ENVIRONMENTAL ASSESSMENT

MAMMAL DAMAGE MANAGEMENT
IN THE STATE OF RHODE ISLAND

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

February 2013

TABLE OF CONTENTS

ACRONYMS ii

CHAPTER 1: PURPOSE AND NEED FOR ACTION
1.1 PURPOSE 1
1.2 NEED FOR ACTION 1
1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT 16
1.5 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS 19
1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES 19
1.6 COMPLIANCE WITH LAWS AND STATUTES 22
1.7 DECISIONS TO BE MADE 28

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES
2.1 AFFECTED ENVIRONMENT 28
2.2 ISSUES ASSOCIATED WITH MAMMAL DAMAGE MANAGEMENT ACTIVITIES 30
2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE 37

CHAPTER 3: ALTERNATIVES
3.1 DESCRIPTION OF THE ALTERNATIVES 43
3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL 49
3.3 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT 54
3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES 55

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES
4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL 58
4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE 140

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED
5.1 LIST OF PREPARERS AND REVIEWERS 147
5.2 LIST OF PERSONS CONSULTED 147

LIST OF APPENDICES

APPENDIX A LITERATURE CITED A-1

APPENDIX B METHODS AVAILABLE FOR USE OR RECOMMENDATION BY THE RHODE ISLAND WS PROGRAM B-1

APPENDIX C THREATENED AND ENDANGERED SPECIES THAT ARE LISTED IN THE STATE OF RHODE ISLAND C-1

APPENDIX D CRITERIA FOR BEAVER DAM BREACHING/REMOVAL D-1

ACRONYMS

ABC	American Bird Conservancy
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
CO_2	Carbon Dioxide
CRMC	Coastal Resource Management Council
CWA	Clean Water Act
CWD	Chronic Wasting Disease
DEA	Drug Enforcement Administration
DFW	Division of Fisheries and Wildlife
DOA	Division of Agriculture
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FeLV	Feline Leukemia Virus
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FIV	Feline Immunodeficiency Virus
FLIR	Forward Looking Infrared
FPV	Feline Panleukopenia Virus
FY	Fiscal Year
GnRH	Gonadotropin-releasing hormone
MMHSRP	Marine Mammal Health and Stranding Response Program
MOU	Memorandum of Understanding
NASS	National Agricultural Statistic Service
NEFO	New England Field Office
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWRC	National Wildlife Research Center
ORV	Oral Rabies Vaccination
PEP	Post - Exposure Prophylaxis
RIDEM	Rhode Island Department of Environmental Management
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TNR	Trap, Neuter, Release Program
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFWS	United States Fish and Wildlife Services
VHF	Very High Frequency
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 Rhode Island continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage associated with coyote (*Canis latrans*), feral/free-ranging dog (*Canis familiaris*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), feral/free-ranging cat (*Felis domesticus*), bobcat (*Lynx rufus*), river otter (*Lontra canadensis*), fisher (*Martes pennanti*), mink (*Neovison vison*), long-tailed weasel (*Mustela frenata*), short-tailed weasel (*Mustela erminea*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), white-tailed deer (*Odocoileus virginianus*), Eastern cottontail (*Sylvilagus floridanus*), New England cottontail (*Sylvilagus transitionalis*), snowshoe hare (*Lepus americanus*), beaver (*Castor canadensis*), porcupine (*Erethizon dorsatum*), woodchuck (*Marmota monax*), gray squirrel (*Sciurus carolinensus*), red squirrel (*Tamiasciurus hudsonicus*), Southern flying squirrel (*Glaucomys volans*), Eastern chipmunk (*Tamias striatus*), muskrat (*Ondatra zibethicus*), black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), woodland jumping mouse (*Napaeozapus insignis*), meadow jumping mouse (*Zapus hudsonius*), meadow vole (*Microtus pennsylvanicus*), woodland vole (*Microtus pinetorum*), Southern red-backed vole (*Myodes gapperi*), Southern bog lemming (*Synaptomys cooperi*), white-footed mouse (*Peromyscus leucopus*), short-tailed shrew (*Blarina brevicauda*), masked shrew (*Sorex cinereus*), smoky shrew (*Sorex fumeus*), American water shrew (*Sorex palustris*), star-nosed mole (*Condylura cristata*), hairy-tailed mole (*Parascalops breweri*), and Eastern mole (*Scalopus aquaticus*). Normally, individual wildlife 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 the need for managing damage caused by mammals in Rhode Island and to evaluate a range of alternatives to meet that need while addressing the issues associated with implementing the different approaches. This EA will also assist with identifying any potentially significant or cumulative effects that could occur from the implementation of the alternative approaches to meet the need for action.

