pounds of mast per year (Knee 2011). When feral swine actively compete for mast, resident deer and wild turkey may enter the winter with inadequate fat reserves; thus, threatening the viability of these native wildlife species (Beach 1993). They can also compete for acorns and hickory nuts with native wildlife during years of poor mast production (Campbell and Long 2009). In years of poor mast production, feral swine were found to have negative effects on white-tailed deer populations due to competition for acorns (Wood and Roark 1980). Due to their acute sense of smell, feral swine more rapidly and efficiently consume fallen mast crop (Beach 1993). Feral swine also have the ability to change to other food sources when acorns were depleted, which deer are often unable to do (Beach 1993). Consumption of hard mast by feral swine in forests also reduces the potential for forest regeneration, further affecting the food chain necessary to maintain species diversity and stable populations (Campbell and Long 2009).

Feral swine will consume animal material year round, including earthworms, arachnids, crustaceans, insects, gastropods, fish, amphibians, reptiles, birds, and mammals (Mayer and Brisbin 2009). The rooting behavior of feral swine has been identified as the cause of the near extirpation of northern short-tailed shrews (*Blarina brevicuada*), and southern red-backed voles (*Clethrionomys gapperi*) in areas with intensive rooting due to the removal of leaf litter, which is crucial for the survival of the shrew and vole (Singer et al. 1984). Feral swine will often search out and excavate food caches used by small mammals, potentially affecting their ability to survive (Campbell and Long 2009).

Feral swine can cause direct mortality through predation on native wildlife species. Feral swine are known to feed on many smaller animals (some threatened or endangered), and will consume voles, shrews, turtles, amphibians, and shrub- or ground-nesting birds (Campbell and Long 2009). Many species, including quail, turkey, and shorebirds, are at risk of predation by nest destruction and the consuming of eggs (Campbell and Long 2009). A study conducted in northern Texas found that feral swine consumed 23.5% and 11.5 % of simulated Northern bobwhite (*Colinus virginianus*) nests in each of the study areas. Researchers concluded feral swine nest predation could be a contributing factor in Northern bobwhite population declines (Timmons et al. 2011).

Plant forage makes up approximately 88% of a feral swine's dietary composition and is consumed year-round (Mayer and Brisbin 2009). This high dependence on vegetation may be why feral swine can cause the greatest damage to environmentally sensitive areas (Campbell and Long 2009). Feral swine can reduce recruitment of saplings, increase the spread of invasive plants, prevent forest regeneration, reduce seedlings and seedling survival, and eliminate understory (Campbell and Long 2009). Rooting behavior by feral swine in beech forest understory was found to be so severe that recovery was unlikely to occur (Bratton 1975). Where feral swine reduced herbaceous and belowground vegetation, recovery time was expected to take more than three years (Howe et al. 1981). Feral swine reduce the amount of vegetative ground cover and leaf litter, reducing the critical microclimatic conditions necessary for seedling establishment and growth in forests (Chavarria et al. 2007).

In terrestrial plant communities, disturbance can threaten native communities by promoting the spread of invasive, exotic plant species (Tierney and Cushman 2006). Following disturbance through feeding activities by feral swine, percent cover of native perennial grasses recovered at a consistently slower rate than exotic grasses (Tierney and Cushman 2006). Tierney and Cushman (2006) also found that removing or reducing the size of feral swine populations is an effective technique for restoring native perennial grasses.

Habitat damage by feral swine is most pronounced in wet environments (Engeman et al. 2007). Wet soils may make it easier for feral swine to obtain the foods they favor, such as the roots, tubers, and bulbs that are characteristic of many wetland plants. Choquenot et al. (1996) found that there appeared to be a strong correlation between soil moisture and rooting damage. Aquatic macrophytes are a key component of habitat in wetlands, providing both an important food resource and structural complexity to the waterscape for associated biota (Thomaz et al. 2008). Macrophytes are an aquatic plant that grows in or near water and are emergent, submergent, or floating. The destruction of wetland vegetation by feral swine was also found to alter production and respiration regimes causing anoxic (depleted of dissolved oxygen) conditions (Doupe et al. 2010). Lower dissolved oxygen levels caused chronic sub-lethal effects for the associated biota.

Feral swine can affect lakes, ponds, streams, and wetlands, since their rooting and wallowing activities near water sources may increase water turbidity in streams and wetlands, and increase soil erosion and alter nutrient cycling (Singer et al. 1982, DeBenedetti 1986). Increases in water turbidity reduce water quality and can affect native fishes (DeBenedetti 1986). Doupe et al. (2010) found that feral swine foraging in wetland floodplains disrupted physical, chemical, and biological environments by increasing turbidity, destroying aquatic macrophytes, and by causing the proliferation of bare ground and open water. Feral swine spend considerable time in aquatic habitat foraging or wallowing (Mersinger and Silvy 2007). They are known to forage both in and out of water to obtain wetland roots and bulbs (Doupe et al. 2010). Due to their foraging behavior, feral swine are more likely to disturb the wetland substrate and water body.

Kaller and Kelso (2003) found that feral and free-ranging swine were linked to increased levels of fecal coliform and other potentially pathogenic bacteria in several watersheds in Louisiana. Kaller et al. (2007) used DNA fingerprinting to determine that feral swine contribute detectable *E. coli* into aquatic ecosystems. Additionally, some species of freshwater mussels and aquatic insects were negatively affected by feral swine fecal coliform within the watershed (Kaller and Kelso 2006).

Deer are considered a "*keystone species*," one that can have a profound impact on vegetation, altering species composition to the point that entire forests either fail to regenerate, or regenerate with tree species that are not beneficial for deer or other species of wildlife, or for lumber (Waller and Alverson 1997). Deer browsing damages and destroys landscaping and ornamental trees, shrubs, and flowers. As rural areas are developed, deer habitat may actually be enhanced because fertilized lawns, gardens, and landscape plants serve as high quality sources of food (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 source for deer. In addition to browsing pressure, male white-tailed deer damage ornamental trees and shrubs by antler rubbing which results in broken limbs and bark removal.

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 have substantial impacts on certain herbaceous and woody species and on overall plant community structure (Waller and Alverson 1997). These changes can lead to adverse impacts on other wildlife species, which depend on these 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 plant diversity (Warren 1991). By one count, deer browsing disturbed 98 species of threatened or endangered plants, many of them orchids and lilies (Ness 2003). In the Great Smokey Mountains National Park in Tennessee, an area heavily populated by deer had a reduction in the number of plant species, a loss of hardwood species and a predominance of conifer species compared to an ecologically similar control area with fewer deer (Bratton 1979). In a single park in Columbus, Ohio, a deer herd eradicated more than 150 plant species (Ness 2003).

The alteration and degradation of habitat from over-browsing by deer can have a detrimental effect on deer herd health 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 surfaces, escape cover, and nesting. Species richness and abundance of intermediate canopy nesting songbirds was reduced in areas with higher deer densities (DeCalesta 1997). Intermediate canopy-nesting birds declined 37% in abundance and 27% in species diversity at higher deer densities. Five species of birds were found to disappear at 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 3 species of birds were lost in a research preserve stocked with high densities of ungulates and that the densities of several other species of birds 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 species of animals and insects.

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 North Carolina.

Need for Mammal Damage Management to Protect Property

Mammals cause damage to a variety of property types in North Carolina each year and damage occurs in a variety of ways. 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, and woodchucks can cause damage to property by digging under porches, buildings, homes, and many other places. Skunks often cause damage to lawns and turf while digging for grubs and insects. Aircraft striking mammals can also cause substantial damage requiring costly repairs and aircraft downtime.

Airports provide ideal conditions for many animal species due to the large grassy areas adjacent to brushy, forested habitat used as noise barriers. Access to most airport properties is restricted so mammals living within airport boundaries are not harvestable during hunting and trapping seasons and are 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 animals is increasing (Dolbeer 2000, MacKinnon et al. 2001). Collisions between aircraft and animals are a concern throughout the world because animal strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with animals 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).

About 59% of mammal strikes resulted in damage compared to 14% for birds (Dolbeer et al. 2009). In addition to damages caused by mammal strikes to aircraft, those incidents can pose serious threats to human safety. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft, causing additional damage to the aircraft and increasing the threat to human safety. Nearly 64% of the reported mammal strikes from 1990 through 2008 occurred at night, with 89% occurring during the landing roll or the takeoff run (Dolbeer et al. 2009). Since 1990, aircraft have struck 32 white-tailed deer, 14 coyotes, two cottontail rabbits, one raccoon, one striped skunk, one skunk (species unspecified), one red fox, one fox (species unspecified), and one opossum in North Carolina according to reports filed with the FAA (FAA 2015). 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 is the goal of those cooperators requesting assistance at airports in North Carolina given that a potential strike can lead to the loss of human life and considerable damage to property.

In addition, some mammal species addressed in this EA pose minimal strike hazards at airports but their presence on airport property could act as attractants for other animal species that do pose higher risks of aircraft strikes. For example, a high density of cottontail rabbits on airport property could attract raptors to the airport as rabbits are a food source for many raptors species. Raptors often pose a high risk to aircraft due to their relative size and their soaring and hovering habits. Therefore, reducing rabbits densities at airports can reduce strike risks with raptors by reducing the availability of a food source.

During FY 2011, WS responded to two requests for assistance associated with black bears at airports in the State. One request for assistance was received from airport authorities when a bear entered a building on airport property. Due to human safety concerns, WS was requested to euthanize the bear using a firearm. WS was also requested during FY 2011 to euthanize an injured bear at an airport after airport personnel shot the bear due to their concerns that the bear posed a risk to incoming and outgoing flights. After obtaining permission from the NCWRC, the injured bear was euthanized by WS. Multiple attempts were made to disperse the bears using non-lethal harassment techniques in both situations, but were unsuccessful.

Animal 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 animals confined inside the airport perimeter fence would not be considered distinct populations nor separate from those populations found outside the perimeter fence. Animals found within the boundaries of perimeter fences originate from populations outside the fence. Those populations inside the fence do not exhibit nor have unique characteristics from those outside the fence and do not warrant consideration as a unique population under this analysis.

Feral swine can damage landscaping, golf courses, roads, drainage ditches and cause erosion by feeding in these areas. Feral swine dig or root in the ground with their nose in search of desired roots, grubs, earthworms, and other food sources. Feral swine can damage landscaping, golf courses, roads, drainage ditches and cause erosion by feeding in these areas. The rooting and digging activity of feral swine turns sod and grass over which often leaves the area bare of vegetation and susceptible to erosion. Feral swine also pose a threat to property from being struck by motor vehicles and aircraft.

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). Conover et al. (1995) estimated that 1.5 million deer-vehicle collisions occur each year in the United States and estimated that the total damage to vehicles in the United States each year from deer-vehicle collisions was greater than $1 billion. State Farm Mutual Automobile Insurance (2012) estimated that 1.23 million deer-vehicle collisions occur annually in the United States. In North Carolina, Oliver (2014) reported 20,308 animal-vehicle strikes during 2013, with approximately 90% of those strikes involving deer. 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). Based on the average repair costs associated with vehicle strikes estimated at $3,171 in 2011 and the number of strikes that have occurred in the State estimated at 18,300, deer-vehicle collisions resulted in over $58 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).

Although rare, vehicle strikes involving deer can cause human fatalities. For example, human fatalities occurred in 0.01% of the vehicle strikes involving white-tailed deer in Ohio. Across North America, 0.03% of the vehicle collisions involving deer caused fatalities (Huijser et al. 2008). A study that used data on human fatalities from animal-vehicle collisions from nine states (Colorado, Georgia, Minnesota, Missouri, North Carolina, Ohio, Pennsylvania, South Carolina, and Wisconsin) showed that 77% of the human fatalities associated with those collisions involved white-tailed deer (Huijser et al. 2008). Conover et al. (1995) estimated that deer-vehicle collisions in the United States result in 29,000 injuries and 211 human fatalities annually.

Airports provide ideal conditions for feeding and bedding sites for deer due to the large grassy areas adjacent to brushy, forested habitat used as noise barriers. Deer living within airport boundaries are usually protected from hunting and many other human disturbances.

Deer are currently regarded as the number one hazardous animal species to aircraft across the nation (Dolbeer et al. 2000) and caused damage to aircraft in 86% of the strikes where deer were involved (Wright 2001). In general, deer strikes result in major component damage to the aircraft. Deer-aircraft strikes can also result in loss of human life, injury to passengers or people on the ground, and damage or malfunction of aircraft, aircraft navigational aids, or airport facilities. Mammals colliding with aircraft during the most vulnerable phases of flight, takeoff or landing, can cause the aircraft to crash or sustain physical damage (Dolbeer et al. 2014). Deer are characteristically unpredictable in their initial response to approaching aircraft. Deer may wander onto runway surfaces and be startled into the path of oncoming aircraft, and at night, they may freeze when caught in the beams of landing lights, resulting in a strike. The majority of deer strikes occur at night and in the fall during the mating season (Dolbeer et al. 2014).

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA documents the need for managing damage caused by the mammal species identified in Section 1.1, 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 North Carolina.

Appendix B of this EA discusses the methods available for use or recommendation under each of the alternative approaches evaluated[9]. 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 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 authorized by the NCWRC, when required, and only at levels authorized.

[9]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.

Federal, State, County, City, and Private Lands

WS could continue to provide damage management activities on federal, state, county, municipal, and private land in North Carolina when WS receives a request for such assistance 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, state, county, municipal, and private when requested.

Native American Lands and Tribes

The WS program in North 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 NCWRC 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 North 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 authorized by the NCWRC, when required, and only at levels authorized.

This EA analyzes the potential impacts of mammal damage management based on previous activities conducted on private and public lands in North Carolina where WS and the appropriate entities entered into a MOU, work initiation document, or another comparable document. This 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 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 analyzes the potential effects 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 occur and are treated as such.

Chapter 2 of this EA identifies and discusses issues relating to mammal damage management in North 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 by WS in any locale and at any time within North 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 NCWRC. 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

Reducing Mammal Damage in the State of North Carolina Environmental Assessment: As was stated previously, WS previously developed an EA that addressed WS' activities to manage damage associated with mammals in the State (USDA 2012). This new EA will address more recently identified changes in activities and will assess the potential environmental impacts of program alternatives based on those changes, primarily a need to evaluate new information. Since this new EA will re-evaluate activities conducted under the previous EA to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued based on the analyses in this EA will supersede the previous EA that addressed managing damage caused by mammals.

White-tailed Deer in North Carolina Damage Management Environmental Assessment: WS has previously prepared an EA to evaluate potential impacts to the human environment from the implementation of a management program to address damage to agricultural resources, natural resources, property, and to reduce threats to human safety caused by white-tailed deer (USDA 2005*a*). This new EA will address more recently identified changes in activities associated with white-tailed deer and will assess the potential environmental impacts of program alternatives based on those changes, primarily a need to evaluate new information. Since this new EA will re-evaluate activities conducted under the previous EA to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued based on the analyses in this EA will supersede the previous EA that addressed managing damage caused by mammals.

***Aquatic Rodent Damage Management in North Carolina Environmental Assessment*:** WS has developed an EA that analyzed the need for action to manage damage associated with beaver (*Castor canadensis*), muskrats (*Ondatra zibethicus*), and nutria (*Myocastor coypus*) in the State (USDA 2015*a*). Although this EA does not specifically address beaver, muskrats, and nutria, many of the methods available to alleviate aquatic rodent damage can also be used to alleviate damage associated with other mammal species. Therefore, this EA will evaluate the cumulative use of methods related to aquatic rodent damage management and the methods available under the alternatives in this EA.

WS' Environmental Assessment – Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Fox, and Coyotes in the United States: WS issued an EA that analyzed the environmental effects of WS' involvement in the funding of and participation in ORV programs to eliminate or stop the spread of raccoon rabies in a number of eastern states (including North Carolina) and gray fox and coyote rabies in Texas (USDA 2009*a*). WS determined the action would not have a significant impact on the quality of the human environment.

***Final Environmental Impact Statement - Feral Swine Damage Management*:** The APHIS and cooperating agencies prepared a programmatic EIS to address feral swine damage management in the United States, American Samoa, Mariana Islands, United States Virgin Islands, Guam, and Puerto Rico (USDA 2015*b*). The Record of Decision selected the preferred alternative in the EIS to implement a nationally coordinated program that integrates methods to address feral swine damage. In accordance with the Record of Decision, WS developed this EA to be consistent with the EIS and the Record of Decision.

North Carolina Wildlife Action Plan: The NCWRC has developed an extensive wildlife action plan that evaluates all species of plant and animal known to exist within the State (NCWRC 2005). The goals of the action plan are "…1) *to improve understanding of the species diversity in North Carolina and enhance our ability to make conservation or management decisions for all species, 2) to conserve and enhance habitats and the communities they support, 3) to foster partnerships and cooperative efforts*

among natural resource agencies, organizations, academia and private industry, 4) to support educational efforts to improve understanding of wildlife resources among the general public and conservation stakeholders, and 5) to support and improve existing regulations and programs aimed at conserving habitats and communities."

North Carolina Black Bear Management Plan: The NCWRC developed a black bear management plan with the goal to "*Use science-based decision making and biologically-sound management principles to manage black bear populations in balance with available habitats and human expectations to assure long term existence and hunting opportunities*" (NCWRC 2012*a*).

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 animal damage management.

WS' Legislative Authority

The primary statutory authorities for WS' program are 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 animals. WS' directives define program objectives and guide WS' activities to manage animal damage management.

North Carolina Wildlife Resources Commission

The NCWRC was established by Article 24 of Chapter 143 of the General Statutes and Part 3 of Article 7 of Chapter 143B of the General Statutes (1965, c. 957, s. 2; 1973, c. 1262, s. 28; 1977, c. 512, s. 5; c. 771, s. 4; 1979, c. 388, s. 1; c. 830, s. 1; 1987, c. 641, s. 4; 1989, c. 727, s. 218(57); 1997-443, s. 11A.119(a); 1998-225, s. 1.1.). Under Chapter 143, Article 24, Section 143-239, "[t]*he purpose of...the North Carolina Wildlife Resources Commission,...shall be to manage, restore, develop, cultivate, conserve, protect, and regulate the wildlife resources of the State of North Carolina, and to administer the laws relating to game, game and freshwater fishes, and other wildlife... (1947, c. 263, s. 3; 1965, c. 957, s. 13.)*".

North Carolina Department of Agriculture and Consumer Services

The Pesticide Section of the Structural Pest Control and Pesticide Division within the NCDACS enforces state laws pertaining to the use and application of pesticides. The North Carolina Pesticide Law of 1971 requires the registration of pesticide products in the state, the licensing and certification of commercial and private applicators and pest control consultants, the proper handling, transportation, storage, and disposal of pesticides, and the licensing of dealers selling restricted use pesticides. The purpose of the Law is to protect the health, safety, and welfare of the people of this State, and to promote a more secure, healthy and safe environment for all people of the state. This is accomplished by regulation in the public interest of the use, application, sale, disposal, and registration of pesticides.

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.

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 Endangered Species Act (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 United States Fish and Wildlife Services (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 NCDACS regulate pesticides that could be available to manage damage associated with mammals in the State.

National Historic Preservation Act of 1966, as Amended

The National Historic Preservation Act (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 animals 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.

Native American Graves Protection and Repatriation Act

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.

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

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

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

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

Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act (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 animals in damage management programs. Those requirements are: (1) a valid "*veterinarian-client-patient*" relationship, (2) well defined record keeping, (3) a withdrawal period for animals that have been administered drugs, and (4) identification of animals. A veterinarian, either on staff or on an advisory basis, would be involved in the oversight of the use of animal capture and handling drugs under any alternative where WS could use those immobilizing drugs and euthanasia chemicals. 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.

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.

Airborne Hunting Act

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

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. The Act authorized funds for cost-sharing grants to states to develop their programs and 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 requiring federal agencies to conduct activities 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, WS would conduct a consistency determination to assure management actions would be consistent with the State's Coastal Zone Management Program.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance to federal agencies to prevent the introduction of invasive species, provide for the control of invasive species, and to minimize the economic, ecological, and human health impacts that invasive species cause. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species.

Environmental Justice - 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.

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

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

Authority of the NCWRC to Issue Permits to Take Wildlife Resources

Under Article 21, Section 113-274 of the North Carolina General Statutes, the NCWRC may issue depredation permits that "*...Authorizes the taking, destruction, transfer, removal, transplanting, or driving away of undesirable, harmful, predatory, excess, or surplus wildlife or wildlife resources. Livestock or poultry owners shall be issued a depredation permit for coyotes upon request. The permit must state the manner of taking and the disposition of wildlife or wildlife resources authorized or required and the time for which the permit is valid, plus other restrictions that may be administratively imposed in accordance with rules of the Wildlife Resources Commission. No depredation permit or any license is needed for the owner or lessee of property to take wildlife while committing depredations upon the property. The Wildlife Resources Commission may regulate the manner of taking and the disposition of wildlife taken without permit or license, including wildlife killed accidentally by motor vehicle or in any other manner*." Permits are defined as "*...written authorization issued without charge by an employee or agent of the Wildlife Resources Commission to an individual or a person to conduct some activity over which the Wildlife Resources Commission has jurisdiction. When sale of wildlife resources is permitted, rules or the directives of the Executive Director may require the retention of invoices or copies of invoices in lieu of a permit*."

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 NCWRC is responsible for managing wildlife in the State of North Carolina, including those wildlife species addressed in this EA. As the authority for the management of wildlife populations in the State, the NCWRC 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 NCWRC 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 NCWRC; therefore, the lethal removal of those species to alleviate damage or reduce threats of damage would only occur at the discretion of NCWRC and only at the levels the NCWRC authorizes. 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 NCWRC, which would ensure the NCWRC 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 North 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 North 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 proposed 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 animal 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 animal species and certain resident wildlife species are managed with little or no restrictions, which allows anyone to lethally remove or capture those species at any time when they are committing damage. The NCWRC has the authority to manage wildlife populations in the State and the authority to allow the lethal removal or capture of wildlife for damage management purposes.

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 authorization when those species are non-native or are unregulated by the NCWRC. In addition, other entities could remove some species of mammals to alleviate damage during the hunting and/or trapping season and/or through authorization by the NCWRC. 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 authorization, during the hunting or trapping season, or through authorization by the NCWRC. 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 authorization, 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 North Carolina in consultation with the NCWRC. 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 Damage Management Activities on Target Mammal Populations

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. A common issue when addressing damage caused by animals is 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 NCWRC authorizes WS to remove.

Another concern is that activities conducted by WS would affect the ability of persons to harvest wildlife during the regulated hunting and/or 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. People in the State can harvest most of the mammal species addressed in this EA during annual hunting and/or trapping seasons. People can harvest bobcats, coyotes, gray fox, red fox, raccoons, opossum, striped skunks, river otters, woodchucks, mink, feral swine, gray squirrels, cottontails, black bears, and deer during annual hunting and/or trapping seasons. The only mammal species addressed in this EA that do not have hunting and trapping seasons in the State are feral cats and feral dogs. Coyotes[10], woodchucks, striped skunks, and feral swine[11] have no closed season, which allows people to harvest those species using hunting methods throughout the year.

When authorized by the NCWRC, people can also address some of the species using available methods themselves or seek assistance from other entities when those species cause damage or pose threats of damage outside of the annual hunting and/or trapping season. Some species (*e.g*., feral cats, feral dogs) do not require authorization from the NCWRC when causing damage or posing threats of damage. 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.

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. 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.

[10]During the development of this document, the NCWRC required people hunting coyotes in Hyde, Beaufort, Washington, Dare, and Tyrrell Counties to obtain a permit.

[11]During the development of this document, the NCWRC allowed people to trap feral swine throughout the year in addition to harvesting feral swine using hunting methods.

Issue 2 - Effects of Activities on the Populations of Non-target Animals, Including T&E Species

The issue of non-target species effects, including effects on T&E species arises from the use of those methods available under each of the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target animals. There are also concerns about the potential for adverse effects to occur to non-target animals 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 could include immobilizing drugs, euthanasia chemicals, GonaCon™ (deer only), gas cartridges (woodchucks, coyotes, fox, skunks only), zinc phosphide (woodchucks only), 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 North 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 ESA to ensure compliance. The WS program also conducts consultations to ensure that *"any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available"* [Sec. 7(a)(2)]. 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 Damage Management Activities on Human Health and Safety

An additional issue often raised is the potential risks to the safety of people 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 animals relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from animals that have been exposed. Under the alternatives identified, the use or recommendation of chemical methods could include immobilizing drugs, euthanasia chemicals, GonaCon™ (deer only), gas cartridges (woodchucks, coyotes, fox, skunks only), zinc phosphide (woodchucks only), and repellents. The United States Environmental Protection Agency (EPA) through the FIFRA and the North Carolina Department of Agriculture and Consumer Services (NCDACS) 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 North 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 animals to eliminate pain, calm fear, and reduce anxiety when handling and transporting animals. Xylazine is a sedative that wildlife professionals often use in combination with ketamine to calm nervousness, irritability, and excitement in animals

during the handling and transporting. Euthanasia chemicals could include sodium pentobarbital and potassium chloride, all of which WS would administer after anesthetizing an animal.