This EA evaluates the need for action to manage damage associated with mammals in the State, the potential issues associated with mammal damage management, and the environmental consequences of conducting different alternatives to meet the need for action while addressing the identified issues. To facilitate planning and to promote interagency coordination with meeting the need for action, WS is coordinating the preparation of this EA with the Rhode Island Department of Environmental Management (RIDEM), Division of Fisheries and Wildlife (DFW). The RIDEM has statewide management authority of those mammal species addressed in this the EA. As part of the scoping process during development, this EA will be made available for review and comment by the public to ensure public involvement and to communicate clearly to the public the analysis of individual and cumulative impacts of the alternatives prior to the issuance of a Decision[2].

1.2 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between people and wildlife. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety. Wildlife can have either positive or negative values depending on the perspectives and circumstances

---

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

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

Both sociological and biological carrying capacities must be considered when resolving wildlife damage problems. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower or has been met. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety.

The alleviation of damage or other problems caused by or related to the behavior of wildlife is termed wildlife damage management and is recognized as an integral component of wildlife management (Leopold 1933, The Wildlife Society 1990, Berryman 1991). The imminent threat of damage or loss of resources is often sufficient for individual actions to be initiated and the need for damage management is derived from the specific threats to resources. Those species have no intent to do harm. They utilize habitats (*e.g.*, reproduce, walk, forage) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people 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 can be based on many factors (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to the individual person and damage occurring to one individual may not be considered damage by another individual. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e*., has reached an individual threshold). The term "*damage*" is most often defined as economic losses to resources or threats to human safety; however, "*damage*" could also be defined as a loss in the aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with mammals in Rhode Island arises from requests for assistance[3] received by WS. WS receives requests to reduce and prevent damage from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. WS has identified those mammal species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. Table 1.1 lists WS' technical assistance projects involving mammal damage or threats of damage to those four major resource types in Rhode Island from the federal fiscal year[4] (FY) 2006 through FY 2011. Technical assistance has been provided by WS to those persons requesting assistance with resolving damage or the threat of damage. Technical assistance provides information and recommendations on activities to alleviate mammal damage that could be

[3] WS would only conduct mammal damage management after receiving a request for assistance. Before initiating damage management activities, a Memorandum of Understanding, cooperative service agreement, or other comparable document would be signed between WS and the cooperating entity that would list all the methods the property owner or manager would allow WS to use on property they own and/or manage.

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

conducted by the requestor without WS' direct involvement in managing or preventing the damage. WS' technical assistance activities will be discussed further in Chapter 3 of this EA. Table 1.1 does not include direct operational assistance projects conducted by WS where WS was requested to provide 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 Rhode Island. As shown in Table 1.1, WS has conducted 41 technical assistance projects in Rhode Island that addressed damage and threats associated with those mammal species identified in this EA from FY 2006 through FY 2011. Almost 50% of the technical assistance projects conducted by WS from FY 2006 through FY 2011 were associated with damage and threats of damage caused by coyotes (19.5%), red fox (17.1%), and gray fox (12.2%) in the State.

Table 1.1 – WS' technical assistance projects conducted in Rhode Island, FY 2006 - FY 2011

Species	Projects	Species	Projects
Beaver	2	**Opossum, Virginia**	2
Coyote	8	**Raccoon**	2
Deer, White-tailed	1	**Rat, Norway**	2
Fisher	1	**Skunk, Striped**	3
Fox, Gray	5	**Squirrel, Eastern Gray**	3
Fox, Red	7	**Weasels (all)**	2
Mink	2	**Woodchucks**	1
		TOTAL	**41**

Table 1.2 lists those mammal species and the resource types that those mammal species can cause damage to in Rhode Island. Many of the mammal species can cause damage to or pose threats to a variety of resources. In Rhode Island, most requests for assistance received by WS are associated with those mammal species causing damage or threats of damage to property and natural resources. For example, many of those mammal species listed in Table 1.2 are predators that feed on the eggs, chicks, and adults of colonial nesting seabirds and shorebirds, including T&E species such as federally and state threatened piping plovers.