Gonacon™ is a product currently registered as a reproductive inhibitor, but is only available to manage local deer populations. Gonacon™ is currently available for use in the State. Gonacon™ would only be available for use by WS and/or the NCWRC, and agents under their direct supervision. The application of Gonacon™ to manage local deer herds could only occur after the NCWRC authorized the use of the reproductive inhibitor.

WS could use products containing the active ingredient zinc phosphide, which could be available to address damage and threats associated with 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 NCDACS. 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 animals by imitating the presence of a predatory animal (*i.e*., animals tend to avoid areas where predators are known to be present). WS could employ or recommend for use zinc phosphide and repellents that were available for use in the State (*i.e*., registered with the EPA pursuant to the FIFRA and registered with the NCDACS for use in North Carolina). WS' personnel would only recommend those chemical methods that were available for use by people with the appropriate applicators license.

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 North Carolina would be available for use under any of the alternatives and by any entity, when authorized. 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 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 target mammals to the public, resource owners, or neighboring residents. People generally regard animals as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that animals 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 animals. Therefore, the public reaction can be variable and mixed to animal 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 animals.

Animal 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, 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 animals 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.

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. Animal 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 animal 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 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 North 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

The WS program 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 North 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 NCWRC and activities associated with many of the mammal species addressed in the EA require authorization from the NCWRC. 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 authorization of lethal removal by the NCWRC 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 some cases, any loss in value of a resource caused by animals could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking 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 animal 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 damage management if the supervisor could show that damage from animals 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, through state funding, 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 North 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 the target animals could contact wildlife control agents and private entities to reduce 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 WS lethally removed the deer. Of recent concern is the potential for lead and other contaminants to be present in the deer meat 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, WS could donate meat from deer lethally removed during damage management activities to charitable organizations for human consumption (see WS Directive 2.510). The WS program in North Carolina would only donate meat from deer under the proposed action alternative. WS could recommend the donation or consumption of meat under the technical assistance only alternative but WS' personnel would not provide direct operational assistance under a technical assistance only alternative.

Stewart and Veverka (2011) documented that white-tailed deer 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 people would process 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 people did not ingest the fragments. WS' personnel would receive training to shoot and target the head and upper neck of white-tailed deer. WS would not donate any deer shot in the lower neck or would process those deer to avoid the areas that could contain lead fragments.

If WS donated deer for human consumption, WS' personnel would follow WS' policies pertaining to the testing or labeling of meat in order to address potential health concerns. The testing of deer donated for exposure to substances such as organophosphate and carbamate insecticides, lead, mercury, arsenic, organochlorines, and organic chemicals could occur prior to distribution for human consumption. WS would not donate deer immobilized using immobilizing drugs or euthanized using euthanasia chemicals for human consumption. WS would dispose of carcasses of deer euthanized with euthanasia chemicals 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.

Donation of Feral Swine Removed Through Management Activities for Human Consumption

Under the Federal Meat Inspection Act, inspectors must inspect all swine prior to the swine entering into any establishment for slaughter. Inspections occur by the Food Safety and Inspection Services under the USDA. The Food Safety and Inspection Services ruled that all swine are amenable to the Federal Meat Inspection Act and even if donated, those swine entered into a system of commerce; therefore, the processing of all animals must occur under inspection at an official establishment. This would entail examining the animal alive, at rest and in motion from both sides before passing the animal for slaughter.

In most instances, it would be difficult to trace the origins of feral swine or determine fitness for human consumption due to the potential for feral swine to carry disease (Wyckoff et al. 2009). Transporting live feral swine to slaughter facilities also increases the potential for spreading disease to domestic swine at the facility. Therefore, the WS program in North Carolina would not donate feral swine to food banks.

Potential for Feral Swine to Disperse to Other Areas Due to Management Activities

Methods involving the exclusion, pursuit, shooting, and/or harassment of feral swine could lead to the abandonment of localized areas traditionally used by swine in North Carolina. If WS' personnel unintentionally dispersed feral swine under the alternatives, damages and threats could arise in other areas.

Under the alternatives where WS would be involved with managing damage, WS would evaluate the damage or threat situation to determine the appropriate methods. Activities conducted under the alternatives would be coordinated between WS and local entities to monitor feral swine populations in areas where dispersal may occur. WS' personnel would consider the potential for methods to disperse feral swine as part of the evaluation of the damage situation and would incorporate those considerations into the decision-making process associated with the alternatives to determine the methods to employ and recommend. WS' personnel would likely use methods that could result in the exclusion, harassment, or dispersal of feral swine (*e.g.*, shooting, propane cannons, pyrotechnics) in those situations where damage, threats of damage, and/or threats to human safety require immediate resolution.

In those situations where feral swine could disperse to areas where damage could occur, individual feral swine could also be radio collared to locate and monitor movements of feral swine. WS could use radio collaring to track movements and locations of feral swine. The tracking of feral swine in relationship to damage management activities would also provide the ability to monitor movements and potential dispersal to other areas. Feral swine often form large groups, which allow personnel to capture, collar, and release one individual of the group. Once released, the collared swine often returns to the group. By collaring one individual, WS' personnel can monitor and track the movement and location of an entire group of feral swine. Radio telemetry would be available to monitor the movements of feral swine and to respond as necessary to swine potentially dispersing.

Coordination between agencies and local entities would ensure people could identify and address any dispersing feral swine when they cause damage or threaten human safety. The limited use of methods that disperse feral swine should further ensure they do not displace to other areas within North Carolina. In addition, the passiveness of the primary methods proposed for use should limit dispersal of feral swine.

Feral swine also occur statewide in the State; therefore, dispersal is not likely to disperse feral swine into areas where they are not already present.

WS is also considering the use of aircraft to aid in alleviating or preventing feral swine damage. Under the proposed action alternative, aerial operations could include the use of aircraft for surveillance and monitoring, as well as, WS' employees shooting feral swine from aircraft. Surveillance and monitoring activities would use aircraft to locate feral swine, to determine the size of a local population, and when using radio telemetry, to locate radio collared swine.

The use of aircraft could rapidly reduce feral swine densities in an area (Saunders 1993, Choquenot et al. 1999, Campbell et al. 2010). Studies conducted in Australia found that shooting feral swine from an aircraft reduced local populations of swine by 65 to 80% and surviving feral swine could continue to cause damage and pose disease risks (Saunders and Bryant 1988, Hone 1990, Saunders 1993). Choquenot et al. (1999) found that the feral swine density in an area could influence the efficiency of aerial gunning. Saunders and Bryant (1988) found feral swine "*...became attuned to the significance of a hovering helicopter and* [feral swine] *modified their behaviour* [sic] *to avoid detection*." Dexter (1996) concluded that harassment caused by the use of aircraft in New South Wales, Australia had little effect on the movements of surviving swine since no statistically significant differences were observed in the hourly distance moved by surviving feral swine, the home ranges of surviving feral swine, and their positions within their home ranges. Campbell et al. (2010) stated the use of aircraft to shoot feral swine "*...had only minor effects on the behavior of surviving swine...*" and the use of aircraft to remove feral swine "*...should be considered a viable tool...*" when managing disease outbreaks. Based on available information, feral swine are not likely to disperse long-distances due to damage management activities.

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. In addition, 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 (Proposed Action/No Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated methods approach utilizing non-lethal and lethal techniques when WS receives a request for assistance in the State. This 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 for each request. WS' personnel would determine the appropriate methods to reduce damage and threats of damage by using the WS Decision Model (see discussion below on the WS Decision Model).

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[12] was available, operational damage management. WS would provide those entities 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 NCWRC and only at levels authorized, unless the NCWRC affords those mammal species 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

[12]Funding for WS to conduct damage management activities could occur through federal appropriations, state appropriations, or from cooperative funding.

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 North Carolina would follow WS Directive 2.345. When receiving requests for assistance associated with feral or free-ranging dogs, the WS program would follow WS Directive 2.340.

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, drop nets, cannon nets, translocation, exclusionary devices, frightening devices, immobilizing drugs, GonaCon™ (deer only), 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, gas cartridges (woodchucks, coyotes, fox, skunks only), euthanasia chemicals, zinc phosphide (woodchucks only), and shooting, including the use of firearms from aircraft (coyotes and feral swine only). Target mammal species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. 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, as stated previously, 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 animals 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.

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[13]; 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 intent of using lethal methods would be 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 intent of those methods would be 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

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

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 NCWRC. 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 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 2010 through FY 2014, WS conducted 293 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. Direct operational assistance project may include the following examples.

- **Management of Feral Swine in North Carolina -** WS evaluates agricultural damage or disease transmission caused by feral swine. Direct operational activities consist of various lethal removal techniques, including corral trapping, snaring, and shooting. In some cases, WS works with adjoining landowners to establish large cooperative relationships suitable for aerial operations to pursue feral swine with aircraft. WS' personnel demonstrate techniques for excluding feral swine from specific areas and utilize harassment techniques to provide time for agricultural crops to mature and become less attractive.

- **Management of Domestic and Exotic Mammals in North Carolina -** Upon request for

assistance, WS participates in emergency response situations where there is a need to capture or lethally control domestic or exotic mammals due to natural disasters, accidental releases, or disease outbreaks. Direct operational activities include various lethal and non-lethal removal techniques, including corral trapping, snaring, and shooting. While these cases are rare, WS' personnel are specially trained to respond to emergency response situations and have the skills and tools necessary to complement and support efforts of various state agencies that would take the lead in responding to these situations.

Educational Efforts

Education is an important element of activities because animal damage management is about finding balance and coexistence between the needs of people and needs of animals. 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 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 animal 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 animal 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 animals 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 animal 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.

Community-based Decision Making

WS could receive requests for assistance from community leaders and/or representatives. In those situations, the WS program in North Carolina, under this alternative, would follow the "*co-managerial approach*" to solve animal 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 animal damage themselves, or seek approval to manage animals 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, animal-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, reproductive inhibitors, 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 (feral swine and coyotes only). Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage associated with feral swine and coyotes would require authorization from the NCWRC. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the NCWRC or those persons under the supervision of the NCWRC.

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 2010 and FY 2014, WS has conducted 293 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 NCWRC, 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 a property owner or another entity could occur after authorization by the NCWRC, when required, and during the hunting and/or trapping seasons. With some restrictions on methods and time of day, coyotes, woodchucks, striped skunks, and feral swine have no closed season, which allows people to harvest those species throughout the year. 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™ (deer only), 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 authorization from the NCWRC. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the NCWRC or those persons under the supervision of the NCWRC.

Those persons experiencing damage or threats of damage could contact WS; however, WS would immediately refer the requester to the NCWRC 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

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 NCWRC, other governmental agencies, 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 North Carolina Administrative Code (NCAC), species in the Order Carnivora must either be released on the property of capture or be euthanized, if live-captured (15A NCAC 10B.0106). Mammal species addressed in this EA that are classified in the Order Carnivora include bobcat, coyote, gray fox, red fox, raccoon, striped skunk, river otter, mink, feral cat, feral dog, and the black bear. Under this alternative, WS' personnel would refer requests for assistance associated with those species classified in the Order Carnivora to other state, federal, and/or private entities or would live-capture and release those species on the property where WS' personnel captured the animal. Under this alternative, WS would address requests for assistance associated with opossum, woodchucks, feral swine, gray squirrels, and cottontails using only live-capture methods and translocation.

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, cage traps, foothold traps, cable restraints, 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 NCWRC 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 NCWRC. Therefore, the translocation of mammals by WS would only occur as directed by the NCWRC. In addition, the property owner would have to authorize WS to release target animals on their property. When the NCWRC 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 (except mammals in the Order Carnivora) under the proposed action alternative (Alternative 1) and could recommend translocation (except mammals in the Order Carnivora) under the technical assistance only alternative (Alternative 2). Translocation by other entities of those species not classified under the Order Carnivora could occur under Alternative 2 and 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 North 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 North 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, even if the NCWRC 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 animals 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 animals 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 NCWRC authorizes the translocations, WS did not consider this alternative 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 animal 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 animal population management.

Reproductive control for animals 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 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 in North Carolina for use on white-tailed deer only. 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 North 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 unknown and completely unregulated because it is difficult or impossible to assure people did not remove animals claimed for bounty 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.

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 animals, 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[14] 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 animal damage. The WS program in North 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:

[14]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 would consistently use and apply the WS Decision Model when addressing mammal damage to identify effective strategies to managing animal damage and their potential impacts.

- WS' personnel would follow EPA-approved label directions for all pesticide use. The intent of the registration process for chemical pesticides is to assure minimal adverse effects occur to the environment when people use the chemicals in accordance with label directions.

- WS' employees would use immobilizing drugs and euthanasia chemicals 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).

- WS' employees that use controlled substances would receive training to use each material and would receive certification 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.

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

- All personnel who use firearms would receive training according to WS' Directives.

- WS' employees participating in any aspect of aerial wildlife operations would receive training and/or would receive certification 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.

- WS' personnel would consider the use of non-lethal methods 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 NCWRC, when applicable, and only at levels authorized.

- WS' personnel would direct management actions toward localized populations, individuals, or groups of target species. WS' personnel would not conduct generalized population suppression across North Carolina, or even across major portions of the State.

- 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.

- WS would use non-lead ammunition within the constraints of availability, performance, and safety.

- The use of all traps, cable devices, and other capture devices by WS' personnel would adhere to WS Directive 2.450.

- WS' personnel would dispose of carcasses retrieved after damage management activities in accordance with WS Directive 2.515. If WS' personnel were directly involved with carcass burial (*i.e*., WS' personnel physically or mechanically digging a hole in the ground to bury carcasses), siting decisions would occur after WS consulted with the North Carolina State Historic Preservation Office or the affected tribal authorities to avoid adverse effects on cultural/historic resources. If WS' personnel discovered cultural resources or artifacts during the burial of carcasses, WS would cease operations and contact the North Carolina State Historic Preservation Office or appropriate tribal authorities. However, WS' personnel rarely, if ever, are directly involved with the burial of carcasses in North Carolina.

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 Damage Management Activities on Target Mammal Populations

- The WS program in North Carolina would report annual activities to the NCWRC so the NCWRC has the opportunity to evaluate population trends and the magnitude of WS' activities in the State.

- The WS program would monitor activities under the selected alternative to ensure activities continued to occur pursuant to the selected alternative. However, under the no involvement by WS alternative, no monitoring would occur by WS.

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

- WS' personnel would use the WS Decision Model, designed to identify the most appropriate damage management strategies and their impacts, to determine strategies for resolving mammal damage.

- WS' personnel would give preference to non-lethal methods, when practical and effective.

Issue 2 - Effects of Activities on the Populations of Non-target Animals, Including T&E Species

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

- As appropriate, WS' personnel would use suppressed firearms to minimize the noise associated with the discharge of a firearm.

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

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

- WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g.*, drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g.*, cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once a day or in accordance with North Carolina laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner.

- Personnel would dispose of the carcasses of mammals retrieved in accordance with WS Directive 2.515.

- WS has consulted with the USFWS and the NCWRC 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.

- WS' personnel would review all projects proposed for implementation for potential to take[15] bald eagles in accordance with the provisions of the Bald and Golden Eagle Protection Act. If WS' personnel identify potential risks of take, WS would work with the USFWS on measures to reduce risks and the need for a non-purposeful take permit.

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

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

- WS' personnel would conduct shooting during times when public activity and access to the control areas were restricted. Personnel involved in shooting operations would receive training in the proper and safe application of this method.

- All personnel employing chemical methods would receive proper training and certification 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 Directive 2.401 and WS Directive 2.430 outline WS' use of chemicals and training requirements to use those chemicals.

[15]The Bald and Golden Eagle Protection Act defines "*take*" as "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb*." Disturb is defined as any activity that can result in injury to an eagle, or cause nest abandonment or decrease in productivity by impacting breeding, feeding, or sheltering behavior.

- 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 NCDACS, as appropriate.

- When using immobilizing drugs for the capture of mammals, WS would adhere to all established withdrawal times for mammals established through consultation with the NCWRC 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.

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

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

- WS' personnel would direct management actions to reduce or prevent damage caused by mammals 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 and the entity requesting assistance would agree upon all methods or techniques applied to resolve damage or threats to human safety by signing a work initiation document, MOU, or comparable document prior to the implementation of those methods.

- WS' personnel would give preference to non-lethal methods, when practical and effective.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- WS' personnel would receive training in the latest and most humane devices/methods for removing target mammals causing damage.

- WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g.*, drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g.*, cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once a day or in accordance with North Carolina laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner.

- 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 damage management devices used by personnel in the field.

- WS' personnel would consider the use of non-lethal methods prior to the use of lethal methods when managing mammal damage.

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 WS program does not expect the alternatives to affect soils, geology, minerals, water quality/quantity, flood plains, wetlands, designated critical habitats, visual resources, air quality, prime/unique farmlands, aquatic resources, timber, and range significantly. Therefore, no further analysis associated with those resources occurs.

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 NCWRC.

Issue 1 - Effects of 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, GonaCon™ (deer only), 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 animals 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 apply those methods at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods generally have minimal impacts on overall populations of animals since those methods do not harm target species. Therefore, 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 animals, another non-lethal method available under the alternatives would be the reproductive inhibitor under the trade name Gonacon™. The reproductive inhibitor Gonacon™ is currently registered for use in North Carolina. 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 NCDACS 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 NCWRC under Alternative 1. Only the NCWRC 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 NCWRC to ensure activities occurred within management objectives for target species. WS would submit annual activity reports to the NCWRC. Therefore, the NCWRC 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 NCWRC 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, gas cartridges (woodchucks, coyotes, fox, skunks only), cable restraints, zinc phosphide (woodchucks only), and the recommendation of harvest during the hunting and/or trapping seasons, where appropriate. 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. In addition, a person experiencing damage could remove target wildlife after seeking and receiving authorization from the NCWRC. People could also seek assistance from the private entities, such as Nuisance Wildlife Control Operators, to manage damage.

WS' personnel and other entities would employ most lethal methods to reduce the number of target animals present at a location since a reduction in the number of target animals 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.

Under Alternative 1 and Alternative 2, WS may recommend that property owners or managers, that request assistance, allow people to harvest certain mammal species 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 NCWRC. 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.

Population and density information specific to North Carolina for many of the target species is not available and is unknown. Frequently, population information is not available for a species and people can calculate conservative estimates 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. The analyses primarily derive the population estimates from available density data for individual species, when available, and their distribution within the State. When density data was available, the analyses based population estimates on those species occupying a certain percentage of the land area within the State. Since information on actual populations and densities was not available for most target species in North Carolina, calculating a statewide population estimate based on a species only occupying a certain

percentage of the land area would likely represent a worst-case scenario since most target species occur statewide throughout the year.

For example, the analysis estimated the statewide population of gray fox based on the species occupying only 50% of the land area within the State. Gray fox occur 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, the analyses evaluated gray fox occupying only 50% of certain land classifications to evaluate potential impacts based on a worst-case scenario and a minimum population estimate.

The analysis of potential impacts on each of the species populations includes the anticipated annual lethal removal by WS, which WS based on previous requests for assistance and in anticipation of additional efforts to manage damage or threats of damage in the future. WS then compared the anticipated number of animals from a species' population that WS could lethally remove annually 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, people can harvest many of the target mammal species 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 (Proposed Action/No 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 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.

American Mink Population Information and Effects Analysis

Mink occur throughout North America, with the exception of the desert southwest and tundra areas (Eagle and Whitman 1987, Larivière 2003). They are shoreline dwellers and their one basic habitat requirement is a suitable permanent water area. This may be a stream, river, pond, marsh, swamp, or lake. Mink often

make their dens in bank burrows, holes, crevices, logjams, and abandoned muskrat houses or beaver lodges. They are active mainly at night and are active year-round except for brief intervals during periods of low temperature or heavy snow (Boggess 1994*a*, Larivière 2003). However, they may adjust hunting times to prey availability (Larivière 2003).

Eagle and Whitman (1987) indicated mink population densities varied spatially based on habitat, and weather, trapping, and intraspecific aggression can influence densities temporally. Generally, populations are most dense in those states and provinces with abundant, stable aquatic habitat. According to harvest statistics, Louisiana populations are most dense in swamps, followed by marshes, and drained bottomlands (Linscombe et al. 1982). In Montana, Mitchell (1961) estimated that 280 mink inhabited a 33-km^2 (12.8 mi^2) area, resulting in a density of one mink per 11.8 ha (29.2 acres). However, the following year, Mitchell (1961) estimated that there were only 109 mink in the area, a density of one mink per 30.3 ha (74.7 acres). Using mink tracks in snow, Marshall (1936), found 0.6 females in one km^2 (1.5/mi^2) of riverbank with a 1:1 sex ratio following heavy trapping in Michigan. Errington (1943) counted one to five mink families occupying a 180-ha (450 acres) marsh in Iowa from 1933 to 1938. In 1939, Errington (1943) found no families in the same marsh. Errington (1943) suggested that over-trapping was responsible for the low numbers, which continued after 1938. Errington (1943) also suggested that intraspecific aggression was responsible for the upper limit of mink inhabiting the marsh.

McCabe (1949) estimated that there were 24 mink on a 445-hectare (1,100 acres) refuge in Wisconsin during 1944, a density of 1 mink per 18.8 hectare (46.3 acres). McCabe (1949) estimated that during the next four years (1945 to 1948) the population ranged from seven to 10 individuals. The estimates derived by McCabe (1949) were inversely related to duration and depth of snow cover, but were poorly related to food supply (rabbits [*Sylvilagus* spp.] and mice [*Peromyscus* spp.]). McCabe (1949) suggested that excessive poaching and heavy trapping on the borders of the refuge caused lower mink numbers following 1944. During a two-year study in Sweden, Gerell (1971) estimated the number of mink present in a 10,000-ha (25,000 acres) area at 11 and 16, respectively, which resulted in a density of one mink per 909 ha (2,245 acres) during the first year of the study and one mink per 625 ha (1,545 acres) in the second year. Along 1.9 km (1.2 miles) of stream in British Columbia, Ritcey and Edwards (1956) caught 11, six, and five mink over three years, respectively, which were similar densities of 1.5 to 3 mink per km (2.5 to 5 mink per mile) found along the coastal shoreline on Vancouver Island reported by Hatler (1976).

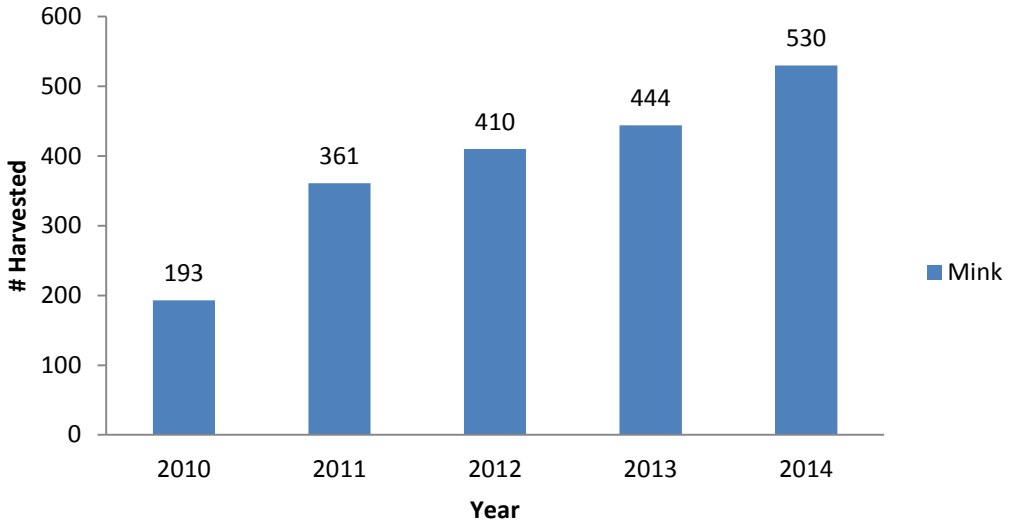
Mink are relatively common throughout North Carolina in areas with aquatic habitats. Densities are likely highest in coastal marshes and swamps, with some speculation that higher densities occur north of Pamlico Sound. Although present, areas in the mountains of western North Carolina have lower densities but can be locally abundant around areas with aquatic habitats (Sumner et al. 2009). The NCWRC classifies mink as a furbearer and allows people to trap mink during an annual trapping season. During the annual trapping season, the NCWRC allows people to trap an unlimited number of mink during the length of the season (NCWRC 2015*a*). The annual statewide fur harvest of mink in North Carolina has ranged between 193 and 530 individuals from the 2010 season to the 2014 season (see Figure 4.1), which is an annual average harvest of 388 mink. In total, trappers have harvested approximately 1,938 mink in the State between the 2010 season and the 2014 season. The number of mink lethally removed by entities other than WS in the State to alleviate damage or threats of damage is unknown.

Between FY 2010 and FY 2014, WS did not receive requests for direct operational assistance associated with mink. In FY 2012, WS' personnel in North Carolina live-captured one mink unintentionally in a cage trap during activities targeting other animals. WS' personnel released the mink unharmed from the cage trap. Although WS did not receive requests for direct operational assistance associated with mink from FY 2010 through FY 2014, WS has received requests for direct operational assistance associated with mink previously. In FY 2008, WS received a request to reduce predation risks occurring to ground-nesting threatened and endangered bird species. During that request for assistance, WS' personnel

lethally removed 27 mink from the project area to reduce predation risks to ground nesting bird species. In addition, WS' personnel could lethally remove mink unintentionally during activities targeting other animal species, primarily activities associated with aquatic rodents.

Based on previous activities conducted by WS and in anticipation of additional efforts, WS' personnel in North Carolina could cumulatively remove up to 50 mink annually in the State, including intentional and unintentional lethal removal. The statewide population of mink is currently unavailable. Therefore, WS calculated a population estimate to provide an indication of the magnitude of lethal removal proposed by WS. There are approximately 5.7 million acres of wetlands in North Carolina (Dahl 1990, Association of State Wetland Managers 2013) along with at least 38,211 miles of rivers and streams in the State (EPA 2012). As was discussed previously, mink are closely associated with aquatic habitats where they forage and den along shorelines of rivers, streams, lakes, and ponds. If only 50% of the 5.7 million acres of wetlands present in the State supported mink and if the population density of mink in the State was one mink per 74.7 acres, the number of mink inhabiting wetlands in the State would be 38,200 mink. If only 50% of the 38,211 miles of rivers and streams in the State supported mink and if the population density of mink were five mink per 1.2 miles of stream, the population inhabiting shoreline could be approximately 79,600 mink. Combining the number of mink inhabiting wetlands and streams, the total statewide mink population could be approximately 117,800 mink. However, the statewide population is likely higher than 117,800 mink.

Figure 4.1 - Number of mink harvested during the trapping season in North Carolina, 2010-2014



If WS' lethal removal of mink reached 50 individuals annually and the mink population remains at least stable, the lethal removal of 50 mink by WS would represent 0.04% of a mink population estimated at 117,800 mink. On average, people have harvested 388 mink per year in the State during the trapping season with a range of harvest from 193 mink to 530 mink. Using the average number of mink harvested per year in the State during the annual harvest season and if WS lethally removed 50 mink annually, the cumulative removal would total 438 mink. The cumulative removal of 438 mink would represent 0.4% of a population estimated at 117,800 mink with the cumulative removal ranging from 0.2% to 0.5% of the estimated population based on previous harvest levels. As stated before, the actual statewide population of mink is likely higher than 117,800 mink; therefore, the cumulative removal would likely be an even smaller percentage of the actual statewide population. Although the actual statewide population of mink

is unknown, the unlimited removal allowed by the NCWRC during the annual trapping season provides an indication that the species is not likely to decline from overharvest, including removal that occurs from damage management activities. Sumner et al. (2009) indicated regulated trapping has little effect on mink populations.

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, wood rats, porcupines, pocket gophers, and woodchucks comprise most of their diet. Bobcats also prey upon opossums, 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. Bobcats 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). Anderson and Lovallo (2003) 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. Nielsen and Woolf (2001) reported the bobcat density in southern Illinois was 0.70 bobcats per square mile (0.27 bobcats per km^2). Bobcats reach densities of approximately four bobcats per square mile (0.4 bobcats per km^2) on some islands in the Gulf Coast of the southeastern United States. Bobcat densities stabilized at 0.8 bobcats per square miles during bobcat reintroduction efforts on an island off the coast of Georgia (Diefenbach et al. 2006). Densities vary from about two per square mile (0.8 bobcats per km^2) in coastal plains to about 0.3 bobcats per square mile (0.1 bobcat per km^2) in portions of the Appalachian foothills. Mid-Atlantic and Midwestern states usually have scarce populations of bobcats (Virchow and Hogeland 1994). 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 are common in suitable habitat and found statewide. Bobcats can occur in a variety of habitats in the State but the wooded habitats of the Coastal Plain region and the mountain region support the highest densities. Bottomland hardwoods, young pine stands, swamps, and wetlands provide excellent habitat for bobcats in eastern North Carolina while mature forests with openings or early successional forests in the mountain region of the state also provide excellent habitat for bobcats (Bryant et al. 2015). Population estimates for bobcats in North Carolina are not currently available; however, Bryant et al. (2015) indicated the population is abundant in the State. Population trend estimates provided by the NCWRC indicate a stable population in North Carolina with local populations showing cyclic increases and decreases every few years (B. Sherrill, NCWRC, pers. comm. 2015). Since population estimates are not available for bobcats, the analysis in this EA will rely on the best available data to calculate a population estimate to analyze potential impacts.

Bobcats are a game species and a furbearing species in North Carolina, with a regulated hunting and trapping season allowing unlimited harvest to occur during those harvest seasons (NCWRC 2015*a*). The number of bobcat pelts tagged by trappers in North Carolina has averaged 1,324 bobcats per year between the 2010 and the 2014 trapping seasons, with the highest level of harvest occurring in 2013 when trappers

harvested 1,484 bobcats in the State (see Table 4.1). In addition, hunters can harvest bobcats in the State during an annual hunting season. Between 2011 and 2014, hunters harvested 13,698 bobcats in the State during the hunting season, which is an average harvest of 3,425 bobcats. The highest hunter harvest occurred in 2013 when hunters harvested 4,591 bobcats during the hunting season.

Table 4.1 – North Carolina bobcat hunting and trapping harvest, 2010 - 2014[‡]

Year	Season		TOTAL
	Hunting	Trapping	
2010	N/A[†]	803	**803**
2011	2,216	1,442	**3,658**
2012	3,451	1,445	**4,896**
2013	4,591	1,484	**6,075**
2014	3,440	1,448	**4,888**
TOTAL	**13,698[*]**	**6,622**	**20,320[*]**

[‡]Hunting and trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[†]Data for the 2010 hunting season is not available

[*]Totals only include hunter harvest from 2011 through 2014

As discussed previously, habitat preferred by bobcats is quite diverse in North Carolina ranging from upland forests to coastal wetlands. The State of North Carolina covers 53,820 square miles with 48,618 square miles being land area (United States Census Bureau 2011). If only 50% of the land area of North Carolina represents suitable bobcat habitat and if bobcat densities in the State averaged one bobcat per square mile, a statewide population could be approximately 24,300 bobcats. However, this estimate would be low given that densities tend to be much higher where quality habitat and prey are available.

Between FY 2010 and FY 2014, WS has removed 10 bobcats in the State during damage management activities, with the highest level of removal occurring in FY 2010 when WS' personnel lethally removed six bobcats. Of the 10 bobcats lethally removed by WS from FY 2010 through FY 2014, WS' personnel killed two bobcats unintentionally during activities targeting other animal species. In addition, one bobcat was live-captured unintentionally during FY 2011 and WS' personnel released the bobcat unharmed. Based on previous activities associated with bobcats and in anticipation of additional efforts to address damage caused by bobcats, the WS program in North Carolina could lethally remove up to 50 bobcats cumulatively per year under the proposed action alternative, including bobcats that personnel could lethally remove unintentionally during activities targeting other animals.

Based on a statewide population estimated at 24,300 bobcats, the removal of up to 50 bobcats would represent 0.2% of the population, if the population remained at least stable. As stated previously, the statewide population of bobcats likely exceeds 24,300 bobcats; therefore, WS' annual lethal removal would represent an even smaller percentage of the actual population. On average, hunters and trappers in the State have harvested 4,879 bobcats per year from 2011 through 2014. Combining WS' highest possible annual removal with the average annual harvest of bobcats in the State would represent 20.3% of the estimated statewide population under a worst-case scenario. The highest annual harvest of bobcats between 2011 and 2014 occurred in 2013 when hunters and trappers harvested 6,075 bobcats in the State. Combining WS' highest possible annual removal and the harvest of 6,075 bobcats would represent 25.2% of the estimated statewide population under a worst-case scenario. Even in the absence of any annual removal by WS, the average annual harvest of bobcats would represent 20.1% of a statewide population estimated at 24,300 bobcats with the highest annual harvest representing 25.0% of the estimated population under a worst-case scenario.

During the annual hunting and the trapping season, the NCWRC allows hunters and trappers to harvest an unlimited number of bobcats during the length of the seasons, which provides some indication that bobcat populations are sufficient to allow unlimited harvest. In addition, the statewide population is likely higher than 24,300 bobcats; therefore, the cumulative removal of bobcats would likely represent an even smaller percentage of the actual statewide population. As stated previously, population trend estimates provided by the NCWRC indicate a general stable population in North Carolina (B. Sherrill, NCWRC, pers. comm. 2015), which also provides an indication that overharvest has not occurred. The lethal removal of bobcats by WS annually would only occur when the NCWRC authorizes the removal and the annual removal would only occur at levels the NCWRC authorizes.

Coyote Population Information and Effects Analysis

Coyotes are a familiar species of 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 (Bekoff and Gese 2003). Color varies greatly; however, 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 (Bekoff and Gese 2003). The size of coyotes varies from about 20 to 40 lbs (9 to 18 kg) (Voigt and Berg 1987). Coyotes often include many items in their diet. Rabbits are one of the most common prey items. Other items in the coyote's diet include carrion, rodents, ungulates (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 kill small domestic pets such as cats and dogs (Voigt and Berg 1987).

Coyotes are highly mobile animals with home ranges (territories) that vary by sex and age of the animal, food abundance, habitat, and season of the year (Pyrah 1984, Bekoff and Gese 2003). Coyote populations are comprised of territorial and non-territorial individuals. Each territory contains a dominant pair, associated subordinates, and pups. Pre-whelping pack size ranges from two to 10 individuals (Gese et al. 1996, Knowlton et al. 1999). 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 study in Texas, 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. Each dominant pair can produce a single litter of four to eight pups (Knowlton 1972, Gese et al. 1996). 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.

Many references indicate that coyotes originally occurred in relatively open habitats, particularly grasslands and sparsely wooded areas of the western United States. The distribution of coyotes in eastern North America began to expand from 1900 to 1920. Now, all eastern states and Canadian provinces have at least a small population of coyotes (Voigt and Berg 1987). Today, coyotes range throughout the United States. 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 et al. 1994).

The coyote is probably the most extensively studied carnivore (Bekoff and Gese 2003), and considerable research has been conducted on population dynamics. 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, Knowlton et al. 1999). The cost to determine absolute coyote densities accurately over large areas is prohibitive (Connolly 1992) and the 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, Knowlton et al. 1999).

Predator abundance indices suggest that densities of coyotes in North America increase from north to south (Knowlton and Stoddart 1985, Parker 1995, Knowlton et al. 1999). Coyote densities can vary considerably between habitat types and vary based on numerous environmental variables. Coyote densities can range from 0.5 coyotes per square mile to six coyotes per square mile (Voigt and Berg 1987, Knowlton et al. 1999, Bekoff and Gese 2003). Knowlton (1972) concluded that coyote densities might approach a high of five to six coyotes per square mile under extremely favorable conditions. Such an estimate is speculative but represents some of 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).

In North Carolina, coyotes were initially introduced during the 1980s in Beaufort County by fox hunters training their dogs (Hill et al. 1987). At the same time, coyotes appeared in western North Carolina by natural migration from bordering states (Hill et al. 1987). Currently, coyotes inhabit all 100 counties of North Carolina. However, actual population estimates and density information for coyotes in North Carolina are not currently available. Coyotes are common throughout the State and inhabit a variety of habitats.

As stated previously, coyote densities can vary considerably between habitat types and vary based on numerous environmental variables. Using the current densities ranges published (Knowlton et al. 1999, Bekoff and Gese 2003), the statewide coyote population could range from 24,300 to 291,700 coyotes based on the land area of the State estimated at 48,618 square miles. The NCWRC classifies coyotes as non-game wildlife in North Carolina with no limits on the number of coyotes that people can lethally remove. In addition, people can lethally remove coyotes using hunting methods throughout the year and people can trap coyotes during annual trapping seasons in the State (NCWRC 2015*a*). Between 2011 and 2014, hunters and trappers harvested 151,725 coyotes in the State, which is an annual average harvest of

37,931 coyotes (see Table 4.2). Despite the annual removal of coyotes, the NCWRC has indicated the coyote population in the State is generally stable with local populations showing increases and decreases every few years (B. Sherrill, NCWRC, pers. comm. 2015). 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). During the development of this document, there was no evidence to suggest that coyote populations were declining rapidly in the State from overharvest.

Table 4.2 – North Carolina coyote harvest and WS' removal, 2010 – 2014‡

Year	Type of Harvest		WS' Removal[1]	TOTAL	WS % of Total
	Hunting	Trapping			
2010	N/A†	2,091	35	-	-
2011	36,041	4,136	21	**40,198**	0.05%
2012	31,662	5,393	17	**37,072**	0.05%
2013	27,151	5,419	29	**32,599**	0.09%
2014	34,972	6,951	60	**41,983**	0.14%

‡Hunting and trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[1]WS' removal is reported by federal fiscal year

†Data for the 2010 hunting season is not available

Between FY 2010 and FY 2014, WS has lethally removed 162 coyotes in the State to alleviate damage or threats, which is an average of 32 coyotes per year. The highest level of lethal removal by WS occurred during FY 2014 when personnel lethally removed 60 coyotes to alleviate damage. WS' personnel also live-captured 34 coyotes intentionally during FY 2011 as part of a research project to determine coyote home ranges and deer depredation. Those coyotes were fitted with radio collars and released under the protocol for the study. In addition, WS' personnel used non-lethal harassment methods to disperse 51 coyotes between FY 2010 and FY 2014. In FY 2010, WS' personnel killed three coyotes unintentionally during activities targeting other animal species. Based on the number of requests for assistance received previously involving coyotes and the number of coyotes addressed previously by WS during damage management activities, the WS program in North Carolina anticipates that personnel could lethally remove up to 500 coyotes annually in the State, including coyotes that personnel may remove unintentionally during activities targeting other animal species. If WS had lethally removed 500 coyotes annually between FY 2011 and FY 2014, WS' annual removal would have represented 1.3% of the harvest of coyotes in the State between 2011 and 2014.

Although exact population estimates for coyotes in North Carolina are not available, the unlimited harvest limits the NCWRC allows for the species indicates the species is not at risk of overharvesting. The highest reported harvest of coyotes in the State occurred in 2014 when people harvested 41,983 coyotes. The lethal removal of up to 500 coyotes by WS would have represented 1.2% of the highest total reported harvest of coyotes. Therefore, WS' removal of coyotes under the proposed action and cumulatively would be of low magnitude when compared to the actual statewide coyote population and the number of coyotes harvested annually.

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, the secretive grey fox is seldom observed in the wild. The gray fox is somewhat smaller in stature than the red fox, having shorter legs and extremities. Gray fox exhibit striking pelage, which has grizzled upper parts resulting from individual guard hairs being 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 from three to seven kg (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 the eastern and southwestern United States along with most of California and western Oregon (Fritzell 1987, Cypher 2003).

Gray fox prefer habitat with dense cover such as thickets, riparian areas, swampland, or rocky pinyon-cedar ridges. In eastern North America, gray fox are closely associated with edges of deciduous forest. They can also occur in urban areas where suitable habitat exists (Phillips and Schmidt 1994, Cypher 2003).

Gray fox mate from January through April and produce litters of one to ten kits after a gestation period of 53 days (Cypher 2003). Gray fox rear young in a maternity den, commonly located in woodpiles, rocky outcrops, hollow trees, or brush piles (Phillips and Schmidt 1994, Cypher 2003). The male parent helps tend to the young but does not stay in the den with them. The young are weaned at three months and hunt for themselves at four months. Rabies and distemper are associated with this species (Cypher 2003).

Accurate estimates of carnivore populations are rare and those for gray fox populations are no exception. Published estimates of gray fox density vary from 1.2 to 2.1 per square kilometer (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 (Follman 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 ha (500 acres), and many exceeded 500 ha (1,235 acres).

Gray fox feed on a wide variety of plant and animal matter and are considered more omnivorous than other North American canids (Fritzell 1987, Cypher 2003). 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 takes refuge in them, especially leaning or thickly branched trees. The gray fox feeds heavily on cottontail rabbits, mice, voles, other small mammals, birds, insect, 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 (Cypher 2003).

Gray fox occur statewide in a variety of habitats. Gray fox are likely most dense in the Piedmont and northern Coastal Plain regions of the State (Olfenbuttel and Sumner 2015). However, information on gray fox densities in North Carolina is also not available. Similarly, the statewide population is unknown.

The NCWRC indicates gray fox populations are stable with local populations showing cyclic trends on a local scale (C. Olfenbuttel, NCWRC, pers. comm. 2015). If gray fox only occupied 50% of the land area of North Carolina and the density of gray fox in the State was 3.1 gray fox per square mile, the statewide population could be approximately 75,400 gray fox. Gray fox occur 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 occur statewide. However, similar to the other furbearing species, the analysis only considered gray fox occupying 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.

Gray fox are game animals in the State with restrictions on where people can harvest fox, restrictions on what methods people can use, and in some cases, with daily and possession limits in place. The harvest of fox during hunting and trapping seasons is based on numerous "*local laws*" which can apply only to one county, to several counties, or could vary within a county (NCWRC 2015*c*). In addition, some counties prohibit the harvest of fox (NCWRC 2015*c*). Table 4.3 shows the number of fox that people harvested in the State between the 2010 and 2014 hunting and trapping seasons. The hunter harvest data published by the NCWRC does not separate the fox harvest by species; therefore, the hunter harvest data presented in Table 4.3 is a combination of red fox and gray fox.

Table 4.3 – North Carolina fox harvest and WS' removal, 2010 – 2014‡

Year	Type of Harvest		WS' Removal[2]	TOTAL	WS % of Total[3]
	Hunting[1]	Trapping			
2010	N/A†	3,313	16	**-**	-
2011	7,416	5,809	2	**13,227**	0.02%
2012	5,335	7,209	8	**12,552**	0.06%
2013	5,335	6,827	7	**12,169**	0.06%
2014	5,547	6,410	6	**11,963**	0.05%

‡Hunting and trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[1]Data for the hunting season is a combination of red fox and gray fox; data specifically for gray fox is not available

[2]WS' removal is reported by federal fiscal year

[3]Percentage based on all fox harvested during the hunting season being gray fox

†Data for the 2010 hunting season is not available

Between the 2010 and 2014 trapping seasons, trappers harvested 29,568 gray fox in the State, which is an annual average harvest of 5,914 gray fox. Between the 2011 and 2014 hunting seasons, hunters harvested 23,633 fox (both red fox and gray fox) in the State, which is an average annual harvest of 5,908 fox. The actual number of gray fox harvested by hunters in the State is unknown. During the trapping season between 2011 and 2014, trappers harvested nearly four gray fox for every red fox harvested. If a similar harvest ratio occurred during the hunting season, hunters harvested approximately 17,700 gray fox in the state between 2011 and 2014. Therefore, hunters and trappers removed approximately 44,000 gray fox in the State between 2011 and 2014, which is an average annual harvest of 11,000 gray fox.

In addition, the NCWRC can allow entities to remove gray fox lethally when those fox are causing damage or posing a threat to the safety of people. Between 2003 and 2010, entities lethally removed an average of 144 fox (both gray and red fox) per year to alleviate damage under authorizations issued by the NCWRC with the highest annual removal occurring in 2003 when entities lethally removed 289 fox (NCWRC 2012*b*). Similar to the hunter harvest data, the data published by the NCWRC (2012*b*) on fox removal to alleviate damage does not separate the removal of fox by species; therefore, the data presented is a combination of red fox and gray fox.

Between FY 2010 and FY 2014, the WS program in North Carolina lethally removed 39 gray fox. In addition, WS dispersed three gray fox using non-lethal methods between FY 2010 and FY 2014. One gray fox was live-captured in a cage trap intentionally and released unharmed between FY 2010 and FY 2014. If hunters and trappers harvested 44,000 gray fox in the State between 2011 and 2014, WS' removal of 39 gray fox would represent 0.1% of the harvest. Based on the number of gray fox lethally removed by WS previously and in anticipation of receiving additional requests to lethally remove gray fox, WS anticipates that up to 100 gray fox could be lethally removed annually by WS in the State, including gray fox that may be lethally removed unintentionally by WS' personnel during activities targeting other animals.

Using a statewide population estimated at 75,400 fox, the lethal removal of 100 gray fox by WS would represent 0.1% of the population. If the average number of gray fox harvested annually and the average number of fox removed to alleviate damage was representative of future removal levels, the cumulative annual removal of gray fox would be 11,244 gray fox. The cumulative removal would include WS' removal of up to 100 gray fox, 144 fox to alleviate damage (if all fox removed were gray fox), and the harvest of 11,000 gray fox annually. The cumulative removal of 11,244 gray fox would represent 14.9% of a statewide population estimated at 75,400 gray fox. Olfenbuttel and Sumner (2015) stated, "*Regulated hunting and trapping activities do not appear to affect overall mortality in gray fox populations. Foxes reproduce well and are able to disperse annually into areas where they have been harvested*." Like other mammal species addressed in this EA, the NCWRC must authorize the removal of gray fox to alleviate damage; therefore, WS would only lethally remove gray fox to alleviate damage after receiving authorization from the NCWRC and lethal removal by WS would only reach levels authorized by the NCWRC.

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 (Cypher 2003). 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, Cypher 2003).

In North America, the red fox weighs from 3.5 kg to 7 kg (7.7 to 15.4 lbs), with males averaging about 1 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 as large as adults (Voigt 1987). They occur over most of North America, north and east from southern California, Arizona, and central Texas. 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, but were plentiful in many parts of Canada. However, it has been suggested that climatic factors, interbreeding with the introduced European red fox, extirpation of the wolves, and clearing of land for agriculture has possibly contributed to the present-day expansion and range of this species in North America (Voigt 1987, Cypher 2003).

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 December to April and produce litters of one to 12 kits after a gestation period of 51 to 54 days. They rear young in a maternity den, commonly an enlarged woodchuck or badger den, usually in sparse ground cover on a slight rise, with a good view of all approaches (Cypher 2003). 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 their first year (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. 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 (Cypher 2003).

The red fox is a skilled nonspecific predator, foraging on a variety of prey. Red fox are 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 killed (Phillips and Schmidt 1994).

The density of red fox populations is difficult to determine because of the animals secretive and elusive nature. 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, Cypher 2003). In Great Britain, where food is abundant in many urban areas, densities as high as 30 fox per square kilometer (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 square kilometer (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.

Home ranges for red fox in the eastern United States are usually from 500 to 2,000 hectares (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.

Red fox can be found statewide in North Carolina in a variety of habitats across the State. Olfenbuttel et al. (2015) considered the red fox population in the State to be stable. However, information on red fox densities in North Carolina is not available. Similarly, the statewide population is unknown. If red fox only occupied 50% of the land area of North Carolina and the density of red fox in the State was 2.6 red fox per square mile, the statewide population could be approximately 63,200 red fox. Red fox occur in a variety of habitats, including urban areas, so red fox occupying only 50% of the land area of the State is unlikely since fox occur statewide. However, similar to the other furbearing species, the analysis only considered red fox occupying 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.

Similar to gray fox, red fox are game animals in the State with restrictions on where people can harvest fox, restrictions on what methods people can use, and in some cases, with daily and possession limits in place. Like gray fox, the harvest of red fox during hunting and trapping seasons is based on numerous "*local laws*", which can apply only to one county, to several counties, could vary within a county, or in some counties, could be prohibited (NCWRC 2015*c*). Table 4.4 shows the number of fox that people harvested in the State between the 2010 and 2014 hunting and trapping seasons. The hunter harvest data published by the NCWRC does not separate the fox harvest by species; therefore, the hunter harvest data presented in Table 4.4 is a combination of red fox and gray fox.