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

Table 1.2 – Mammal species and the resource type damaged by those species

	Resource[a]					Resource[a]			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Beaver		X	X	X	**Otter, River**	X	X	X	X
Bobcat	X	X	X	X	**Porcupine**	X	X	X	X
Cat, Feral/Free-ranging	X	X	X	X	**Cottontail, New England**			X	X
Chipmunk, Eastern		X	X	X	**Cottontail, Eastern**			X	X
Coyote	X	X	X	X	**Raccoon**	X	X	X	X
Deer, White-tailed	X	X	X	X	**Rat, Black**	X	X	X	X
Dog, Feral/Free-ranging	X	X	X	X	**Rats, Norway**	X	X	X	X
Fisher	X	X	X		**Shrew, American Water**			X	X
Fox, Gray	X	X	X		**Shrew, Masked**			X	X
Fox, Red	X	X	X		**Shrew, Short-tailed**			X	X
Hare, Snowshoe			X	X	**Shrew, Smoky**			X	X
Lemming, Southern Bog			X	X	**Skunk, Striped**	X	X	X	X
Mink	X	X	X	X	**Squirrel, Red**			X	
Mole, Eastern			X	X	**Squirrel, Southern Flying**			X	
Species	**Resource[a]**				**Species**	**Resource[a]**			

	A	N	P	H		A	N	P	H
Mole, Hairy-tailed			X	X	**Squirrels, Eastern Gray**		X	X	
Mole, Star-nosed			X	X	**Vole, Meadow**			X	X
Mouse, Meadow Jumping			X	X	**Vole, Southern red-backed**			X	X
Mouse, White-footed			X	X	**Vole, Woodland**			X	X
Mouse, Woodland Jumping			X	X	**Weasel, Long-tailed**	X	X		
Muskrat	X		X	X	**Weasel, Short-tailed**	X	X		
Opossum, Virginia	X	X	X	X	**Woodchuck**	X		X	X

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

Need for Mammal Damage Management to Protect Human Health and Safety

Zoonoses (*i.e.*, wildlife diseases transmissible to people) are a major concern of cooperators when requesting assistance with managing threats from mammals. Disease transmission could occur from direct interactions between humans 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 humans. Table 1.3 shows common diseases affecting humans that can be transmitted by wild mammals in addition to diseases that affect other animals, including domestic species. These include viral, bacterial, mycotic (fungal), protozoal, and rickettsial diseases.

Individuals or property owners that request assistance with mammals frequently are concerned about potential disease risks but are unaware of the types of diseases that can be transmitted by those animals. In those types of situations, assistance is requested because of a perceived risk to human health or safety associated with wild animals living in close association with humans, from animals acting out of character by roving in human-inhabited areas during daylight, or from animals showing no fear when humans are present.

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 humans by mammals. Thus, the risk of disease transmission would be the primary reason for requesting assistance from WS. Situations in Rhode Island where the threat of disease associated with wild or feral mammal populations may include:

- Exposure of residents to the threat of rabies due to high densities of raccoons or from companion animals encountering infected raccoons.
- Exposure of humans to threats of rabies posed by skunks that den under buildings or from companion animals interacting with infected skunks.
- Accumulated droppings from denning or foraging raccoons and the subsequent exposure of the public to raccoon roundworm in fecal deposits.

The most common disease concern expressed by individuals requesting assistance is the threat of rabies transmission to humans, 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 humans. Indirect threats to humans occur from exposure from pets or livestock that have been infected from bites of a rabid animal. Direct threats can occur from handling infected wildlife or from aggressive animal behavior caused by rabies. The disease can be effectively prevented in humans when exposure is identified early and treated. In addition, domestic animals and pets can be vaccinated for rabies. However, the abundant and widely distributed reservoir among wild mammals complicates rabies control. The vast majority of rabies cases reported to the Centers for Disease Control and Prevention (CDC) each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order Chiroptera) (CDC 2011).

Over the last 100 years, the vector of rabies in the United States has changed dramatically. About 90% or greater of all animal cases reported annually to CDC now occur in wildlife (Krebs et al. 2000, CDC 2011). Before 1960, the majority of cases were reported 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).

Table 1.3 - Wildlife diseases in the Eastern United States that pose potential health risks through transmission to humans (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
Lyme disease	*Borellia burgdorferi*	deer	tick bite (vectored by deer)
Human ehrlichiosis	*Ehrlichia* spp.	deer	tick bite (vectored by deer)
Tularemia	*Francisella tularensis*	rodents, rabbits	direct contact, ingestion, inhalation
Hantavirus	Hantaviruses	rodents	direct contact, ingestion, inhalation