Table 4.4 – North Carolina fox harvest and WS' removal, 2010 – 2014‡

Year	Type of Harvest		WS' Removal[2]	TOTAL	WS % of Total[3]
	Hunting[1]	Trapping			
2010	N/A†	769	5	**774**	0.7%
2011	7,416	1,271	1	**8,688**	0.01%
2012	5,335	1,682	0	**7,017**	-
2013	5,335	1,768	19	**7,122**	0.3%
2014	5,547	2,186	2	**7,735**	0.03%

‡Hunting and trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[1]Data for the hunting season is a combination of red fox and gray fox; data specifically for red fox is not available

[2]WS' removal is reported by federal fiscal year

[3]Percentage based on all fox harvested during the hunting season being red fox

†Data for the 2010 hunting season is not available

Between the 2010 and 2014 trapping seasons, trappers harvested 7,676 red fox in the State, which is an annual average harvest of 1,535 red fox. Between the 2011 and 2014 hunting seasons, hunters harvested 23,633 fox (both red fox and gray fox) in the State, which is an average annual harvest of 5,908 fox. The actual number of red fox harvested by hunters in the State is unknown. During the trapping season between 2011 and 2014, trappers harvested nearly four gray fox for every red fox harvested. If a similar harvest ratio occurred during the hunting season, hunters harvested approximately 5,900 red fox in the state between 2011 and 2014. Therefore, hunters and trappers removed approximately 13,600 red fox in the State between 2011 and 2014, which is an average annual harvest of 3,400 red fox.

In addition, the NCWRC can allow entities to remove red fox lethally when those fox are causing damage or posing a threat to the safety of people. Between 2003 and 2010, entities lethally removed an average of 144 fox (both gray and red fox) per year to alleviate damage under authorizations issued by the NCWRC with the highest annual removal occurring in 2003 when entities lethally removed 289 fox (NCWRC 2012*b*). Similar to the hunter harvest data, the data published by the NCWRC (2012*b*) on fox removal to alleviate damage does not separate the removal of fox by species; therefore, the data presented is a combination of red fox and gray fox.

Between FY 2010 and FY 2014, the WS program in North Carolina lethally removed 27 red fox, including one red fox that personnel lethally removed unintentionally during activities targeting other animals. In addition, WS dispersed one red fox intentionally using non-lethal methods between FY 2010 and FY 2014. Between FY 2010 and FY 2014, two red fox were live-captured in a foothold trap unintentionally but WS' personnel released those fox unharmed. If hunters and trappers harvested 13,600 red fox in the State between 2011 and 2014, WS' removal of 27 red fox would represent 0.2% of the harvest. Based on the number of red fox lethally removed by WS previously and in anticipation of receiving additional requests to lethally remove red fox, WS anticipates that up to 100 red fox could be lethally removed annually in the State under this alternative, including red fox that may be lethally removed unintentionally by WS' personnel during activities targeting other animals.

Using a statewide population estimated at 63,200 fox, the lethal removal of 100 red fox by WS would represent 0.2% of the population. If the average number of red fox harvested annually and the average number of fox removed to alleviate damage was representative of future removal levels, the cumulative annual removal of red fox would be 3,644 red fox. The cumulative removal would include WS' removal of 100 red fox, 144 fox to alleviate damage (if all fox removed were red fox), and the harvest of 3,400 red fox annually. The cumulative removal of 3,644 red fox would represent 5.8% of a statewide population estimated at 63,200 red fox. Like other mammal species addressed in this EA, the NCWRC must authorize the removal of red fox to alleviate damage; therefore, WS would only lethally remove red fox to alleviate damage after receiving authorization from the NCWRC and lethal removal by WS would only reach levels authorized by the NCWRC.

Raccoon Population Information and Effects Analysis

The raccoon is a stocky mammal ranging from 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*b*). 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 also eat most foods prepared for human or animal consumption (Sanderson 1987). They occasionally kill poultry (Boggess 1994*b*).

The raccoon is found 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*a*, Gehrt 2003). Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains (Boggess 1994*b*), and are frequently found in cities or suburbs as well as rural areas (Gehrt 2003). 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. A raccoons home range generally ranges in size from 50 hectares to 300 hectares (123 acres to 741 acres) (Gehrt 2003).

Absolute raccoon population densities are difficult or impossible to determine because of the difficulty in knowing what percentage of the population someone has already counted or estimated. In addition, it can be difficult to determine how large an area the raccoons are using (Sanderson 1987). Due to their adaptability, raccoon densities reach higher levels in urban areas than that of rural areas. People have inferred relative raccoon population densities that they based on removal of animals per unit area. For example, Twichell and Dill (1949) reported removing 100 raccoons from tree dens in a 41-hectare (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 1938-39, 170 in 1939-1940, and 60 in 1940-1941. Slate (1980) estimated one raccoon per 7.8 hectares (19.3 acres) in predominantly agricultural land on the inner coastal plain of New Jersey. Kennedy et al. (1991) estimated 13 raccoons per 100 ha (1 raccoon per 19 acres) of lowland forest in Tennessee. Around abundant food sources, Kern (2002) found raccoon densities could reach 100 raccoons per square mile (1 raccoon per 6.4 acres). Riley et al. (1998) summarized rural raccoon densities based on published literature that ranged from 2 to 650 per square mile in rural habitats, with an average of 10 to 80 raccoons per square mile.

In North Carolina, raccoons can cause damage to gardens, residential and non-residential buildings, fish, domestic fowl, and pets, as well as general property damage. 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*b*).

The public are also concerned about health and safety issues associated with raccoons, primarily associated with the risk of disease transmission. Those diseases include, but are not limited to, canine distemper and rabies, and the roundworm *Baylisascaris procyonis*, the eggs of which survive for extremely long periods in raccoon feces and soil contaminated by them. Ingestion of those eggs can result in serious or fatal infections in other animals as well as people (Davidson 2006) (see Table 1.3).

The statewide population of raccoons in North Carolina is currently unknown but the population is generally stable with cyclic population changes occurring in local populations, likely due to canine distemper outbreaks (C. Olfenbuttel, NCWRC, pers. comm. 2015). Raccoons can be found throughout the State and thrive in a variety of habitats including rural, suburban, and urban areas. Using the average of 10 to 80 raccoon per square mile reported by Riley et al. (1998), the statewide population could range from 243,100 to 1.9 million raccoons if raccoons only inhabited 50% of the land area in the State. Similar to estimates derived for the other mammal species in this EA, estimating that raccoons inhabit only 50% of the land area of the State designates a minimum population estimate to compare the potential range of WS' proposed removal of raccoons and to determine the magnitude of WS' proposed lethal removal.

WS continues to provide assistance in efforts to contain the spread of raccoon rabies in North Carolina. Those activities are part of the national rabies barrier program addressed under separate environmental analyses (USDA 2009*a*). Other rabies monitoring or control activities may occur as part of this program. An evaluation of the raccoons killed under the ORV program occurs in a separate EA (USDA 2009*a*) but is included in this EA for cumulative impact analysis.

Raccoons are a furbearing and a game species in North Carolina with a regulated annual hunting and trapping season with unlimited harvest allowed during the length of those seasons (NCWRC 2015*a*). During the annual hunting season for raccoons, people can harvest up to three raccoons daily with no limit on the number that people can possess during the length of the season. During the development of this EA, there were no limits on the number of raccoons that people could trap daily or in possession during the annual trapping season in the State. Table 4.5 shows the number of raccoons reported as harvested in the State from 2010 through 2014. As with other furbearing species, people can also lethally remove raccoons to alleviate damage or threats of damage when authorized by the NCWRC. The current number of raccoons lethally removed by other entities for damage management purposes from July 1, 2009 through June 30, 2014 in the State to alleviate damage or threats of damage is 6,701 raccoons (C. Olfenbuttel, NCWRC, pers. comm. 2015), which is an average removal of 1,340 raccoons annually. The total lethal removal of raccoons to alleviate damage in the State for the 2013-2014 reporting period was 1,618 raccoons (C. Olfenbuttel, NCWRC, pers. comm. 2015), which includes raccoons lethally removed by WS to alleviate damage.

Of the 107 raccoons lethally removed by WS from FY 2010 through FY 2014, WS removed 56 raccoons unintentionally during other damage management activities, primarily activities to alleviate damage associated with aquatic rodents. In addition, WS' personnel live-captured nine raccoons unintentionally between FY 2010 and FY 2014 and personnel released those raccoons unharmed. WS also live-captured 591 raccoons intentionally between FY 2010 and FY 2014 and released those raccoons unharmed. WS' annual removal of raccoons during all projects from FY 2011 through FY 2014 never exceeded 0.03% of the annual reported harvest for the corresponding year (see Table 4.5). The average number of raccoons reported harvested in the State during the annual hunting and trapping seasons from 2011 through 2014 is 92,506 raccoons per year.

Based on previous requests for assistance received by WS to alleviate damage and in anticipation of additional efforts to manage damage, up to 1,000 raccoons could be lethally removed by WS annually under all damage management activities, including unintentional removal during other damage

management activities. 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. However, if raccoons were visibly injured or exhibited signs of disease, WS' personnel may euthanize those raccoons. The number of raccoons lethally removed in the State during the post-baiting trapping varies, but is not likely to exceed 100 individuals (USDA 2009*a*). Under the proposed action alternative, WS' anticipated annual removal of raccoons includes those raccoons that personnel could euthanize as part of the program to prevent the further spread of rabies.

Table 4.5 – North Carolina raccoon harvest and WS' removal, 2010 – 2014‡

Year	Type of Harvest		WS' Removal[1]	TOTAL	WS % of Total
	Hunting	Trapping			
2010	N/A†	5,442	20	**5,462**	0.4%
2011	72,727	10,169	14	**82,910**	0.02%
2012	92,104	14,991	32	**107,127**	0.03%
2013	70,854	16,827	23	**87,704**	0.03%
2014	69,278	23,075	18	**92,371**	0.02%

‡Hunting and trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[1]WS' removal is reported by federal fiscal year

†Data for the 2010 hunting season is not available

Using the lowest population estimate of 243,100 raccoons in the State, the lethal removal of 1,000 raccoons would represent 0.4% of the population. People have harvested approximately 92,506 raccoons per year between 2011 and 2014, with the highest annual harvest occurring in 2012 when people harvested 107,127 raccoons. If the average number of raccoons harvested annually and the average number of raccoons lethally removed annually to alleviate damage was representative of future harvest levels, the cumulative removal of raccoons would represent 39.0% of a statewide population estimated at 243,100 raccoons. The cumulative removal of raccoons would include WS' potential removal of 1,000 raccoons annually, the removal of 1,340 raccoons by other entities to alleviate damage annually, and the harvest of 92,506 raccoons annually. If the statewide population of raccoons was 1.9 million, the cumulative removed would represent 5.0% of the statewide population. If WS lethally removed 1,000 raccoons and the annual harvest reached 107,127 raccoons along with the lethal removal of 1,340 raccoons by other entities to alleviate damage, the cumulative removal would range between 5.8% and 45.0% of a statewide population ranging from 243,100 raccoons to 1.9 million raccoons. If WS' annual lethally removal had reached 1,000 raccoons in the State from FY 2011 and FY 2014, the annual removal would have represent 0.9% to 1.2% of the corresponding annual harvest of raccoons in the State. Therefore, WS' annual removal, if removal reached 1,000 raccoons annually between FY 2011 and FY 2014, would be a very low percentage of the annual harvest of raccoons in the State. WS anticipates the annual removal of raccoons by the program would continue to be a low percentage of the statewide harvest of raccoons.

Raccoon populations can remain relatively abundant if annual harvest levels are below 49% (Sanderson 1987). In addition, the statewide population is likely more than 1.9 million raccoons; therefore, annual removal is likely a lower percentage of the actual statewide population. As with many of the other mammals species harvested for fur in the State, the unlimited harvest levels allowed by the NCWRC during the length of the hunting and trapping seasons provides an indication that cumulative removal, including removal for damage management, would not reach a level where overharvest of the raccoon population would occur. Despite previous levels of harvest and removal for damage management, the population continues to be generally stable. The NCWRC has regulatory authority over the management of wildlife within the State, including raccoons, and all removal by WS has occurred and would continue

to occur only after the NCWRC authorized the removal and WS' removal would only occur at levels the NCWRC authorized. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of raccoons annually would have no effect on the ability of those persons interested to harvest raccoons during the regulated harvest season.

Virginia Opossum Population Information and Effects Analysis

Opossums are the only marsupials (*i.e*., possess a pouch in which young are reared) found north of Mexico (Seidensticker et al. 1987, Gardner and Sunquist 2003). They occur over most of the eastern and central United States with scattered occurrences across parts of the western United States, primarily around urbanization areas (Gardner and Sunquist 2003). They also occur in the western portions of California, Oregon, and Washington (Gardner and Sunquist 2003). 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 have a fairly broad range of pelage colors, but are usually considered as "*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 its diet. In addition, opossum eat insects, frogs, birds, snakes, small mammals, earthworms, corn, berries, and other fruits, such as persimmons and apples (Gardner and Sunquist 2003). They use a home range of 4 to 20 hectares (10 to 50 acres), foraging throughout this area frequently (Jackson 1994*a*), but concentrating on a few sites where fruits abound, when they are in season (Seidensticker et al. 1987, Gardner and Sunquist 2003).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude (Gardner 1982, Gardner and Sunquist 2003). Gestation is short (average of 12.8 days) with 1 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, Gardner and Sunquist 2003). Those young remain in the pouch for about two months. After two months, the young begin to explore 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 that five-year study, Seidensticker et al. (1987) noted there was a wide variation in opossum numbers, in what they considered 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 of 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 North Carolina in appropriate habitat. Population trends show a stable to slightly increasing population especially in urban areas (C. Olfenbuttel, NCWRC, pers. comm. 2015). Population estimates and density information for opossum in the State are not available. Therefore, a population estimate will be derived 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. The land area of North Carolina covers approximately 48,618 square miles. If opossum only occurred on 50% of the land area using a mean density of 10.1 opossum per square mile found by Seidensticker et al. (1987) in Virginia, the estimated population would be 245,500 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 the land area of the State being occupied by opossum, the statewide population would range from a low of 31,600 opossum to a high of nearly 491,000 opossum. Opossums can occur in a variety of habitats, including urban areas, so opossum occupying only 50% of the land area of the State would be unlikely, since opossum can occur almost statewide.

Opossums are a game and furbearing species in the State and people can harvest opossum during annual hunting and trapping seasons (NCWRC 2015*a*). During the development of the EA, hunters and trappers could harvest opossums during the open seasons with no limit on the number of opossum that people could harvest during those seasons. In addition, people can lethally remove opossums when causing damage or posing a threat of damage when authorized by the NCWRC. As shown in Table 4.6, trappers have harvested an estimated 44,842 opossum in the State between the 2010 and 2014 trapping seasons. The number of opossum harvested by hunters during the annual hunting season is unknown in the State.

The current number of opossum lethally removed by other entities for damage management purposes from July 1, 2009 through June 30, 2014 in the State to alleviate damage or threats of damage is 3,532 opossum (C. Olfenbuttel, NCWRC, pers. comm. 2015), which is an annual removal of 706 opossum. The total removal of opossum to alleviate damage or threats for the 2013-2014 reporting period was 863 opossum (C. Olfenbuttel, NCWRC, pers. comm. 2015), which includes the number of opossum that WS lethally removed to alleviate damage.

Table 4.6 – North Carolina Virginia opossum trapping harvest and WS' removal, 2010 – 2014‡

Year	Trapping Harvest	WS' Removal[1]	TOTAL	WS % of Total
2010	3,841	8	**3,849**	0.2%
2011	7,568	2	**7,570**	0.03%
2012	9,483	0	**9,483**	-
2013	12,320	3	**12,323**	0.02%
2014	11,630	13	**11,643**	0.1%

‡Trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[1]WS' removal is reported by federal fiscal year

During activities conducted by WS in the State, WS has lethally removed 26 opossum and live-captured and released 132 opossum intentionally from FY 2010 through FY 2014. Of the 26 opossum that WS removed from FY 2010 through FY 2014, personnel removed one opossum unintentionally during damage management activities targeting other animals. WS has also live-captured 190 opossum unintentionally during activities targeting other animals but WS released those opossum unharmed, primarily activities targeting raccoons for rabies surveillance activities. Based on previous requests for assistance received by WS and in anticipation of additional requests for assistance, WS could lethally remove up to 50 opossum annually in the State, including opossum that personnel could lethally remove unintentionally during activities targeting other animals. The lethal removal of 50 opossum by WS annually would represent 0.02% of a statewide population estimated at 245,500 opossum if the overall population remains at least stable.

Between the 2010 and the 2014 trapping seasons, trappers harvested an average of 8,968 opossum in the State. Combining the average harvest of 8,968 opossum by trappers, the average removal of 706 opossum to alleviate damage, and the anticipated annual removal by WS of 50 opossum would represent 4.0% of a statewide population of 245,500 opossum. Combining the highest annual harvest of opossum that occurred during the trapping season in 2013 with WS' anticipated annual removal of up to 50 opossum and the average annual removal of opossum to alleviate damage would represent a cumulative removal of 5.3% of the population. Since the statewide population of opossum likely exceeds 245,500 opossums, the cumulative removal likely represents a much smaller percentage of the actual population.

The NCWRC allows people to harvest an unlimited number of opossum during the annual hunting and trapping season in the State, which provides an indication the population of opossum is not likely to decline from overharvest. The authorizing of the lethal removal by the NCWRC ensures cumulative

removal would occur within population objectives established by the NCWRC. Although the number of opossum lethally removed in the State during the annual hunting season is unknown, the cumulative removal of opossum, including the proposed removal of up to 50 opossum annually by WS, would be of a low magnitude when compared to the actual statewide opossum population. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of opossum annually would have no effect on the ability of those persons interested to harvest opossum during the regulated harvest season.

Striped Skunk Population Information and Effects Analysis

Although easily recognized by their black and white fur, the striped skunk may be most readily recognized by the odiferous smell of their musk. They are common throughout the United States and Canada (Rosatte 1987, Rosatte and Larivière 2003). Striped skunks are primarily nocturnal and do not have a true hibernation period, although during extremely cold weather skunks may become temporarily dormant. The striped skunk is an omnivore, feeding heavily on insects, such as grasshoppers, crickets, beetles, bees, and wasp (Rosatte and Larivière 2003). The diet of the striped skunk also includes small mammals and the eggs of ground-nesting birds and amphibians. Striped skunks are typically non-aggressive and they will attempt to flee when approached by people (Rosatte 1987). However, when provoked, skunks will give a warning and assume a defensive posture prior to discharging their foul-smelling musk. This musk is comprised of sulfur-alcohol compounds known as butylmercaptan (Rosatte and Larivière 2003).

Adult skunks begin breeding in mid-February through mid-April. Yearling females (born in the preceding year) mate in late March. Gestation usually lasts about 59 to 77 days. Litters commonly consist of five to seven young with two litters per year possible (Rosatte and Lariviere 2003). The home range of striped skunks is usually not consistent. Home ranges appear to be reliant upon life history requirements, such as winter denning, feeding activities, dispersal, and parturition (Rosatte 1987). According to Chamberlain and Leopold (2001), very little information regarding striped skunk densities in the southeast exists except densities based on harvest numbers and trapper/hunter observations. During the breeding season, males may travel larger areas in search of females. Skunk densities vary widely according to season, food sources, and geographic area. Densities may range from one skunk per 77 acres to one per 10 acres (Rosatte 1987).

Population estimates and density information for striped skunks in North Carolina are currently not available. Striped skunks occur in a variety of habitats across the State. If skunks only inhabit 50% of the land area of the State and densities occurred at one skunk per 77 acres, the statewide population could be approximately 202,000 skunks based on the land area of the State. Similar to other furbearing species, skunks occur throughout the State and the intent of the estimate is to evaluate the magnitude of lethal removal proposed under the proposed action under a worst-case scenario. The statewide population of skunks is likely higher than 202,000 skunks. Populations of striped skunks are likely stable in most areas and increasing in other areas, primarily urban areas (C. Olfenbuttel, NCWRC, pers. comm. 2015).

People can lethally remove skunks using weapons and archery equipment throughout the year in the State with no limit on the number of skunks that people can remove. In addition, people can trap skunks during an annual season that places no limit on the number of skunks that people can harvest daily and no limit on the number of skunks that people can possess throughout the trapping season. Table 4.7 shows the reported number of skunks harvested during the annual trapping seasons in the State. Other entities besides WS also likely lethally remove skunks to alleviate damage or threats of damage; however, the number of skunks lethally removed annually in the State to alleviate damage or threats of damage is currently unknown and Table 4.7 does not include removal reported by other entities to alleviate damage or threats of damage.

As shown in Table 4.7, the WS program in North Carolina has lethally removed 18 striped skunks to alleviate damage or threats of damage in the State between FY 2010 and FY 2014. The highest annual removal by WS occurred during FY 2014 when personnel removed 14 striped skunks in the State. Based on previous requests for assistance received by WS to alleviate damage and in anticipation of receiving additional requests for assistance with managing damage, personnel could lethally remove up to 200 skunks annually, when requested, including skunks that personnel could lethally remove unintentionally during other damage management activities.

Using the lowest population estimate of 202,000 skunks, the lethal removal of 200 skunks would represent 0.1% of the estimated statewide population. People have harvested at least 3,647 striped skunks in the State between the 2010 and the 2014 harvest seasons, which is an average of 729 skunks harvested annually. The actual harvest level is unknown since people can lethally remove skunks throughout the year in the State. The highest harvest level occurred during 2014 harvest season when people reported harvesting 1,163 skunks. If WS had lethally removed 200 skunks during the 2014 harvest season, the cumulative removal would have represented 0.7% of the statewide population estimated at 202,000 skunks. Combining the average annual harvest of 729 skunks in the State with WS' potential removal of 200 skunks annually, the cumulative removal would represent 0.5% of the lowest population estimate in the State.

Table 4.7 – North Carolina striped skunk trapping harvest and WS' removal, 2010 – 2014‡

Year	Trapping Harvest	WS' Removal[1]	TOTAL	WS % of Total
2010	324	0	**324**	-
2011	599	0	**599**	-
2012	779	3	**782**	0.4%
2013	782	1	**783**	0.1%
2014	1,163	14	**1,177**	1.2%

‡Trapping data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[1]WS' removal is reported by federal fiscal year

The NCWRC allows people to remove skunks using weapons and archery equipment at any time throughout the year. In addition, the NCWRC places no limits on the number of skunks that people can harvest during the annual trapping season in the State. As with many of the mammal species addressed in this document, the unlimited removal allowed by the NCWRC provides an indication that annual removal is not likely to reach a level where overharvest would occur. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of skunks annually would have no effect on the ability of those persons interested to harvest skunks during the regulated harvest season.

Feral Cat Population Information and Effects Analysis

Feral cats are domesticated cats living in the wild. Free-ranging cats are those cats that belong to, possessed, or otherwise owned by a person, but are allowed the ability to wander freely within the environment. In general, most feral cats 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). Other cats that are not considered feral, but may be considered free-ranging are capable of attaining much higher weights.

Feral cats are typically 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 square kilometers (1.5 mi^2). After several generations, feral cats can be considered to be totally wild in habits and temperament (Fitzwater 1994).

Where it has been documented, the impact of feral and free ranging 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 may 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 and they are 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. Feral cats can transmit all of those diseases 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, indoor cats may transmit the virus to indoor cats through indirect routes, such as on shoes (Berthier et al. 2000, Truyen et al. 2009). Feral cats serve as a reservoir for human and animal diseases, including cat scratch fever, distemper, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various parasites (Fitzwater 1994).

The statewide population of feral cats in North Carolina is unknown. Many wildlife biologists and ornithologists consider feral cats 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 provide some benefit to the natural environment by eliminating predation and competition from an introduced species.

WS killed ten feral cats in North Carolina from FY 2010 through FY 2014. WS' personnel also dispersed two feral cats using non-lethal methods. In addition, WS' personnel live-captured and released 13 feral cats in the State between FY 2010 and FY 2014. Requests for assistance received by WS involving feral cats have primarily been associated with human safety threats that cats can pose and damage to property.

During activities that targeted other animals, WS live-captured 34 feral cats unintentionally between FY 2010 and FY 2014 but released those cats unharmed or relinquished those cats to a local animal control facility. Those feral cats were primarily live-captured unintentionally during activities targeting raccoons for the rabies surveillance program.

In most cases, WS would employ live-capture methods to alleviate damage or threats of damage associated with feral cats. Once live-captured, WS could 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. In anticipation of WS receiving requests to remove feral cats lethally, WS could remove up to 100 feral cats annually to address 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 100 cats annually.

Based upon the above information, WS' limited lethal removal of feral cats would have minimal effects on local or statewide populations in North Carolina. Any damage management activities involving the use of lethal or non-lethal methods by WS would be restricted to isolated individual sites. Removal by WS using non-lethal or lethal methods could temporarily reduce some local populations of feral cats because of WS' activities aimed at reducing damage at a local site. In those cases where feral cats were causing damage or where feral cats were a nuisance and complete removal of a local population occurred, the removal could provide some benefit since feral cats are not part of the native ecosystem.

Feral Dog Population Information and Effects Analysis

Like domestic dogs, feral dogs (sometimes referred to as wild or free-ranging 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 could not be classified 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 and coyotes. Travel routes to and from the gathering or den sites may be well defined. Food scraps and other evidence of concentrated activity may be observed 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 those 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 be correspondingly varied, unlike the tracks of a group of coyotes (Green and Gipson 1994).

Feral dogs may occur wherever people are present and permit 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 and are probably 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 square kilometers (50 mi^2) or more (Green and Gipson 1994).

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

Like coyotes, feral dogs are best described as 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, 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 has been documented, even in areas with harsh winter weather. Gipson (1983) found that only one female in a pack of feral dogs studied in Alaska gave birth during two years of study, even though other adult females were present in the pack. The breeding female gave birth during late September or early October during both years. It is noteworthy that all pups from both litters had similar color markings, suggesting that the pups had the same father. Adult males of different colors were present in the pack. Nesbitt (1975) commented on the rigid social organization of a pack of feral dogs where nonresident dogs were excluded, including females in estrus. In one instance, Nesbitt (1975) used three separate female dogs in estrus as bait (dogs were chained in the back of a corral-type trap) over a 59-day period and captured no feral dogs. Nesbitt (1975) then baited the same trap with carrion, and a pack of feral dogs, including four adult males, entered the trap within one week.

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).

When receiving requests for assistance associated with feral and free-ranging dogs, the WS program in North Carolina would follow WS Directive 2.340. 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. 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.

From FY 2010 through FY 2014, WS lethally removed four feral dogs during damage management activities in North Carolina. WS live-captured 13 feral dogs intentionally between FY 2010 and FY 2014 and released those dogs unharmed. In addition, the WS program dispersed 16 feral dogs between FY 2010 and FY 2014 to alleviate damage. Feral dogs and free-ranging dogs may also be live-captured or killed by WS' personnel unintentionally during activities targeting other animals. Between FY 2010 and FY 2014, WS' personnel live-captured seven feral dogs unintentionally during activities targeting other animals but released those dogs unharmed.

Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 100 feral dogs per year under the proposed action alternative. 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 100 dogs annually.

Based upon the above information, WS' limited lethal removal of feral dogs would have minimal effects on local or statewide populations in North Carolina. Any damage management activities involving the use of lethal or non-lethal methods by WS would be restricted to isolated individual sites. Removal by WS using non-lethal or lethal methods could temporarily reduce some local populations of feral dogs because of WS' activities aimed at reducing damage at a local site. In those cases where feral dogs were causing damage or where feral dogs were a nuisance and complete removal of a local population occurred, the removal could provide some benefit since feral dogs are not part of the native ecosystem.

Gray Squirrel Population Information and Effects Analysis

Eastern gray squirrels are variable in color with a distinct reddish cast to their gray coat. The black color phase is common in some northern parts of their range. Gray squirrels are found throughout most of the eastern United States, including North Carolina. They inhabit mixed hardwood forests, especially those containing nut trees such as oak/hickory mix. While this species are referred to 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. Nuts are often cached for later use. In late winter and early spring, they prefer tree buds. In summer, they eat fruits, berries, and succulent plant materials. Fungi, corn, and cultivated fruits are taken 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*b*).

Gray squirrels generally produce young in early spring and summer but may actually produce young at any time (Edwards et al. 2003). Older adults may produce two litters per year (Jackson 1994*b*, Edwards et al. 2003). The gestation period is 42 to 45 days and two to three young comprise a litter. Young begin to explore outside the nest at about 10 to 12 weeks of age (Jackson 1994*b*, Edwards et al. 2003). Home ranges of squirrels range from 1.2 to over 40 acres in size (Flyger and Gates 1982).

Gray squirrel populations periodically rise and fall, and during periods of high populations they may go on mass emigrations, during which time many animals 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 (Edwards et al. 2003). 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*b*, Edwards et al. 2003).

Gray squirrel densities fluctuate based on available food sources but long-term densities tend to be stable (Gurnell 1987, Edwards et al. 2003). Edwards et al. (2003) summarized gray squirrel density estimates that ranged from 0.1 gray squirrels per acre to 5.7 squirrels per acre. Densities in some small urban parks can reach densities of 9.1 squirrels per acre to 50 squirrels per acre (Manski et al. 1981, Hadidian et al. 1987). A somewhat conservative approximation of those estimates is one squirrel per acre (B. Sherrill, NCWRC, pers. comm. 2015).

Gray squirrels occur statewide in North Carolina in appropriate habitat, including urban areas. However, a statewide population estimate for the gray squirrel is currently not available. To determine a statewide population, the analysis will rely on the best available information to estimate a statewide population. In 2002, the State contained 18 million acres of forested land (Brown 2004). The best quality forests for gray squirrels are hardwood dominated forests rather than forests dominated by pine. Hardwood forests covered 13 million acres in 2002 (Brown 2004). If only 50% of the hardwood forest acres in the State supported squirrels, under a worst-case scenario, with an estimate of one gray squirrel per acre, the statewide populations could be approximately 6.5 million gray squirrels. This would be a worst-case scenario since squirrel populations are likely to inhabit a much larger portion of the State and squirrels are likely to occur at much higher densities.

Gray squirrels are a game species in North Carolina with an annual hunting season. The current hunting season for squirrels runs for approximately 16 weeks from October to January (NCWRC 2015*a*). Currently, hunters can harvest eight gray squirrels a day with no limit on the number a hunter can possess during the length of the hunting season (NCWRC 2015*a*). Hunting pressure on squirrels has declined drastically in North Carolina since the 1960s. During the 1965 hunting season, 271,000 hunters spent 2.5 million days hunting squirrels in the State with hunters harvesting 3.5 million squirrels. In contrast, during the 2009 season, 77,000 hunters spent 0.5 million days hunting squirrels and harvesting 0.6 million squirrels (B. Sherrill, NCWRC, pers. comm. 2015). This represents an approximately 80% reduction in harvest. North Carolina is not alone in declining squirrel harvests as a similar trend has occurred nationally over the past 30 years, and reflects a shift in hunting pressure from small game species, such as squirrels, to big game species, such as deer and turkeys (Flather et al. 2009). Gray squirrels remain abundant in North Carolina, and despite the drop in hunting pressure, they remain one of the most popular game animals in the State.

Previous hunting statistics in North Carolina combined the harvest of the three squirrel species (gray, fox, and red) found in the State. Since most squirrel hunting in the State is for gray squirrels, the NCWRC interprets previous harvest totals of squirrels as a slightly inflated representation of the gray squirrel harvest (B. Sherrill, NCWRC, pers. comm. 2015). However, more recent harvest surveys separate hunter harvest by squirrel species. From the 2011 hunting season to the 2014 hunting season for squirrels, hunters harvested nearly 2.5 million gray squirrels in the State (see Table 4.8), which is an average annual harvest of approximately 625,000 gray squirrels. Despite the annual harvest, gray squirrel populations are generally stable to increasing, especially around urban areas (B. Sherrill, NCWRC, pers. comm. 2015).

WS has previously received requests for direct operational assistance associated with gray squirrels. In response to requests for assistance, WS lethally removed 26 gray squirrels between FY 2010 and FY 2014 in the State. In addition, the WS program in the State live-captured one gray squirrel unintentionally in a cage trap but released the squirrel unharmed. The number of gray squirrels addressed by WS each year would be dependent on the number of requests received, the number of squirrels associated with causing damage or the threat of damage, and the efficacy of methods employed to resolve the damage. Based on previous request for assistance and in anticipation of additional efforts, WS anticipates that personnel could lethally remove up to 100 gray squirrels annually. WS' personnel could also lethally remove gray squirrels unintentionally during activities targeting other animal species. However, WS' personnel have

not lethally removed gray squirrels unintentionally during previous activities. Cumulatively, WS does not anticipate the intentional and unintentional lethal removal of squirrels to exceed 100 individuals annually.

Table 4.8 – North Carolina gray squirrel harvest and WS' removal, 2010 – 2014‡

Year	Harvest	WS' Removal[1]	TOTAL	WS % of Total
2010	N/A†	0	**-**	-
2011	622,033	11	**622,044**	0.002%
2012	630,660	2	**630,662**	0.0003%
2013	649,258	7	**649,265**	0.001%
2014	552,056	6	**552,062**	0.001%

‡Harvest data based on mail surveys (adapted from NCWRC, unpublished data)

[1]WS' removal is reported by federal fiscal year

†Data for the 2010 hunting season is not available

WS' annual removal of gray squirrels from FY 2011 through FY 2014 has represented less than 0.002% of the annual harvest of gray squirrels in the State (see Table 4.8). If WS lethally removed up to 100 gray squirrels, the lethal removal would represent 0.002% of the estimated gray squirrel population in the State under a worst-case scenario. People have harvested nearly 2.5 million gray squirrels in the State between the 2011 and the 2014 hunting seasons, which is an average of 625,000 gray squirrels harvested annually. The highest harvest level occurred during 2013 harvest season when people reported harvesting 649,258 gray squirrels. If had WS lethally removed 100 gray squirrels during the 2013 harvest season, the cumulative removal would have represented 10.0% of the statewide population estimated at 6.5 million gray squirrels. Combining the average annual harvest of 625,000 squirrels in the State with WS' potential removal of 100 squirrels annually, the cumulative removal would represent 9.6% of the population estimate in the State under a worst-case scenario.

The actual statewide population of gray squirrels is likely higher than 6.5 million squirrels; therefore, the cumulative removal would likely be an even smaller percentage of the statewide population. In addition, the NCWRC places no possession limits on the number of gray squirrels that people can harvest during the length of the annual hunting season in the State. As with many of the mammal species addressed in this document, the unlimited removal allowed by the NCWRC provides an indication that annual removal is not likely to reach a level where overharvest would occur. In addition, removal by WS would only occur when authorized by the NCWRC and only at levels authorized. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of gray squirrels annually would have no effect on the ability of those persons interested to harvest squirrels during the regulated harvest season.

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 North Carolina. They dig large burrows, generally eight to 12 inches at the opening, sometimes 5 feet deep and 30 feet long with more than one entrance to a spacious grass-filled chamber. Green vegetation, such as grasses, clover, and alfalfa, forms its diet. At times, woodchucks may cause damage to a variety of crops, such as grains, clover, alfalfa, beans, peas, corn, and apple trees (Armitage 2003). Woodchucks may also jeopardize the integrity of earthen dams, present hazards to livestock and farm equipment because of burrowing; gnaw electrical cables, and damage hoses and other accessories on automobiles by gnawing (Bollengier 1994, Armitage 2003).

The breeding season for woodchucks is usually from March through April (Bollengier 1994). Female woodchucks usually produce from four to six young (Armitage 2003). The offspring breed at age one 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, with an average litter size of four with a 1:1 sex ratio; they could produce over 645 woodchucks through their lifetime. The range of the woodchuck 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 (Armitage 2003).

Both sexes are similar in appearance, but the male is slightly larger, weighing an average of five to 10 pounds (2.2 to 4.5 kg). The total length of the head and body averages 16 to 20 inches (40 to 51 cm). The tail is usually four to seven inches (10 to 18 cm) long. Like other rodents, woodchucks have white or yellowish-white, chisel-like incisor teeth. Their eyes, ears, and nose are located toward the top of the head, which allows them to remain concealed in their burrows while they check for danger over the rim or edge. Although they are slow runners, woodchucks are alert and scurry quickly to their dens when they sense danger (Bollengier 1994).

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. Study of woodchuck colonies to determine the social structure of a typical colony is limited. However, at a minimum, a colony would generally consist of two adults and the young of that year, totaling at least six to eight individuals.

Woodchucks occur across most of the northern and western portion of the State and have expanded their range southward since 1985 (Sumner 1997). Like many mammal species, the current statewide population of woodchuck is unknown and density information specific to North Carolina is not available. As stated previously, woodchucks are typically associated with pastures, meadows, fields, open woodlands, and clearings (Armitage 2003). If only 25% of statewide land area supported woodchucks, under a worst-case scenario, with an estimate of a single woodchuck home range at 124 acres and only one woodchuck occupying a home range and no home ranges overlapped, the woodchuck population would be approximately 62,700 woodchucks in North Carolina. This would be a worst-case scenario since the woodchuck population likely inhabits a much larger portion of the statewide land area and woodchuck colonies likely consist of six to eight individuals.

Woodchucks are a non-game species in North Carolina with a year-round statewide open hunting season using hunting equipment. In addition, people can harvest woodchucks during the annual trapping season in the State. Therefore, people can harvest woodchucks throughout the year using hunting methods and during the trapping season with no limits on the number that people can harvest. However, the number of woodchucks removed annually in the State is currently unknown.

People have and could request direct operational assistance from the WS program in North Carolina, including the use of lethal methods to remove woodchucks causing damage or posing a threat of damage. Between FY 2010 and FY 2014, the WS program in the State lethally removed 99 woodchucks intentionally, which is an annual average removal of 20 woodchucks. In addition, the WS program live-captured two woodchucks intentionally between FY 2010 and FY 2014 and personnel released those woodchucks unharmed. When receiving requests for assistance associated with woodchucks, the WS program in North 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. WS' personnel would place the cartridges inside active burrows at the entrance and ignite the fuse on the cartridge. Then, personnel would seal the entrance to the burrow with dirt, which would allow the burrow to fill with carbon monoxide gas.

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 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). When using gas cartridges to fumigate burrows, WS' personnel would base the number of woodchucks lethally removed 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. Removing woodchucks to alleviate damage at a local site under the proposed action alternative would likely temporarily reduce some local populations. If WS' annual removal reached 200 woodchucks, the removal would represent 0.3% of a statewide population estimated at 62,700 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. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of woodchucks annually would have no effect on the ability of those persons interested to harvest woodchucks during the regulated harvest season.

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 (Melquist et al. 2003). 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 are found in both marine and freshwater environments, ranging from coastal to high 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, their present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987, Melquist et al. 2003). River otters remained relatively abundant in North Carolina despite declines in other parts of the country. River otter occur throughout North Carolina where habitat exists. However, the number of otters present in the State is currently unknown. In southeast Alaska, Woolington (1984) found river otter densities in waterways were one otter per 0.7 miles. 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), which is an average of 1 otter per 2.4 miles of waterway. Melquist and Hornocker (1983) found a population density range of 1 otter per 1.8 to 3.6 miles of waterway (primarily streams) in west central Idaho, with an average of 1 otter per 2.4 miles. Erickson et al. (1984) found one otter per 5.0 miles of linear waterways in Missouri and one otter per 1.5 square miles in wetland habitat. More recently, Mowry et al. (2011) found an average otter density of one otter per 2.6 miles along streams in Missouri using latrine surveys.

Density information for otter specific to North Carolina is not currently available. To provide an indication of the potential magnitude of lethal removal that could occur by WS, this analysis will use the available otter densities to estimate a statewide otter population. The otter density data found in Missouri most likely represents similar conditions found in North Carolina (C. Olfenbuttel, NCWRC, pers. comm. 2015). As was discussed previously, there are approximately 38,211 miles of rivers and stream in the State (EPA 2012). Using 38,211 miles of rivers and stream in North Carolina and one otter per 2.6 miles of waterway would result in a statewide population estimated at 14,700 otter. Erickson et al. (1984) found one otter per 1.5 square miles of habitat in Missouri. If similar otter densities occurred in wetland habitats within North Carolina, approximately 6,000 otters occupy the 5.7 million acres of wetlands in the State. Therefore, the entire statewide population would be 20,700 otters.

River otters are a state-regulated furbearer in North Carolina with a regulated annual trapping season. During the trapping season, people can harvest an unlimited number of otter. During the annual trapping season from 2010 through 2014, people harvested 12,950 otters in the State with a range of 1,322 otters harvested during 2010 to 3,155 otters harvested during 2012 (see Table 4.9). Trappers in the State harvested an average of 2,590 otters annually from 2010 through 2014.

Table 4.9 – North Carolina river otter harvest and WS' removal, 2010 – 2014‡

Year	Harvest[a,b]	WS' Removal[c]	Total Removal	WS % of Total
2010	1,322	58	**1,380**	4.2%
2011	2,778	58	**2,836**	2.1%
2012	3,155	43	**3,198**	1.3%
2013	2,787	77	**2,864**	2.7%
2014	2,908	71	**2,979**	2.4%

‡Harvest data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[a]Harvest data reported by trapping season

[b]Harvest data provided by the NCWRC

[c]WS' lethal removal is reported by FY; includes intentional and unintentional removal

In addition to the annual harvest during the trapping season, WS has also lethally removed otter during damage management activities. WS lethally removed one otter during FY 2013 to alleviate damage based on requests for assistance received. Unintentional lethal removal of otter has also occurred by WS during other damage management activities, primarily aquatic rodent damage management. WS' removal presented in Table 4.9 reflects otter killed unintentionally by WS during other damage management activities. Based on previous activities conducted by WS and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 150 river otters annually in the State, including unintentional lethal removal that could occur during other damage management activities.

If the lowest derived population estimate were reflective of the actual statewide population of otter in the State, removal of up to 150 otter by WS would represent 0.7% of the population estimated at 20,700 otter. Between FY 2010 and FY 2014, WS' lethal removal of otter has not exceeded 4.2% of the total number of otter harvested in the State from 2010 through 2014. On average, WS' annual removal has represented 2.5% of the annual harvest of otters in the State. If WS had lethally removed 150 otters annually from FY

2010 through FY 2014, the total removal would have represented less than 6.0% of the total harvest of otter in the State. The lowest harvest of otter during the annual trapping season from 2010 through 2014 occurred in 2010 when trappers harvested 1,322 otters. If WS had lethally removed 150 otter during FY 2010, WS' removal would have represented 10.2% of the overall harvest of otter in the State.

The highest annual harvest of otter occurred during 2012 when trappers removed 3,155 otters during the trapping season. During FY 2012, the WS program removed 43 river otters and when combined with the harvest of otter during 2012 would represent a cumulative removal of 3,198 otters. The cumulative removal of 3,198 otters would represent 15.5% of a statewide population estimated at 20,700 otters. If WS' annual removal during FY 2012 reached 150 otters, the cumulative removal of otter would have represented 16.0% of a population estimated at 20,700 otters. Some models have shown that population stability in otters can be maintained with an annual harvest of 15% to 17% of the available autumn otter population (Melquist et al. 2003).

As with many of the mammal species addressed in this document, the unlimited removal allowed by the NCWRC provides an indication that harvest during the regulated trapping season and removal for damage management, is not likely to reach a level where overharvest would occur. Otter maintain sufficient densities in the State to allow annual harvesting, which the NCWRC regulates, including removal that occurs during damage management activities. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of otters annually would have no effect on the ability of those persons interested to harvest otters during the regulated harvest season.

Feral Swine Population Information and Effects Analysis

Feral swine present in the State are not native to North Carolina or any part of North America. Introduction of domestic swine to North America likely occurred during the arrival of the first European explorers to the continent. The first introductions likely occurred along the coastal areas of North American by European explorers that used domesticated swine as a food source. Closed-range or fencing requirements for livestock were not common until the 1900s and allowing domestic swine to range freely was common (Ruth 2011). Some established feral swine populations originated from free-ranging domestic swine that became feral (*i.e.*, living in a wild state), from the intentional release of domestic swine that became feral, or from domestic swine that escaped confinement and became feral. In addition, people have introduced the wild boar, which is native to Europe and Asia, into the United States. Although morphologically distinct, domestic swine, feral domestic swine, and the wild boar are all the same species (*Sus scrofa*). When free roaming in North America, domestic swine and the wild boar are included in the term "*feral swine*", as are hybrids of the two types. Therefore, the use of the term feral swine includes other common names, including "*wild pigs*", "*wild boars*", and "*feral hogs*".

Feral swine occur in a variety of habitats across much of the southern United States, including North Carolina. Densities of feral swine in an area often varies from abundant to sparse depending on the quality of habitat and the history of the local population, which can create an uneven distribution (Sweeney et al. 2003). A similar patchy distribution of feral swine occurs in North Carolina. The current feral swine population in the State likely originated from many sources, including the intentional release of unwanted domestic swine, the intentional release of swine by hunters trying to establish local populations, the escape of swine from confinement, and free-ranging swine that have become feral. In addition, people have introduced wild boars into the State. In the early 1900s, a property owner released wild boar from Europe on a private game reserve in Graham County, North Carolina (NCWRC 2015*d*). Some of the wild boars escaped from the preserve and thrived in the area, which lead to the spread of wild boars to other counties in western North Carolina and into the Great Smoky Mountains National Park.

Feral swine can produce young throughout the year; however, two general peaks occur. Those peaks occur in the winter (November-March) and summer (July) (Sweeney et al. 2003). Litter sizes generally range from one to 12 piglets, with the mean litter size ranging from three to eight piglets (Sweeney et al. 2003). Feral swine are capable of producing two litters per year; however, in most cases, female swine only produce one litter (Sweeney et al. 2003). Feral swine may begin to breed before six months of age (Barrett and Birmingham 1994). Given adequate nutrition, a feral swine population can double in just four months. The NCWRC (2015*d*) stated, "*Populations of free-ranging feral swine continue to grow and spread in North Carolina*". However, the population of feral swine in North Carolina is currently unknown and population density information is not currently available to estimate a statewide population.

Evidence of the presence of feral swine may be rooted up earth, tree rubs at ground level to 900 cm (36 inches) high with clinging hair or mud, and muddy wallows. Damage in areas supporting feral swine populations is sometimes a serious natural resource management concern for land managers. Substantial damage has occurred to natural resources, including destruction of fragile plant communities, killing of tree seedlings, and erosion of soils (Barrett and Birmingham 1994). Food sources for feral swine include acorns, hickory nuts, pecans, beech nuts, and a wide variety of vegetation, including roots, tubers, grasses, fruit, and berries. Feral swine also eat crayfish, frogs, snakes, salamanders, mice, and eggs, along with nestlings of ground-nesting birds, young rabbits, and any other easy prey or carrion encountered. They may also kill considerable numbers of domestic livestock, especially young animals, in some areas (Barrett and Birmingham 1994).

In 1979, the North Carolina legislature classified wild boars as game animals in the State; however, in 2011, the legislature changed the status of all free-ranging swine, including wild boars, from a game animal to a non-game animal in the State (NCWRC 2015*d*). As a non-game animal, people can harvest feral swine throughout the year with no closed season and no limit on the number of feral swine people can harvest. Table 4.10 shows the number of feral swine harvested in the State from 2011 through 2014. In total, people have harvested 47,589 feral swine, which is an average harvest of 11,897 swine from 2011 through 2014. The highest harvest level occurred during the 2014 season when people harvested nearly 14,000 feral swine in the State, which compares to the lowest harvest level estimated at nearly 9,300 swine that occurred during the 2012 season.

Table 4.10 – North Carolina feral swine harvest and WS' removal, 2010-2014‡

Year	Harvest[a]	WS' Removal[a]	Total Removal	WS % of Total
2010	N/A†	65	-	-
2011	10,590	18	**10,608**	0.2%
2012	9,306	8	**9,314**	0.1%
2013	13,734	18	**13,752**	0.1%
2014	13,959	39	**13,998**	0.3%

‡Harvest data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[a]WS' removal is reported by FY

†N/A=Information is not available

WS has lethally removed 148 feral swine from FY 2010 through FY 2014 in the State to alleviate damage and threats of damage. WS' total removal of feral swine has represented 0.2% of the total number of feral swine harvested in the State. Based on previous requests for assistance and the likelihood that the statewide population of feral swine will continue to increase in North Carolina, WS anticipates that personnel could kill up to 8,000 feral swine annually in the State to alleviate damage associated with requests for assistance and for disease surveillance. However, the annual removal of feral swine by WS could exceed 8,000 feral swine if populations continue to increase, if WS received additional funding to manage feral swine damage, and the number of requests for assistance continued to increase. Feral swine

are not a native species in North Carolina; therefore, maintaining a local and/or statewide population at the lowest level, including extirpation, could be the goal of the NCWRC and to achieve those goals of lowering the statewide population, the annual removal by WS could exceed 8,000 feral swine. Damage management activities associated with feral swine would target single animals or local populations of feral swine at sites where their presence was causing unacceptable damage or threats to agriculture, human health and safety, natural resources, or property. WS may use any legal methods among those outlined by Barrett and Birmingham (1994), West et al. (2009), and Hamrick et al. (2011) as suitable for feral swine damage management, including the use of aircraft to shoot feral swine.

WS does not expect the removal of up to 8,000 feral swine to affect the overall statewide population of feral swine because of the high reproductive rates exhibited by these animals (Barrett and Birmingham 1994). For example, Timmons et al. (2012) was able to model population growth rates for the feral swine population in Texas using demographic parameters gathered from feral swine in the southeastern United States. Using those demographic parameters, Timmons et al. (2012) estimated an average annual growth rate of 21% for feral swine populations in Texas. If the average annual harvest of feral swine in Texas represented 28% of the population, Timmons et al. (2012) expected the statewide population to double every five years. If annual harvest rates reached 41% of the statewide population, Timmons et al. (2012) predicted the population would continue to increase at a rate of 12% per year. The model determined that an annual harvest of 66% of the population was needed to hold the population stable (Timmons et al. 2012).

In 2010, the statewide feral swine population in neighboring South Carolina was approximately 150,000 swine (SCDNR 2014). If a similar statewide feral swine population occurred in North Carolina and using a required harvest level of 66% found by Timmons et al. (2012) to hold a population stable, the annual removal of feral swine in the State would have to reach 99,000 feral swine. Even if the statewide feral swine population in North Carolina were half of the population estimate in neighboring South Carolina, the annual removal of feral swine would need to reach 49,500 feral swine to maintain a stable population. The South Carolina Wild Hog Task Force (2012) estimated that entities would have to remove 50 to 75% of the statewide population annually to stabilize or reduce the population in South Carolina. Based on current harvest levels in North Carolina and the anticipated annual removal by WS, the annual removal of feral swine would not reach a level where feral swine populations would decline statewide.

Where feral swine are causing damage or a nuisance and WS could achieve complete removal of a local population, the removal could provide some benefit to the native environment since feral swine are not part of the native ecosystem. The NCWRC (2015*d*) stated, "...[feral swine] *are considered to be an undesirable species on North Carolina's landscape*". In addition, the current management goal of the NCWRC (2015*d*) is "…*to contain and control the spread of* [feral swine] *across the landscape*". The National Invasive Species Council specifically lists feral swine as an invasive species pursuant to Executive Order 13112. Executive Order 13112 directs federal agencies to address invasive species to the extent practicable and permitted by law. The WS program in North Carolina has reviewed the feral swine damage management programmatic EIS developed by the APHIS (USDA 2015*b*) and activities associated with feral swine conducted under this alternative would be consistent with the EIS.

Eastern Cottontail Population Information and Effects Analysis

There are nine species of cottontail rabbits in North America, north of Mexico. The eastern cottontail is the most abundant and widespread of all the species. Eastern cottontails occur statewide in a wide variety of disturbed, early successional or shrub-dominated habitats (Chapman and Litvaitis 2003). In addition, marsh rabbits (*S. palustris*) and Appalachian cottontails (*S. obscurus*) occur in the State (Chapman and Litvaitis 2003). Marsh rabbits are associated with the wetland habitats along the eastern coastal areas of the State while the Appalachian cottontail occurs in the mountainous areas along the western edge of the

State (Chapman and Litvaitis 2003). Eastern cottontails are the most abundant rabbit species found in the State and they are the most widely distributed species.

However, eastern cottontails do not distribute themselves evenly across the landscape, but tend to concentrate in favorable habitats, such as brushy fence rows or field edges, gullies filled with debris, brush piles, areas of dense briars invaded with Japanese honeysuckle, or landscaped backyards where food and cover are suitable. Rabbits are rarely found in dense forest or open grasslands, but fallow crop fields may provide suitable habitat. Within these habitats, they spend their entire lives in an area of 10 acres or less. Occasionally they may move a mile or so from summer range to winter cover or to a new food supply. In suburban areas, rabbits are numerous and mobile enough to fill any "*empty*" habitat created when other rabbits are removed. Population densities vary with habitat quality, but one rabbit per 0.4 hectares (1 acre) is a reasonable average (Craven 1994).

The average lifespan of a rabbit in the wild is 15 months (Chapman et al. 1980), yet they make the most of the time available reproductively. They can raise as many as eight litters per year of one to 12 young (usually three to six), having a gestation period of 25 to 35 days with a mean of 28 days (Chapman and Litvaitis 2003).

No population estimates were available for cottontail rabbits in North Carolina. Information on population densities of cottontails is also unavailable. As discussed previously, there are 48,618 square miles of land in the State, which equates to over 31.1 million acres of land. If 25% of the land area of the State had sufficient habitat to support rabbits, home ranges of rabbits do not overlap, and rabbit densities average one rabbit per acre, a statewide rabbit population would be over seven million rabbits.

People can harvest cottontail rabbits in the State during statewide hunting seasons. The number of cottontail rabbits that people can harvest per day is limited to five. However, the NCWRC allows a person to harvest an unlimited number of cottontails throughout the duration of the season. As shown in Table 4.11, people have harvested over 1.2 million rabbits in the State from 2011 through 2014, which is an average annual harvest of 300,000 rabbits. The highest harvest level occurred during the 2013 season when people harvested 341,508 rabbits in the State. Harvest data combines all of the rabbit species (eastern cottontail, swamp rabbit, Appalachian rabbit). Harvest totals that only represent eastern cottontails are not currently available.

Table 4.11 – North Carolina rabbit harvest and WS' removal, 2010-2014‡

Year	Harvest[a]	WS' Removal[b]	Total Removal
2010	N/A†	3	-
2011	326,799	1	**326,800**
2012	272,956	1	**272,957**
2013	341,508	0	**341,508**
2014	293,486	0	**293,486**

‡Harvest data based on mail surveys (adapted from NCWRC, unpublished data, NCWRC 2015*b*)

[a]Includes all species of rabbits found in the State

[b]WS' removal is reported by FY

†N/A=Information is not available

From FY 2010 through FY 2014, WS has lethally removed five cottontails to alleviate damage and threats of damage in the State. In addition, WS dispersed four cottontails and live-captured and released one cottontail to alleviate damage or threats of damage in the State. WS also live-captured three cottontails unintentionally during activities targeting other animals but personnel released those cottontails unharmed. Based on the locations where WS' personnel addressed those rabbits from FY 2010 through

FY 2014, those rabbits addressed by WS were eastern cottontails. Overall, WS' removal of rabbits previously has represented a very small percentage of the estimated number of cottontails and rabbits that people harvested in the State from 2011 through 2014. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 500 cottontails annually to alleviate damage and threats of damage, primarily at airports where rabbits may act as attractants for other animals that could pose aircraft strike hazards. WS' personnel are most likely to receive requests for assistance associated with eastern cottontails based on the locations where WS is likely to receive requests for assistance (*e.g.*, at airports, military facilities) and the habitat types associated with those locations.

On average, people have harvested 300,000 rabbits in the State annually from 2011 through 2014. Based on the average number of rabbits harvested, WS' lethal removal of up to 500 rabbits would represent 0.2% of the annual rabbit harvest. The lowest harvest level occurred during the 2012 season when people harvested 272,956 rabbits in the State. If WS had lethally removed 500 cottontails during FY 2012, the removal would have represented 0.2% of the lowest harvest level. Studies show that even if hunters harvest as many as 40% of the rabbits available in autumn, the rabbit population the following year would not decline because of the tremendous reproductive potential of rabbits (Fergus 2006). Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of cottontails annually would have no effect on the ability of those persons interested to harvest rabbits during the regulated harvest season.

Black Bear Population Information and Effects Analysis

The American black bear is the smallest and most widely distributed of the three North American bear species (Pelton 1982, Pelton 2003). The black bear has a wide but patchy distribution in the United States with populations found primarily in areas of dense forest, swamps, and thickets but can occur in a variety of other habitats as they forage for food, including cropland, orchards, and forest plantations. Black bears can occur throughout the Rockies and West Coast mountain ranges; the lower Mississippi Valley, Gulf Coast, and Florida; and the northern Great Lakes area, Appalachian Mountains, and Northeastern States.

Female black bears reach reproductive maturity normally at three to four years of age (Kohn 1982, Pelton 2003). Following a seven to eight month gestation period, they may have one to five cubs (Rogers 1976, Alt 1981, Kolenosky and Strathearn 1987), although the typical litter size is two to three cubs. Juvenile black bear annual mortality ranges between 20% and 70%, with orphaned cubs having the highest mortality (Kolenosky and Strathearn 1987). Natural mortality in adult black bears is approximately 10% to 20% (Fraser et al. 1982). Black bears in the wild can also live more than 25 years (Rogers 1976).

Bears are omnivorous and will feed on a variety of food sources, including berries, fruits, nuts, grasses, twigs, buds, leaves, nuts, roots, fruit, corn, berries, and newly sprouted plants. Black bears will rip open bee trees to feed on honey, honeycomb, bees, and larvae. They will also tear apart rotting logs for grubs, beetles, crickets, and ants. The black bear's diet also includes small to medium-sized mammals or other vertebrates. Although it comprises a small portion of their diet, bears will prey on wildlife and domestic livestock, including sheep, goats, and cattle. Bears can also cause damage to telephone poles and tree plantings through clawing activities, raid apiaries in search of honey, and rummage through human refuse.

Bears are often a problem around open dumps, and may become dangerous if they lose their fear of people. Occasionally, black bears have killed people (Herrero et al. 2011); however, no reports of bear attacks have occurred in North Carolina. Habituated, food-conditioned bears pose the greatest threat to people and such bears are usually found in association with campgrounds and sites where people regularly feed them (Herrero 1982, Herrero 1985, Kolenosky and Strathearn 1987). With the rise in the

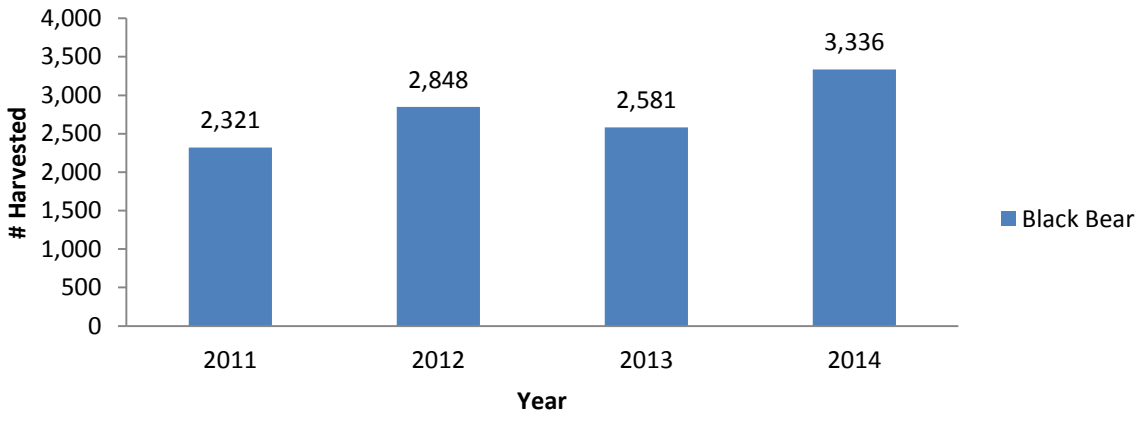
bear population and the human population, bears are more likely to live in close proximity to people. In North Carolina, black bears have also been seen at airports, parks, and even shopping centers, possibly jeopardizing the safety of aircraft and human life. However, for all the incidents of human/bear interaction in recent years, conflict is rare and serious injury and death has not occurred in North Carolina.

In North America, black bear densities can range from 0.3 and 3.4 bears per square mile, depending on region and habitat (Hygnstrom 1994). Densities are greatest in highly diverse forests at a relatively early stage of development. In non-hunted and lightly hunted populations, the annual survival rate of adult female black bears is about 80 to 90%, while adult male survival is slightly less. As hunting pressure increases, the number of males decreases more rapidly than that of females because of their greater vulnerability to hunting (Fraser et al. 1982).

In North Carolina, bears can occupy ranges of 2.7 to 175 km^2 (1 to 68 mi^2) (NCWRC 2012*a*). The home range of the male black bear can be double that of the female. Black bear populations in North Carolina are stable to increasing, with populations in the eastern and western portions of the State (C. Olfenbuttel, NCWRC, pers. comm. 2015). The NCWRC estimates that there are 14,000 to 17,000 black bears in North Carolina (C. Olfenbuttel, NCWRC, pers. comm. 2015). The NCWRC is currently managing black bears with the objective of stabilizing populations in the coastal and mountain regions and limiting the establishment of a bear population in the Piedmont region (NWRC 2012, C. Olfenbuttel, NCWRC, pers. comm. 2015).

Black bears are a protected big game species in North Carolina that people can harvest during an annual hunting season. Between 2011 and 2014, people harvested 11,086 black bears in the State during the hunting season, which is an average annual harvest of 2,772 black bears (see Figure 4.2). The highest harvest level occurred during the 2014 hunting season when people harvested 3,336 black bears in the State.

Figure 4.2 - Number of black bears harvested during the hunting season in North Carolina, 2011-2014



Between FY 2010 and FY 2014, WS has lethally removed two black bears in the State to alleviate damage. During FY 2011, WS responded to two requests for assistance associated with black bears at airports in the State. WS received one request for assistance from airport authorities when a bear entered a building on airport property. Due to human safety concerns, airport authorities and the NCWRC requested WS euthanize the bear using a firearm. During a separate request for assistance during FY

2011, WS' personnel euthanized an injured bear at an airport after airport personnel shot the bear due to their concerns that the bear posed a risk to incoming and outgoing flights. WS' personnel euthanized the bear after obtaining permission from the NCWRC. Airport personnel made multiple attempts to disperse the bears using non-lethal harassment techniques in both situations, but were unsuccessful. WS' personnel also dispersed a black bear during FY 2013 to alleviate damage using pyrotechnics. The WS program also live-captured one black bear unintentionally between FY 2010 and FY 2014 during activities targeting other animals but personnel released the bear unharmed.

The WS program in North Carolina would only provide direct operational assistance to alleviate damage caused by black bears after receiving authorization from the NCWRC. WS' personnel must seek and receive authorization from the NCWRC for any activities involving the handling of bears. If authorized by the NCWRC, WS' personnel could euthanize black bears to protect human safety or to address seriously injured bears. Based on those requests for assistance received by WS previously, the program anticipates that personnel could address up to five black bears per year in the State to alleviate damage or threats of damage. The lethal removal of bears by WS' personnel would only occur after receiving authorization from the NCWRC. Therefore, the activities of WS would occur within the objectives of the bear management plan developed by the NCWRC.

Based upon the above information, WS' limited lethal removal of five black bears would not adversely affect overall black bear populations in the State. The NCWRC has determined that there is no evidence to suggest that human-mediated mortality resulting from damage management activities, including removal of bears by WS, would be detrimental to the survival of the black bear population in the State of North Carolina (C. Olfenbuttel, NCWRC, pers. comm. 2015). In addition, the removal of five black bears annually would not adversely affect the ability of people to harvest bears during the annual hunting season in the State.

White-tailed Deer Population Information and Effects Analysis

White-tailed deer have a wide distribution in North America (Miller et al. 2003) and some people have suggested that the white-tailed deer currently occupies the largest geographic range of any other land mammal in North America (Pagel et al. 1991). Rural areas containing a matrix of forest and agricultural crops can contain the highest deer densities (Roseberry and Woolf 1998). One challenge currently facing biologists and resource managers is 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), 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 (Dolbeer et al. 2013).

The white-tailed deer is one of the most ubiquitous and well-known wild animals in North Carolina (E. Stanford, NCWRC, pers. comm. 2015). Deer occur in areas with adequate woodlands interspersed with early-successional habitats (Miller et al. 2003). White-tailed deer are highly adaptable and live in many habitats, including woodlots in rural areas, the suburbs, and deep within heavily forested areas.

Deer are strictly herbivorous (*i.e.*, eat only plants), including mushrooms. Deer eat leaves and twigs from a vast assortment of woody plants, including dogwood, maple, oak, willow, greenbriar, honeysuckle, grape, blackberry, and rhododendron (E. Stanford, NCWRC, pers. comm. 2015). Deer grub out the corms of ferns, nibble on lichens, strip bark from trees, and consume lily pads and pond plants. Deer eat garden vegetables, wild mushrooms, fruits such as apples and pears, and crops, including soybeans, corn,

and alfalfa. Acorns are a favorite food, and deer consume them in great quantities when putting on fat for winter. A deer can eat 5 to 9 pounds of food daily (Fergus 2000).

The NCWRC is responsible for managing the statewide deer population. The NCWRC collects and compiles information on white-tailed deer population trends and lethal removal, and uses this information to manage deer populations. The primary tool for the management of deer populations is through adjusting the allowed lethal removal during the deer harvest season in the State that the NCWRC regulates. The NCWRC estimates the North Carolina white-tailed deer population using population modeling, which includes harvest trend analysis and monitoring vital statistics of the deer herd. The most current population estimate for deer in the State is approximately 1.35 million deer (NCWRC 2015*e*). Currently, the deer populations statewide, including the three regional populations (Coast, Piedmont, Mountains) are generally considered stable, with populations increasing/decreasing in some select areas (E. Stanford, NCWRC, pers. comm. 2015).

The NCWRC classifies white-tailed deer as a big-game species in North Carolina and allows people to harvest deer during annual hunting seasons. Where deer damage is severe, the NCWRC may also authorize people to remove deer lethally outside of the regulated season to reduce damage. Between the 2010 deer harvest season in North Carolina and the 2014 season, the highest level of harvest occurred during the 2014 season when hunters harvested 238,185 deer (see Table 4.12). Hunters have harvested nearly 1.1 million deer between 2010 and 2014 during the regulated harvest season. In addition to harvest occurring during the regulated season, other factors may regulate deer populations. Mortality also occurs from vehicle collisions, dogs, illegal lethal removal, tangling in fences, depredation permits, disease, and other causes (Crum 2003). Deer mortality associated with other factors is currently unknown in the State. During 2013, Oliver (2014) reported 20,308 animal-vehicle strikes in North Carolina, with approximately 90% of those strikes involving deer. Therefore, during 2013, approximately 18,300 deer may have died from collisions with vehicles in the State. In addition, entities killed 2,764 deer in the State during 2013 pursuant to deer depredation permits issued by the NCWRC (E. Stanford, NCWRC, pers. comm. 2015).

Since FY 2010, WS has used lethal methods to remove 438 deer intentionally in North Carolina with the highest level of removal occurring in FY 2012 when WS' personnel lethally removed 178 deer (see Table 4.12). All intentional lethal removal by WS has occurred after receiving a request for assistance with resolving damage caused by deer and after the NCWRC authorized WS to remove deer. In addition, WS' personnel employed non-lethal methods to disperse 268 deer between FY 2010 and FY 2014. WS also live-captured four deer between FY 2010 and FY 2014 and released those deer unharmed. One white-tailed deer was live-captured unintentionally during activities targeting other animals during FY 2010 but WS' personnel released the deer unharmed. WS also killed one white-tailed deer during FY 2010 unintentionally during activities targeting other animals.

As stated previously, the highest level of removal by WS occurred in FY 2012 when personnel removed 178 deer using lethal methods, which accounted for 0.08% of the total known mortality of deer in North Carolina. Since FY 2010, WS' personnel have lethally removed 439 deer, which represents 0.04% of the harvest of deer in the State. Based on previous requests for assistance, the magnitude of WS' lethal removal of deer to resolve damage or threats has been low in North Carolina. When lethal removal of deer has occurred by WS, the magnitude of removal compared to the total harvest of deer has ranged from 0.01% to 0.08% since FY 2010. Based on the limited removal by WS from FY 2010 through FY 2014, WS' activities to resolve or prevent damage have not adversely affected the deer population.

Based on current population trend data and previous requests for assistance associated with deer, WS anticipates requests for assistance to increase in the State. An increasing number of requests for assistance would likely result in the escalated use of lethal and non-lethal methods to resolve damage and threats associated with deer as authorized by the NCWRC. Non-lethal methods generally have minimal

impacts on animal populations since no lethal removal occurs and animals are only dispersed to other areas. No population reduction is likely from the use of non-lethal methods, except from the use of reproductive inhibitors, such as GonaCon™. Therefore, the increased use of non-lethal methods to resolve and prevent damage would not adversely affect deer populations in the State.

Table 4.12 – North Carolina white-tailed deer harvest and WS' removal, 2010-2014‡

Year	Harvest	WS' Removal[a,b]	Total Removal	WS % of Total
2010	169,273	89	**169,362**	0.05%
2011	234,195	123	**234,318**	0.05%
2012	217,146	178	**217,324**	0.08%
2013	219,385	17	**219,402**	0.01%
2014	238,185	32	**238,217**	0.01%

‡Harvest data based on mail surveys (adapted from NCWRC, unpublished data)

[a]WS' removal is reported by FY

[b]Includes deer lethally removed by WS unintentionally

After review of previous activities conducted by WS and in anticipation of a gradual increase in requests for lethal removal, WS anticipates that future lethal removal would not exceed 2,000 deer annually. In addition, WS may receive requests from the NCWRC and/or the NCDACS to assist with sampling and managing the spread of diseases found in free-ranging and/or captive deer populations. In the case of a disease outbreak, WS could lethally remove up to 5,000 additional white-tailed deer for sampling and/or to prevent further spread of diseases (*e.g.*, CWD). Therefore, WS' total annual removal would not exceed 7,000 deer annually under the proposed action. The NCWRC must authorize and permit any lethal removal of free-ranging deer in the State, including any removing occurring by WS.

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 of the potential spread of diseases to free-ranging herds. The spread of diseases among deer inside those facilities can occur rapidly due to their close contact with one another. Often, once someone detects a disease in a confined deer herd, destruction of the entire herd occurs 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 NCWRC and/or the NCDACS. As proposed in this alternative, in those cases where a person requests assistance from WS to assist with the removal of a captive deer herd in North Carolina, the lethal removal would not exceed 5,000 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 management objectives. However, since lethal removal of deer by WS for disease surveillance or monitoring could occur in free-ranging or captive herds, the potential lethal removal of up to 5,000 deer for disease surveillance and monitoring by WS would be part of the impact analysis on the statewide free-ranging deer population. Therefore, the analyses will evaluate the lethal removal of up to 7,000 deer annually by WS at the request of cooperators and approved by the NCWRC and/or the NCDACS.

In addition to WS' intentional removal of deer to resolve or prevent damage, WS also conducts other damage management activities that pose a risk of lethally removing deer unintentionally, primarily projects that target coyotes, fox, and feral swine. From FY 2010 through FY 2014, WS' personnel lethally removed one white-tailed deer unintentionally during activities targeting other animals. In addition, one deer was live-captured unintentionally but WS' personnel released the deer unharmed. Based on the limited unintentional removal that occurred from FY 2010 through FY 2014 during other program activities in North Carolina and after the review of proposed activities, the unintentional removal of deer by WS during other activities is not likely to increase to any appreciable extent. The unintentional

removal of deer by WS would continue to be minimal when compared to the number of deer harvested annually. WS would report all lethal removal, including unintentional removal, to the NCWRC. In addition, WS will evaluate removal, whether intentional or unintentional, cumulatively to ensure activities do not adversely affect deer populations in the State.

Deer harvest levels and other mortality events fluctuate annually in the State; therefore, the analysis of impacts of WS' removal on the statewide deer population under this alternative will occur using several scenarios. WS' proposed removal would not exceed 2,000 deer annually. In the event of a disease threat, the lethal removal of deer by WS for disease monitoring and surveillance would not exceed 5,000 deer when requested by the NCWRC and/or the NCDACS. Under a worst-case scenario, WS' personnel could lethally remove 7,000 deer annually under this alternative, including the unintentionally removal of deer that could occur by WS. Since the worst-case scenario would represent the highest level of annual removal, the analyses will evaluate the lethal removal of 7,000 deer to determine the maximum possible potential impact. However, the removal of 7,000 deer annually is unlikely and would likely be less than 2,000 deer.

When combined, the highest deer harvest (238,185) in North Carolina, the possible removal of deer under depredation permits (2,764), the possible mortality from vehicle collisions (18,300), and WS' highest possible removal (7,000) would result in the lethal removal of 266,249 deer. If WS' lethal removal reached 7,000 deer during the highest known mortality of deer in the State, WS' lethal removal of 7,000 deer would have represented 2.6% of the total known mortality in the State. Between 2010 and 2014, the lowest annual deer harvest was 169,273 deer. If WS' lethal removal reached 7,000 deer and the lowest mortality event occurred during the same year along with 18,300 deer killed from vehicle collisions and 2,764 killed pursuant to depredation permits, WS' removal of deer would represent 3.6% of the lowest cumulative mortality.

If WS had lethally removed 7,000 deer each year from FY 2010 through FY 2014, WS' lethal removal would have presented 3.2% of the total harvest of deer in the State during the annual hunting season and the estimated mortality of deer from vehicle strikes. Currently, the deer population in North Carolina is approximately 1.35 million (NCWRC 2015*e*). The annual removal of 7,000 deer would represent 0.5% of the estimated statewide population. Cumulatively, WS' removal of 7,000 deer, the highest deer harvest (238,185) in North Carolina, the possible removal under depredation permits (2,764), and the possible mortality from vehicle collisions (18,300) would represent 19.7% of the estimated statewide deer population. Despite previous levels of annual removal, the deer population has generally remained stable in the State (E. Stanford, NCWRC, pers. comm. 2015).

The lethal removal of deer unintentionally during other WS' damage management activities is not likely to increase greatly; therefore, even under the worst-case scenario, the potential impacts on the deer population in North Carolina is likely to be extremely low. With oversight of the NCWRC, the magnitude of removal by WS annually to resolve damage and threats would be low. WS would continue to report all program removal to the NCWRC to ensure the NCWRC has the opportunity to incorporate WS' activities into deer population objectives for the State. People can also remove deer to alleviate damage after receiving authorization from the NCWRC. Therefore, in the absence of any involvement by WS, people could lethally remove deer to alleviate damage or threats of damage or seek assistance from other entities to remove deer. WS' damage management activities associated with deer would only occur after the NCWRC authorizes the activities. WS could conduct activities after the NCWRC provides authorization directly to a property owner or property manager where WS was working as an agent of the owner or manager under the authorization or WS could conduct activities pursuant to authorization granted directly to the WS program by the NCWRC. Therefore, in some cases, WS' activities would target deer that the property owner and/or manager could remove themselves under authorizations from the NCWRC but the property owner/manager has chosen to request assistance from WS. Even in the

event of a disease threat, those deer that WS' personnel remove other entities would likely remove whether WS was directly involved or not. Therefore, WS' activities under the proposed action would not likely be additive to the mortality that could occur under permits and that could occur during disease threats. The potential impacts to the statewide deer population under the proposed action would likely be similar to the other alternatives given that WS' activities would not substantially increase the removal that could occur in the absence of WS' direct involvement since removal could occur when authorized by the NCWRC. The deer that WS could remove under the proposed action would likely be those deer that other entities would remove in the absence of WS' direct involvement in the activities.

The EPA approved the use of GonaCon™ in 2009 for use in reducing fertility in female white-tailed deer. According to the label, only WS or state wildlife management agency personnel or individuals working under their authority can use the reproductive inhibitor. Additionally, in order for WS or a wildlife management agency to use GonaCon™ in any given state, the appropriate state agency responsible for managing wildlife must also approve the use of the product along with the appropriate state agency responsible for registering pesticides. The reproductive inhibitor Gonacon™ is currently registered for use in North Carolina. Therefore, WS could consider the use of the reproductive inhibitor under the proposed action as part of an integrated methods 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 being 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. The number of deer that do not develop sufficient antibodies after the initial vaccination cannot be predicted beforehand. 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™ are reversible if deer do not receive a booster shot periodically, the reduction in a local population of deer from the use of GonaCon™ could be maintained at appropriate levels where damages or threats were resolved by increasing or decreasing the number of deer receiving booster injections. Although localized deer populations would likely be reduced from the use of GonaCon™, the extent of the reduction would be variable. For example, not all vaccinated deer are prevented from entering into a reproductive state and those deer that were initially prevented from entering into a reproductive state 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, the reduction in a local deer population could be fully reversed if deer are no longer vaccinated or provided booster shots and other conditions (*e.g.*, food, disease) are favorable for population growth.

Turner et al. (1993) noted that although contraception in white-tailed deer may be used to 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 contend 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 NCWRC. If removal by WS had reached 7,000 deer when the lowest known deer mortality occurred in the State, WS' removal would have represented 3.6% of the total known mortality. Based on those worst-case scenarios, WS' removal of up to 7,000 deer under the proposed action would be extremely low when compared to the total known mortality. WS would report to the NCWRC and monitor removal to ensure WS' activities do not adversely affect deer. The permitting of all WS' removal by the NCWRC ensures WS' removal would meet the population goals for deer in the State as determined by the NCWRC. Based on the limited removal proposed by WS and the oversight by the NCWRC, WS' removal of deer annually would have no effect on the ability of those persons interested to harvest deer during the regulated harvest season. The cumulative lethal removal of deer from WS and other entities appears to be far beneath the level that would begin to cause a decline in the overall statewide North Carolina deer population, but some local population reductions may occur (E. Stanford, NCWRC, pers. comm. 2015).

ANIMAL 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 NCWRC, removal of non-regulated mammal species could occur without the need for authorization from the NCWRC, 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. 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 NCWRC determines the number of mammals that may be lethally removed during the hunting/trapping season and under authorizations issued by the NCWRC.

With the oversight of the NCWRC, 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 NCWRC, 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 animal 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 NCWRC, 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. In addition, 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 NCWRC would continue to regulate populations through adjustments of the allowed removal during the regulated harvest season and the continued use of permits.

Issue 2 - Effects of Activities on the Populations of Non-target Animals, 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 animal species, including T&E species, are analyzed below.

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (Proposed Action/No 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 animal 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 animals, 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 animals. 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 animals since individuals of those species were unharmed. Overall, the use of non-lethal methods would not adversely affect populations of animals 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 animals once captured; therefore, those methods would be 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 2010, 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 NCDACS. 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 animals to Gonacon™ could occur primarily from secondary hazards associated with animals 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 animals to Gonacon™ while being administered to deer would be nearly non-existent. Several factors inherent with Gonacon™ reduce risks to non-target animals 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 that if consumed would be broken down by stomach acids and enzymes (EPA 2009, USDA 2010). The EPA determined that the potential risks to

non-target animals 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 NCWRC 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, gas cartridges (woodchucks, coyotes, fox, skunks only), zinc phosphide (woodchucks only), 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 gas cartridges, burrows and dens would be observed for the presence of non-targets before the use of gas cartridges. 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 gas cartridges. 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).

WS' personnel would only use gas cartridges 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 gas cartridges would be limited.

Zinc phosphide could be available to remove woodchucks from non-crop areas using fruits and/or vegetables as bait; however, zinc phosphide is currently not registered in the State for use to remove 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). 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 animals 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, the zinc phosphide label requires baits for woodchucks to be placed under rock overhangs, in protected crevices, or at the sides of burrows.

Use of zinc phosphide on various types of fruit and/or vegetable baits (*e.g.*, apples, carrots, sweet potatoes, potatoes, pears) has proven to be effective at removing woodchucks causing damage. All chemicals that could be used by WS would be registered under the FIFRA and administered by the EPA and the NCDACS. 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 NCDACS and would be required to adhere to all certification requirements set forth in the FIFRA and North 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.

An additional concern that has arisen is the potential for low-level flights to disturb animals, including T&E species. Aerial operations could be an important method of damage management in North Carolina when used to address damage or threats associated with feral swine and/or coyotes in remote areas where access was limited due to terrain and habitat. Aerial operations involving shooting would only occur in those areas where a work initiation document allowing the use of aircraft had been signed between WS and the cooperating landowner or manager. Aircraft could also be used for aerial surveys of wildlife or radio telemetry. Aerial operations would typically be conducted with aircraft between the months of December and April when the foliage has fallen; however, aircraft could be used at any time of year. The amount of time spent conducting aerial operations would vary depending on the survey area, severity of damage, the size of the area where damage or threats were occurring, and the weather, as low-level aerial activities would be restricted to visual flight rules and would be impractical in high winds or at times when animals were not easily visible.

Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on low flying aircraft to monitor the status of many animal populations, including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (Bellrose 1976), and colonial waterbirds (Speich 1986). Low-level flights also occur when aircraft are used to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1996).

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

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

***Waterbirds and Waterfowl*:** Low-level overflights of two to three minutes in duration by a fixed-wing airplane and a helicopter produced no "*drastic*" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens*

atlantica) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance. Belanger and Bedard (1989, 1990) observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse effects. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the "*time-activity budgets*" of the species. Low-level aerial operations conducted by WS would not be conducted over federal, state, or other governmental agency property without the concurrence of the managing entity. Those flights, if requested, would be conducted to reduce threats and damages occurring to natural resources and should not result in impacts to bird species. Thus, there is little to no potential for any adverse effects on waterbirds and waterfowl.

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

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

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period since results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but found that ferruginous hawks (*B. regalis*) were sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco* spp.), and golden eagles (*Aquila chrysaetos*) were "*incredibly tolerant*" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and the overflights never limited productivity.

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

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

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

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

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

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

***Domestic Animals and Small Mammals*:** A number of studies with laboratory animals (*e.g.*, rodents [Borg 1978]) and domestic animals (*e.g.*, sheep [Ames and Arehart 1972]) have shown that these animals can become habituated to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "*fight or flight*" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National

Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 dbA (United States Forest Service 1992).

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

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

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 animal species during damage management activities conducted under the proposed action alternative would primarily be associated with the use of body-gripping traps and in some situations, with live-capture methods, such as foothold traps, cage traps, and cable restraints.

Table 4.13 shows the number and species of non-target animals that WS' personnel lethally removed unintentionally between FY 2010 and FY 2014 while conducting activities targeting other mammal species. The lethal removal of non-target animals could result in declines in the number of individuals in a population if the number of non-target animals that WS' personnel lethally removed reached a high magnitude. The non-target animals lethally removed unintentionally by WS previously are representative of non-target animals 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 substantially above the number of non-target animals removed annually by WS during previous damage management activities.

Those species lethally removed previously during activities targeting mammal species addressed in this EA 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. Therefore, the analyses evaluated lethal removal of those species cumulatively under Issue 1, including removal that could occur when a species was 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.

Table 4.14 shows the number and species of non-target animals that WS' personnel live-captured and released unharmed from FY 2010 through FY 2014 during activities targeting mammal species addressed in this EA. WS' employees would release live-captured non-target if releasing the animal could occur safely (*e.g.*, without harming the employee, the public, or posing a safety hazard) and no serious harm had occurred to the animal. The live-capture and release of unharmed non-target animals would not adversely affect a species population. Table 4.14 includes those non-target animals live-captured and released by WS' personnel during activities associated with the ORV program, which targets raccoons in those areas

where WS dropped ORV baits as part of post-baiting sampling protocols. The EA analyzing the oral vaccination program to control specific rabies virus variants in raccoons, gray fox, and coyotes in the United States (USDA 2009*a*) provides additional details on the program and the post-baiting sampling protocols.

Table 4.13 – WS' lethal non-target removal by species in North Carolina, FY 2010 – FY 2014

SPECIES	Fiscal Year					TOTAL
	2010	2011	2012	2013	2014	
Bobcat	1	0	0	1	0	**2**
Coyote	3	0	0	0	0	**3**
Raccoon	14	11	13	18	0	**56**
Red Fox	0	1	0	0	0	**1**
Virginia Opossum	1	0	0	0	0	**1**
White-tailed deer	1	0	0	0	0	**1**

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 NCWRC any non-target animals that WS' personnel lethally removes to ensure the NCWRC has the opportunity to consider all removal by WS as part of management objectives established for those species by the NCWRC. The potential for adverse effects to occur to non-target animals would be similar to the other alternatives and would be minimal to non-existent based on previous non-target animal removal.

Table 4.14 – Non-targets captured and released by WS during mammal damage management activities in North Carolina, FY 2010 - FY 2014†

SPECIES	2010	2011	2012	2013	2014	Total
Black Bear	1	0	0	0	0	**1**
Bobcat	0	1	0	0	0	**1**
Eastern Cottontail	1	0	0	2	0	**3**
Feral Cat	0	0	11	21	0	**32**
Feral Dog	0	2	4	1	0	**7**
Gray Squirrel	0	0	0	0	1	**1**
Mink	0	0	1	0	0	**1**
Raccoon	2	1	4	1	1	**9**
Red Fox	1	1	0	0	0	**2**
Virginia Opossum	4	9	70	90	17	**190**
White-tailed Deer	1	0	0	0	0	**1**

†Includes the unintentional live-capture and release of non-target animals during activities associated with the ORV baiting program (USDA 2009*a*)

As discussed previously, the use of non-lethal methods to address damage or threats would generally have 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 WS' personnel would take precautions 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 of this EA describes those SOPs that WS' employees would implement to avoid effects to T&E species.

Although an exact estimate of population numbers for each of the target mammal species is not available, target mammal species can occur statewide in North Carolina. Therefore, damage or threats of damage caused by those mammal species could occur statewide in North Carolina wherever they 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 MOU, work initiation document, or another comparable document. Therefore, WS has defined the action area as the State of North Carolina, which encompasses the known areas occupied by all of the T&E species listed within the State.

The WS program in North Carolina consulted with the USFWS on the potential effects to threatened or endangered species from managing damage associated with mammals in 2012. The USFWS concurred with WS' determinations that activities to manage damage associated with mammals would not adversely affect threatened or endangered species in the State (P. Benjamin, USFWS, pers. comm. 2012). Since those consultations with the USFWS were completed, no incidental take of threatened or endangered species has occurred by WS during activities targeting target mammal species.

During the development of this EA, WS reviewed the current list of species designated as threatened or endangered in North 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 North Carolina. In addition, WS reviewed the methods available to manage mammal damage, the use patterns of those methods, and the areas where previous requests for assistance associated with mammals 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 Appendix C). 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 Appendix C).

Pursuant to Section 7 of the ESA, WS consulted with the USFWS on those effects analysis and determinations. The USFWS concurred with those effects determination made by WS for those species listed in Appendix C (J. Hammond, USFWS, pers. comm. 2015, P. Benjamin, USFWS, pers. comm. 2015). Personnel from WS would have the experience and training to identify animals correctly and to select the most appropriate methods for capturing or removing targeted animals and excluding non-target species. Non-target animals would be individuals that WS captures or kills unintentionally because of mammal damage management. To reduce the likelihood of capturing non-target animals, WS would employ selective methods for the target species, would employ the use of attractants that were specific to target species, and determine placement of methods to avoid exposure to non-targets. WS' personnel

have not captured, killed, or otherwise adversely affected any T&E species during activities conducted previously within the State.

WS' personnel would determine the appropriate methods to resolve requests for assistance using WS' Decision Model (Slate et al. 1992), which allows for an adaptive approach to managing damage or threats of damage (see WS Directive 2.201). The Decision Model allows WS' personnel to apply site-specific factors into determining the appropriate methods for addressing damage or threats of damage while considering other known factors, such as the likely presence of T&E species in the area where WS' personnel might employ methods.

State Listed Species – The current list of State listed species as endangered or threatened by the State as determined by the NCWRC was 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 will not adversely affect those species currently listed by the State. The NCWRC has concurred with WS' determination for State listed species (B. Sherrill, NCWRC, pers. comm. 2015).

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 animals than the proposed action. When those persons experiencing damage caused by animals 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 animals (*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 animal 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 NCWRC, 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 NCWRC. 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 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 (Proposed Action/No 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, gas cartridges (woodchucks, coyotes, fox, skunks only), zinc phosphide (woodchucks only), 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 animal 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 were 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 animals, 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 animals relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from animals that have been exposed. Under the alternatives identified, the use of chemical methods could include immobilizing drugs, euthanasia chemicals, GonaCon™ (deer only), gas cartridges (woodchucks, coyotes, fox, skunks only), zinc phosphide (woodchucks only), and repellents.

WS' employees would only administer immobilizing drugs to mammals that have been live-captured using other methods or administered through injection using a projectile (*e.g.*, dart gun). WS' employees could use immobilizing drugs to sedate animals that require handling (*e.g.*, during disease sampling) and/or animals being transported (*e.g.*, placed in an animal crate and transported to a release site). Sedating the animal could lessen the distress of the animal during the handling and/or transportation process. 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 animals 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 animals 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 damage management programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to the hunting 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 zinc phosphide or the use of zinc phosphide products registered for use to manage woodchucks in the State could occur under the proposed action as part of an integrated approach to managing damage. Zinc phosphide products 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 zinc phosphide or the direct use of zinc

phosphide would be similar across all the alternatives. WS' involvement, either through recommending the use of zinc phosphide or the direct use of zinc phosphide, would ensure that label requirements of zinc phosphide 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 zinc phosphide 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 NCDACS 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.

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 NCWRC 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 NCWRC 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.

CONSEQUENCES OF AERIAL WILDLIFE OPERATIONS ACCIDENTS

Aerial wildlife operations, like any other flying, may result in an accident. WS' pilots and crewmembers would be trained and experienced to recognize the circumstances that lead to accidents. The national WS Aviation Program has increased its emphasis on safety, including funding for additional training, the establishment of a WS Flight Training Center and annual recurring training for all pilots. Still, accidents may occur and the environmental consequences should be evaluated.

***Major Ground or Wild/Forest Fires*:** Although fires could result from aircraft-related accidents, no such fires have occurred from aircraft incidents previously involving government aircraft and low-level flights.

Fuel Spills and Environmental Hazard from Aviation Accidents: A representative of the National Transportation Safety Board has stated previously that aviation fuel is extremely volatile and will evaporate within a few hours or less to the point that even its odor cannot be detected (USDA 2005*b*). The fuel capacity for aircraft used by WS varies. For fixed-winged aircraft, a 52-gallon capacity would generally be the maximum, while 91 gallons would generally be the maximum fuel capacity for helicopters. In some cases, little or none of the fuel would be spilled if an accident occurs. Thus, there should be little environmental hazard from unignited fuel spills.

Oil and Other Fluid Spills: With the size of aircraft used by WS, the quantities of oil (*e.g.*, 6 to 8 quarts maximum for reciprocating (piston) engines and 3 to 5 quarts for turbine engines) capable of being spilled in any accident would be small with minimal chance of causing environmental damage. Aircraft used by WS would be single engine models, so the greatest amount of oil that could be spilled in one accident would be about eight quarts.

When exposed to oxygen, petroleum products biodegrade through volatilization and bacterial action (EPA 2000). Thus, small quantity oil spills on surface soils can be expected to biodegrade readily. Even in subsurface contamination situations involving underground storage facilities that would generally be expected to involve larger quantities than would ever be involved in a small aircraft accident, the EPA guidelines provide for *"natural attenuation"* or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents were not cleaned up, the oil does not persist in the environment or persists in such small quantities that no adverse effects would be expected. In addition, WS' accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low to nonexistent.

For these reasons, the risk of ground fires or fuel/oil pollution from aviation accidents could be considered low. In addition, based on the history and experience of the program in aircraft accidents, it appears the risk of significant environmental damage from such accidents is exceedingly low.

No adverse effects to human safety have occurred from WS' use of methods to alleviate mammal damage in the State from FY 2010 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 animals. 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 NCWRC or their designated agents could use GonaCon™ under this alternative, if registered. Immobilizing drugs and euthanasia chemicals used in capturing and handling animals 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 NCWRC. 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 authorization from the NCWRC.

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 NCDACS 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 NCWRC 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 NCWRC 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, gas cartridges, zinc phosphide, 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 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 (Proposed Action/No 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 animals if the resource being damaged was acting as an attractant. Thus, once the attractant was removed or made unavailable, the animals 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 NCWRC authorizes the removal, without the need for specific authorization if the species was unregulated, or during the regulated hunting or trapping seasons.

WS' removal of mammals from FY 2010 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 when authorized, during the regulated hunting and trapping seasons, or if the mammals were unregulated, removal could occur without the need for specific authorization. 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 authorized by the NCWRC, 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 specific authorization.

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 NCWRC 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 NCWRC would regulate and adjust the number of mammals lethally removed annually through hunting and the number lethally removed to alleviate damage.

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 (Proposed Action/No 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 animals 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 animals to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of animals 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 animals. 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 animals 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 animals. 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 action to alleviate conditions that cause pain or distress in animals.

WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g.*, drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g.*, cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once daily or in accordance with North Carolina laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner. 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 animals, 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.

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 have limited availability to those people experiencing damage associated with mammals would be reproductive inhibitors, immobilizing drugs, euthanasia chemicals, and the use of aircraft. 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 North 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 animals 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 animals.

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 NCWRC, 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 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 animals 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 animals 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 NCWRC 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 NCWRC to ensure activities were within management objectives for those species. WS would submit annual activity reports to the NCWRC. The NCWRC 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 animal 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 wildlife populations in the State, the NCWRC 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 NCWRC had the opportunity to consider any activities WS conducts.

The populations of several wildlife species are sufficient to allow for annual harvest seasons that typically occur during the fall. The NCWRC establishes hunting and trapping seasons in the State for wildlife. With oversight of activities to alleviate damage associated with wildlife, the NCWRC maintains the ability to regulate removal by WS to meet management objectives for wildlife in the State. Therefore, the NCWRC would have the opportunity to consider the cumulative removal of wildlife as part of their objectives for wildlife populations in the State. WS' removal of mammals in North Carolina from FY 2010 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 anticipated annual removal of target animal species would also be of low magnitude when compared to estimated populations and the annual harvest of those species. Therefore, the proposed activities would not limit the ability of people to harvest target wildlife species in the State.

The NCWRC could consider all known removal when determining population objectives for wildlife and could adjust the number of individuals within a wildlife species that could be harvested during the regulated harvest season and the number of individual animals that people can remove for damage management purposes to achieve the population objectives. Any removal of regulated wildlife species by WS would occur at the discretion of the NCWRC. Therefore, any wildlife population declines or increases would be the collective objective for those wildlife populations established by the NCWRC through the regulation of lethal removal. The cumulative removal of individuals from a wildlife species annually or over time by WS would occur at the discretion of the NCWRC as part of management objectives for wildlife in the State. WS does not expect cumulative adverse effects to occur to the populations of target and non-target animals from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on mammal populations

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 North 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 animal 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 Activities on the Populations of Non-target Animals, 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 animals. However, the effects of non-lethal methods are often temporary and often do not involve the removal (killing) of non-target animal species. When using exclusion devices and/or repellents, both target and non-target animals 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 animals 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 animals 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 animals, 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 animals that would be subsequently euthanized using humane methods. With all live-capture devices, non-target animals captured could be released on site if determined to be able to survive following release. SOPs are intended to ensure removal of non-target animals was minimal during the use of methods to capture target animals.

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 animals. 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, GonaCon™ (deer only), gas cartridges (woodchucks, coyotes, fox, skunks only), zinc phosphide (woodchucks only), 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 North 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 North Carolina when used according to label requirements.

When using zinc phosphide, 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 zinc phosphide, the label requires people place baits for woodchucks under rock overhangs, in protected crevices, or at the sides of burrows.

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. The unintentional removal of animals 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 NCWRC, 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 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 animals. 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 NCDACS. 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, gas cartridges and zinc phosphide must also be registered for use with the EPA and the NCDACS. Given the use patterns of repellents, zinc phosphide, and gas cartridges, 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 2010 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 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 animals because they feel that overabundant species are objectionable and interfere with their enjoyment of animals 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 animals or the natural environment. The actions of WS could positively affect the aesthetic enjoyment of animals 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 NCWRC 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 NCWRC. Since those persons seeking assistance could remove mammals from areas where damage was occurring when authorized by the NCWRC, 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 animal populations and specific individuals among a species may experience death early in life. Mortality in animal 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 animals. 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 North Carolina laws and regulations to ensure any animals 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 animals 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 animals captured were addressed in a timely manner to minimize distress.

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED

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APPENDIX A
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APPENDIX B
MAMMAL DAMAGE MANAGEMENT METHODS AVAILABLE FOR USE OR RECOMMENDATION

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 North 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 North 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, the landowner or administrator authorizing the use of each damage management method must sign a MOU, work initiation document, or another similar document. 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, especially if 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. People can sometimes use hardware cloth or other metal barriers to prevent girdling and gnawing of valuable trees and to prevent the entry of mammals into buildings through existing holes or gaps. Riprap can also be used on dams and levees to deter woodchuck burrowing. 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. Removal of trees from around buildings can sometimes reduce damage associated with tree squirrels and raccoons.

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 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, 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 North 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. Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise in North 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 NCWRC.

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 NCWRC or other natural resource agencies. An entity may be required to obtain authorization from the NCWRC 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 would be 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 and corral 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. Cage traps would be available to all entities to alleviate damage.

Corral traps for feral swine are generally large circular traps consisting of panels anchored to the ground using steel posts with a door allowing entrance. Side panels are typically woven metal fencing referred to as swine panels or cow panels. The entrances into the traps generally consist of a door that allows entry into the trap but prevents exit. The doors are often designed to allow swine to continually enter the trap, which allows for the possibility of capturing multiple swine.

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. Disadvantages associated with corral traps include: 1) the expense of purchasing the materials to construct trap, 2) once constructed, corral traps are not moveable until disassembled and transported, and 3) in remote areas, getting all the required equipment to the location can be difficult.

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

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

Body-grip Traps are designed to cause the quick death of the animal that activates the trap, such as 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 or feral swine. 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*). WS Directive 2.425 provides guidelines for the use of denning by WS' personnel to manage animal damage.

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 Shooting or aerial hunting (*i.e.*, shooting from an aircraft) is a commonly used damage management method for coyotes and feral swine. Aerial shooting can be especially effective in removing offending coyotes that have become "*bait-shy*" to trap sets or are not susceptible to calling and shooting. Aerial shooting is one of the preferred damage management methods for reducing feral swine damage as well, in that local swine populations can quickly be removed when weather and habitat conditions are favorable. Aerial hunting is mostly species-selective (there is a slight potential for misidentification) and can be used for immediate control to reduce livestock and natural resource losses if weather, terrain, and cover conditions are favorable. WS has also used aerial shooting for disease surveillance (*e.g.*, taking deer samples for chronic wasting disease and searching for carcasses in areas where an anthrax outbreak has occurred). Fixed-wing aircraft are most frequently used in flat and gently rolling terrain whereas helicopters with better maneuverability have greater utility and are safer over rugged terrain and timbered areas.

In broken timber or deciduous cover, aerial shooting can be more effective in winter when snow cover can improve visibility and leaves have fallen. The WS program aircraft-use policy helps ensure that aerial shooting is conducted in a safe and environmentally sound manner, in accordance with federal and state laws. Pilots and aircraft must be certified under established WS program procedures and only properly trained WS' employees are approved as gunners. Ground crews are often used with aerial operations for safety reasons. Ground crews can also assist with locating and recovering target animals, as necessary.

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

WS has used fixed-wing aircraft and helicopters for aerial hunting in areas inhabited by wildlife for years. WS conducts aerial activities on areas only under signed agreement and concentrates efforts during

certain times of the year and to specific areas. WS' Predator Damage Management Environmental Assessments (*e.g.*, see USDA 2005*b*) that have looked at the issue of aerial hunting overflights on wildlife have found that WS has annually flown less than 10 min./mi.^{2} on properties under agreements. WS flies very little over any one property under agreement in any given year. As a result, no known problems to date have occurred with WS' aerial hunting overflights on wildlife, nor are they anticipated in the future.

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 NCDACS. All WS personnel in North Carolina who apply restricted-use pesticides would be certified pesticide applicators by the NCDACS and have specific training by WS for pesticide application. The EPA and the NCDACS 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).

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 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, 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 placement 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
FEDERAL THREATENED AND ENDANGERED SPECIES IN NORTH CAROLINA

Common Name	Scientific Name	Status[†]	Determination[‡]
Animals			
Arachnids			
Spruce-fir Moss Spider	*Microhexura montivaga*	E	NE
Spruce-fir Moss Spider		CH	NE
Birds			
Piping Plover	*Charadrius melodus*	T	MANLAA
Piping Plover		CH	NE
Red Knot	*Calidris canutus rufa*	T	NE
Red-cockaded Woodpecker	*Picoides borealis*	E	MANLAA
Roseate Tern	*Sterna dougallii dougallii*	E	NE
Wood Stork	*Mycteria Americana*	T	NE
Clams			
Appalachian Elktoe	*Alasmidonta raveneliana*	E	MANLAA
Appalachian Elktoe		CH	NE
Carolina Heelsplitter	*Lasmigona decorate*	E	MANLAA
Carolina Heelsplitter		CH	NE
Cumberland Bean	*Villosa trabalis*	E	NE
Dwarf Wedgemussel	*Alasmidonta heterodon*	E	NE
James Spinymussel	*Pleurobema collina*	E	NE
Littlewing Pearlymussel	*Pegias fabula*	E	NE
Tar River Spinymussel	*Elliptio steinstansana*	E	MANLAA
Fishes			
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	NE
Cape Fear Shiner	*Notropis mekistocholas*	E	NE
Cape Fear Shiner		CH	NE
Shortnose Sturgeon	*Acipenser brevirostrum*	E	NE
Spotfin Chub	*Erimonax monachus*	T	NE
Spotfin Chub		CH	NE
Waccamaw Silverside	*Menidia extensa*	T	NE
Waccamaw Silverside		CH	NE
Insects			
Saint Francis' Satyr Butterfly	*Neonympha mitchellii francisci*	E	NE
Mammals			
Carolina Northern Flying Squirrel	*Glaucomys sabrinus coloratus*	E	NE
Gray Bat	*Myotis grisescens*	E	NE
Indiana Bat	*Myotis sodalist*	E	MANLAA
Northern Long-eared Bat	*Myotis septentrionalis*	T	NE
Virginia Big-eared Bat	*Corynorhinus townsendii virginianus*	E	MANLAA
Red Wolf	*Canis rufus*	E	MANLAA
West Indian Manatee	*Trichechus manatus*	E	NE
Reptiles			
American Alligator	*Alligator mississippiensis*	T/SA	NE
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
Snails			
Magnificent Ramshorn	*Planorbella magnifica*	C	NE
Noonday Globe	*Patera clarki Nantahala*	T	NE
Plants			
Flowering Plants			
American Chaffseed	*Schwalbea Americana*	E	NE
Blue Ridge Goldenrod	*Solidago spithamaea*	T	NE
Bunched Arrowhead	*Sagittaria fasciculate*	E	NE
Canby's Dropwort	*Oxypolis canbyi*	E	NE
Cooley's Meadowrue	*Thalictrum cooleyi*	E	NE
Dwarf-flowered Heartleaf	*Hexastylis naniflora*	T	NE
Golden Sedge	*Carex lutea*	E	NE
Golden Sedge		CH	NE
Green Pitcher-plant	*Sarracenia oreophila*	E	NE
Harperella	*Ptilimnium nodosum*	E	NE
Heller's Blazingstar	*Liatris helleri*	T	NE
Michaux's Sumac	*Rhus michauxii*	E	NE
Mountain Golden Heather	*Hudsonia montana*	T	NE
Mountain Golden Heather		CH	NE
Mountain Sweet Pitcher-plant	*Sarracenia rubra ssp. Jonesii*	E	NE
Pondberry	*Lindera melissifolia*	E	NE
Roan Mountain Bluet	*Hedyotis purpurea var. montana*	E	NE
Rough-leaved Loosestrife	*Lysimachia asperulaefolia*	E	NE
Schweinitz's sunflower	*Helianthus schweinitzii*	E	NE
Seabeach amaranth	*Amaranthus pumilus*	T	NE
Sensitive Joint-vetch	*Aeschynomene virginica*	T	NE
Small Whorled Pogonia	*Isotria medeoloides*	T	NE
Small-anthered Bittercress	*Cardamine micranthera*	E	NE
Smooth Coneflower	*Echinacea laevigata*	E	NE
Spreading Avens	*Geum radiatum*	E	NE
Swamp Pink	*Helonias bullata*	T	NE
Virginia Spiraea	*Spiraea virginiana*	T	NE
White Irisette	*Sisyrinchium dichotomum*	E	NE
Lichens			
Rock Gnome Lichen	*Gymnoderma lineare*	E	NE

†T=Threatened; E=Endangered; C=Candidate; P=Proposed; SA=Similarity of Appearance; CH=Critical Habitat

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

APPENDIX D

STATE THREATENED OR ENDANGERED SPECIES AND SPECIES OF SPECIAL CONCERN IN NORTH CAROLINA

15A NCAC 10I .0103 ENDANGERED SPECIES LISTED

(a) The following species of resident wildlife are designated as federally-listed endangered species:

(1) Amphibians:
None Listed At This Time.

(2) Birds:
(A) Bachman's warbler (*Vermivora bachmanii*);
(B) Ivory-billed woodpecker (*Campephilus principalis*);
(C) Kirtland's warbler (*Dendroica kirtlandii*);
(D) Piping plover (*Charadrius melodus circumcinctus*);
(E) Red-cockaded woodpecker (*Picoides borealis*);
(F) Roseate tern (*Sterna dougallii dougallii*);
(G) Wood stork (*Mycteria americana*).

(3) Crustacea: None Listed At This Time.

(4) Fish:
(A) Cape Fear shiner (*Notropis mekistocholas*);
(B) Roanoke logperch (*Percina rex*);
(C) Shortnose sturgeon (*Acipenser brevirostrum*), when found in inland fishing waters.

(5) Mammals:
(A) Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*);
(B) Eastern cougar (*Puma concolor*);
(C) Gray bat (*Myotis grisescens*);
(D) Indiana bat (*Myotis sodalis*);
(E) Manatee (*Trichechus manatus*), when found in inland fishing waters;
(F) Virginia big-eared bat (*Corynorhinus townsendii virginianus*).

(6) Mollusks:
(A) Appalachian elktoe (*Alasmidonta raveneliana*);
(B) Carolina heelsplitter (*Lasmigona decorata*);
(C) Dwarf wedge mussel (*Alasmidonta heterodon*);
(D) James spinymussel (*Pleurobema collina*);
(E) Little-wing pearlymussel (*Pegias fabula*);
(F) Tan riffleshell (*Epioblasma florentina walkeri*);
(G) Tar River spinymussel (*Elliptio steinstansana*).

(7) Reptiles:
(A) Kemp's ridley seaturtle (*Lepidochelys kempii*);
(B) Atlantic hawksbill seaturtle (*Eretmochelys imbricata imbricata*);
(C) Leatherback seaturtle (*Dermochelys coriacea*).

(b) The following species of resident wildlife are designated as state-listed endangered species:

(1) Amphibians: Green salamander (*Aneides aeneus*).

(2) Birds:
(A) American peregrine falcon (*Falco peregrinus anatum*);
(B) Bewick's wren (*Thryomanes bewickii*).

(3) Crustacea: Bennett's Mill cave water slater (*Caecidotea carolinensis*).

(4) Fish:
(A) Blotchside logperch (*Percina burtoni*);
(B) Bridle shiner (*Notropis bifrenatus*);
(C) Dusky darter (*Percina sciera*);
(D) Orangefin madtom (*Noturus gilberti*);
(E) Paddlefish (*Polyodon spathula*);
(F) Robust redhorse (*Moxostoma robustum*);
(G) Rustyside sucker (*Thoburnia hamiltoni*);

(H) Stonecat (*Noturus flavus*).

(5) Mammals: None Listed At This Time.

(6) Mollusks:

(A) Atlantic pigtoe (*Fusconaia masoni*);
(B) Barrel floater (*Anodonta couperiana*);
(C) Brook floater (*Alasmidonta varicosa*);
(D) Carolina creekshell (*Villosa vaughaniana*);
(E) Fragile glyph (*Glyphyalinia clingmani*);
(F) Green floater (*Lasmigona subviridis*);
(G) Greenfield rams-horn (*Helisoma eucosmium*)
(H) Knotty elimia (*Elimia christyi*);
(I) Magnificent rams-horn (*Planorbella magnifica*);
(J) Neuse spike (*Elliptio judithae*);
(K) Purple wartyback (*Cyclonaias tuberculata*);
(L) Savannah lilliput (*Toxolasma pullus*);
(M) Slippershell mussel (*Alasmidonta viridis*);
(N) Tennessee clubshell (*Pleurobema oviforme*);
(O) Tennessee heelsplitter (*Lasmigona holstonia*);
(P) Tennessee pigtoe (*Fusconaia barnesiana*);
(Q) Yellow lampmussel (*Lampsilis cariosa*);
(R) Yellow lance (*Elliptio lanceolata*).

(7) Reptiles:

(A) Eastern coral snake (*Micrurus fulvius fulvius*);
(B) Eastern diamondback rattlesnake (*Crotalus adamanteus*).

History Note: *Authority G.S. 113-134; 113-291.2; 113-292; 113-333;*
Eff. June 11, 1977;
Amended Eff. May 1, 2008; April 1, 2001; February 1, 1994; November 1, 1991; April 1, 1991; June 1, 1990.

15A NCAC 10I .0104 THREATENED SPECIES LISTED

(a) The following species of resident wildlife are designated as federally-listed threatened species:

(1) Amphibians: None Listed At This Time.
(2) Birds: Piping plover (*Charadrius melodus melodus*).
(3) Crustacea: None Listed At This Time.
(4) Fish:

(A) Spotfin chub (*Cyprinella monacha*);
(B) Waccamaw silverside (*Menidia extensa*).

(5) Mammals: None Listed At This Time.
(6) Mollusks: Noonday globe (*Patera clarki nantahala*).
(7) Reptiles:

(A) Bog turtle (*Glyptemys muhlenbergii*);
(B) American alligator (*Alligator mississipiensis*);
(C) Green seaturtle (*Chelonia mydas*);
(D) Loggerhead seaturtle (*Caretta caretta*).

(b) The following species of resident wildlife are designated as state-listed threatened species:

(1) Amphibians:

(A) Carolina gopher frog (*Rana capito capito*);
(B) Eastern tiger salamander (*Ambystoma tigrinum tigrinum*);
(C) Junaluska salamander (*Eurycea junaluska*);
(D) Wehrle's salamander (*Plethodon wehrlei*).

(2) Birds:

(A) Bald eagle (*Haliaeetus leucocephalus*)
(B) Gull-billed tern (*Sterna nilotica aranea*);
(C) Northern saw-whet owl (*Aegolius acadicus*).

(3) Crustacea: None Listed At This Time.

(4) Fish:
- (A) American brook lamprey (*Lampetra appendix*);
- (B) Banded sculpin (*Cottus carolinae*);
- (C) Bigeye jumprock (*Scartomyzon ariommus*);
- (D) Blackbanded darter (*Percina nigrofasciata*);
- (E) Carolina madtom (*Noturus furiosus*);
- (F) Carolina pygmy sunfish (*Elassoma boehlkei*);
- (G) Carolina redhorse (*Moxostoma* sp.) (Pee Dee River and its tributaries and Cape Fear River and its tributaries);
- (H) Least brook lamprey (*Lampetra aepyptera*);
- (I) Logperch (*Percina caprodes*);
- (J) Rosyface chub (*Hybopsis rubrifrons*);
- (K) Sharphead darter (*Etheostoma acuticeps*);
- (L) Sicklefin redhorse (*Moxostoma* sp.) (Hiwassee River and its tributaries and Little Tennessee River and its tributaries);
- (M) Turquoise darter (*Etheostoma inscriptum*);
- (N) Waccamaw darter (*Etheostoma perlongum*).

(5) Mammals:
- (A) Eastern woodrat (*Neotoma floridana floridana*);
- (B) Rafinesque's big-eared bat (*Corynorhinus rafinesquii rafinesquii*).

(6) Mollusks:
- (A) Alewife floater (*Anodonta implicata*);
- (B) Big-tooth covert (*Fumonelix jonesiana*);
- (C) Cape Fear threetooth (*Triodopsis soelneri*);
- (D) Carolina fatmucket (*Lampsilis radiata conspicua*);
- (E) Clingman covert (*Fumonelix wheatleyi clingmanicus*);
- (F) Eastern lampmussel (*Lampsilis radiata radiata*);
- (G) Eastern pondmussel (*Ligumia nasuta*);
- (H) Engraved covert (*Fumonelix orestes*);
- (I) Mountain creekshell (*Villosa vanuxemensis*);
- (J) Roan supercoil (*Paravitrea varidens*);
- (K) Roanoke slabshell (*Elliptio roanokensis*);
- (L) Sculpted supercoil (*Paravitrea ternaria*);
- (M) Seep mudalia (*Leptoxis dilatata*);
- (N) Smoky Mountain covert (*Inflectarius ferrissi*);
- (O) Squawfoot (*Strophitus undulatus*);
- (P) Tidewater mucket (*Leptodea ochracea*);
- (Q) Triangle floater (*Alasmidonta undulata*);
- (R) Waccamaw ambersnail (*Catinella waccamawensis*);
- (S) Waccamaw fatmucket (*Lampsilis fullerkati*);
- (T) Waccamaw spike (*Elliptio waccamawensis*).

(7) Reptiles: None Listed At This Time.

History Note: *Authority G.S. 113-134; 113-291.2; 113-292; 113-333;*
Eff. March 17, 1978;
Amended Eff. June 1, 2008; April 1, 2001; November 1, 1991; April 1, 1991; June 1, 1990; September 1, 1989.

15A NCAC 10I .0105 SPECIAL CONCERN SPECIES LISTED

The following species of resident wildlife are designated as state-listed special concern species:

(1) Amphibians:
- (a) Crevice salamander (*Plethodon longicrus*);
- (b) Dwarf salamander (*Eurycea quadridigitata*);
- (c) Eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*);
- (d) Four-toed salamander (*Hemidactylium scutatum*);
- (e) Longtail salamander (*Eurycea longicauda longicauda*);

(f) Mole salamander (*Ambystoma talpoideum*);
(g) Mountain chorus frog (*Pseudacris brachyphona*);
(h) Mudpuppy (*Necturus maculosus*);
(i) Neuse River waterdog (*Necturus lewisi*);
(j) River frog (*Rana heckscheri*);
(k) Southern zigzag salamander (*Plethodon ventralis*);
(l) Weller's salamander (*Plethodon welleri*).

(2) Birds:
(a) American oystercatcher (*Haematopus palliatus*);
(b) Bachman's sparrow (*Aimophila aestivalis*);
(c) Black-capped chickadee (*Poecile atricapillus*);
(d) Black rail (*Laterallus jamaicensis*);
(e) Black skimmer (*Rynchops niger*);
(f) Brown creeper (*Certhia americana nigrescens*);
(g) Cerulean warbler (*Dendroica cerulea*);
(h) Common tern (*Sterna hirundo*);
(i) Glossy ibis (*Plegadis falcinellus*);
(j) Golden-winged warbler (*Vermivora chrysoptera*);
(k) Henslow's sparrow (*Ammodramus henslowii*);
(l) Least bittern (*Ixobrychus exilis*);
(m) Least tern (*Sterna antillarum*);
(n) Little blue heron (*Egretta caerulea*);
(o) Loggerhead shrike (*Lanius ludovicianus*);
(p) Olive-sided flycatcher (*Contopus cooperi*);
(q) Painted bunting (*Passerina ciris*);
(r) Red crossbill (*Loxia curvirostra*);
(s) Snowy egret (*Egretta thula*);
(t) Tricolored heron (*Egretta tricolor*);
(u) Vesper sparrow (*Pooecetes gramineus*);
(v) Wilson's plover (*Charadrius wilsonia*);
(w) Yellow-bellied sapsucker (*Sphyrapicus varius appalachiensis*).

(3) Crustacea:
(a) Broad River spiny crayfish (*Cambarus spicatus*);
(b) Carolina skistodiaptomus (*Skistodiaptomus carolinensis*);
(c) Carolina well diacyclops (*Diacyclops jeannelli putei*);
(d) Chowanoke crayfish (*Orconectes virginiensis*);
(e) Graceful clam shrimp (*Lynceus gracilicornis*);
(f) Greensboro burrowing crayfish (*Cambarus catagius*);
(g) Hiwassee headwaters crayfish (*Cambarus parrishi*);
(h) Little Tennessee River crayfish (*Cambarus georgiae*);
(i) North Carolina spiny crayfish (*Orconectes carolinensis*);
(j) Oconee stream crayfish (*Cambarus chaugaensis*);
(k) Waccamaw crayfish (*Procambarus braswelli*).

(4) Fish:
(a) Atlantic sturgeon (*Acipenser oxyrinchus*);
(b) Bluefin killifish (*Lucania goodei*);
(c) Blue Ridge sculpin (*Cottus caeruleomentum*);
(d) Blueside darter (*Etheostoma jessiae*);
(e) Broadtail madtom (*Noturus* sp.) (Lumber River and its tributaries and Cape Fear River and its tributaries);
(f) Carolina darter (*Etheostoma collis*);
(g) Cutlip minnow (*Exoglossum maxillingua*);
(h) Freshwater drum (*Aplodinotus grunniens*) (French Broad River);
(i) Highfin carpsucker (*Carpiodes velifer*) (Cape Fear River and its tributaries);
(j) Kanawha minnow (*Phenacobius teretulus*);
(k) Lake sturgeon (*Acipenser fulvescens*);

(l) Least killifish (*Heterandria formosa*);
(m) Longhead darter (*Percina macrocephala*);
(n) Mooneye (*Hiodon tergisus*);
(o) Mountain madtom (*Noturus eleutherus*);
(p) Olive darter (*Percina squamata*);
(q) Pinewoods darter (*Etheostoma mariae*);
(r) River carpsucker (*Carpiodes carpio*);
(s) Riverweed darter (*Etheostoma podostemone*);
(t) Sandhills chub (*Semotilus lumbee*);
(u) Sharpnose darter (*Percina oxyrhynchus*);
(v) Smoky dace (*Clinostomus* sp.) (Little Tennessee River and tributaries);
(w) Striped shiner (*Luxilus chrysocephalus*);
(x) Tennessee snubnose darter (*Etheostoma simoterum*);
(y) Thinlip chub (*Cyprinella zanema*) (Lumber River and its tributaries and Cape Fear River and its tributaries);
(z) Waccamaw killifish (*Fundulus waccamensis*);
(aa) Wounded darter (*Etheostoma vulneratum*);
(bb) Yellowfin shiner (*Notropis lutipinnis*) (Savannah River and its tributaries);

(5) Mammals:
(a) Allegheny woodrat (*Neotoma magister*);
(b) Buxton Woods white-footed mouse (*Peromyscus leucopus buxtoni*);
(c) Coleman's oldfield mouse (*Peromyscus polionotus colemani*);
(d) Eastern big-eared bat (*Corynorhinus rafinesquii macrotis*);
(e) Eastern small-footed bat (*Myotis leibii leibii*);
(f) Elk (*Cervus elaphus*);
(g) Florida yellow bat (*Lasiurus intermedius floridanus*);
(h) Pungo white-footed mouse (*Peromyscus leucopus easti*);
(i) Southeastern bat (*Myotis austroriparius*);
(j) Southern rock shrew (*Sorex dispar blitchi*);
(k) Southern rock vole (*Microtus chrotorrhinus carolinensis*);
(l) Southern water shrew (*Sorex palustris punctulatus*);
(m) Star-nosed mole (*Condylura cristata parva*).

(6) Mollusks:
(a) Appalachian gloss (*Zonitoides patuloides*);
(b) Bidentate dome (*Ventridens coelaxis*);
(c) Black mantleslug (*Pallifera hemphilli*);
(d) Blackwater ancylid (*Ferrissia hendersoni*);
(e) Blue-foot lancetooth (*Haplotrema kendeighi*);
(f) Cape Fear spike (*Elliptio marsupiobesa*);
(g) Dark glyph (*Glyphyalinia junaluskana*);
(h) Dwarf proud globe (*Patera clarki clarki*);
(i) Dwarf threetooth (*Triodopsis fulciden*);
(j) Fringed coil (*Helicodiscus fimbriatus*);
(k) Glossy supercoil (*Paravitrea placentula*);
(l) Great Smoky slitmouth (*Stenotrema depilatum*);
(m) High mountain supercoil (*Paravitrea andrewsae*);
(n) Honey glyph (*Glyphyalinia vanattai*);
(o) Lamellate supercoil (*Paravitrea lamellidens*);
(p) Mirey Ridge supercoil (*Paravitrea clappi*);
(q) Notched rainbow (*Villosa constricta*);
(r) Open supercoil (*Paravitrea umbilicaris*);
(s) Pink glyph (*Glyphyalinia pentadelphia*);
(t) Pod lance (*Elliptio folliculata*);
(u) Queen crater (*Appalachina chilhoweensis*);
(v) Rainbow (*Villosa iris*);
(w) Ramp Cove supercoil (*Paravitrea lacteodens*);

(x) Saw-tooth disc (*Discus bryanti*);
(y) Spike (*Elliptio dilatata*);
(z) Spiral coil (*Helicodiscus bonamicus*);
(aa) Velvet covert (*Inflectarius subpalliatus*);
(bb) Waccamaw amnicola (*Amnicola* sp.);
(cc) Waccamaw lampmussel (*Lampsilis crocata*);
(dd) Waccamaw siltsnail (*Cincinnatia* sp.);
(ee) Wavy-rayed lampmussel (*Lampsilis fasciola*).

(7) Reptiles:
(a) Carolina pigmy rattlesnake (*Sistrurus miliarius miliarius*);
(b) Carolina watersnake (*Nerodia sipedon williamengelsi*);
(c) Diamondback terrapin (*Malaclemys terrapin*);
(d) Eastern smooth green snake (*Opheodrys vernalis vernalis*);
(e) Eastern spiny softshell (*Apalone spinifera spinifera*);
(f) Mimic glass lizard (*Ophisaurus mimicus*);
(g) Northern pine snake (*Pituophis melanoleucus melanoleucus*);
(h) Outer Banks kingsnake (*Lampropeltis getula sticticeps*);
(i) Southern hognose snake (*Heterodon simus*);
(j) Stripeneck musk turtle (*Sternotherus minor peltifer*);
(k) Timber rattlesnake (*Crotalus horridus*).

History Note: *Authority G.S. 113-134; 113-291.2; 113-292; 113-333;*
Eff. September 1, 1989;
Amended Eff. May 1, 2008; July 18, 2002; April 1, 2001; November 1, 1991; April 1, 1991; June 1, 1990.