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

‡ The host species provided for each zoonosis includes only those mammalian species addressed in this EA unless the zoonoses listed potentially infects a broad range of mammalian wildlife. Zoonoses infecting a broad range of mammals are denoted by the general term "*mammals*" as the host species. 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).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the United States each year is unknown, it has been estimated to be as high as 40,000. When rabies becomes epizootic (*i.e.*, affecting a large number of animals over a large area) or enzootic (*i.e.*, present in an area over time but with a low case frequency) in a region, the number of PEPs in that area increases. Although the cost varies, a course of rabies immunoglobulin and five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2011) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in wildlife populations, the risk of "*mass*" human exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increases. One case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for 71 persons (CDC 1999). The total cost of this single incident exceeded $160,000 based on a median cost of $2,376 per PEP in Massachusetts. Likely, the most expensive single mass exposure case on record in the United States occurred in 1994 when a kitten from a pet store in Concord, New Hampshire tested positive for rabies after a brief illness. Because of potential exposure to the kitten or to other potentially rabid animals in the store, at least 665 persons received post-exposure rabies vaccinations at a total cost of more than $1.1 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 Rhode Island (USDA 2005). Rabies was confirmed through laboratory testing in 13 raccoons in Rhode Island during 2010 (Blanton et al. 2011). Raccoons continue to be one of the most frequently reported rabid wildlife species in the United States (Blanton et al. 2011). Raccoons accounted for 44.8% of laboratory confirmed cases of animal rabies in Rhode Island and 48.2% of confirmed cases in wild mammals in 2010 (Blanton et al. 2011). From 2006 to 2010, raccoons accounted for 42.6% of all laboratory confirmed cases of rabies in animals in Rhode Island comprising 78 of 183 cases.

Rabies in raccoons was virtually unknown prior to the 1950s. It was first described in Florida and spread slowly during the next three decades into Georgia, Alabama, and South Carolina. It was unintentionally introduced into the Mid-Atlantic States, probably by translocation of infected animals (Krebs et al. 1998). The first cases appeared in West Virginia and Virginia in 1977 and 1978, respectively. Since then, the raccoon variant of rabies expanded to form the most intensive rabies outbreak in the United States. The variant is now enzootic in all of the eastern coastal states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and most recently, parts of Ohio (Krebs et al. 2000). The raccoon rabies epizootic front reached Maine in 1994, reflecting a movement rate of about 30 to 35 miles per year. The westward movement of the raccoon rabies front has slowed, probably in response to both natural geographic and man-made barriers. The Appalachian Mountains and perhaps river systems flowing eastward have helped confine the raccoon variant to the eastern United States. In addition, the USDA has created an oral rabies vaccine (ORV) "*barrier*" of vaccinated wild animals on the western edge of the Appalachian Mountains (USDA 2005). 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 the rabies strain has spread in the eastern United States (Sanderson and Huber, Jr. 1982, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999).

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

Skunks are also an important wildlife host for the rabies virus in North America and are second only to raccoons in being the most commonly reported rabid wildlife species in the United States (Majumdar et al. 2005, Blanton et al. 2011). Four skunks accounted for 13.8% of laboratory confirmed cases of rabies in both domestic and wild mammals in Rhode Island in 2010 (14.8% of confirmed cases in wild mammals) (Blanton et al. 2011). From 2006 to 2010, skunks accounted for 27.3% of all laboratory confirmed cases of rabies in animals in Rhode Island comprising 50 of 183 cases.

The skunk variant of rabies may be found in the Midwest and California; however, skunks found throughout North America may be infected with different variants of rabies 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, Blanton et al. 2011). 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 are often manifested as the "*furious*" form of rabies (Majumdar et al. 2005).

Increasing populations of raccoons have been implicated in the outbreak of distemper in certain areas (Majumdar et al. 2005). Distemper has not been identified as transmissible to humans. However, cooperators 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 humans and can act aggressively which increases the risk that people, livestock, or companion animals may be bitten. Distemper is also known to occur in coyotes, red fox, and gray fox with symptoms that are similar to those exhibited by animals infected with the rabies virus.

Diseases and parasites affecting feral cats and dogs can have particularly serious implications to human health given the close association of those animals with people and companion animals. The topic of feral animals and their impacts on native wildlife and human health elicits a strong response in numerous professional and societal groups with an interest in the topic. Feral cats and dogs are considered by most professional wildlife groups to be a non-native species that has detrimental impacts 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 outside the home for extended periods. If interactions occur between companion animals and feral animals of the same species, companion animals could become exposed to a wide-range of zoonoses that could be brought back into the home where direct contact between the companion animal and people increases the likelihood of disease transmission. Feral animals that are considered companion animals are also likely to affect multiple people if disease transmission occurs since those animals are likely to come in direct contact with several members of families and friends before diagnosis of a disease occurs.

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

Most of the zoonoses known to infect cats and dogs that are infectious to humans 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 Florida children were hospitalized with encephalitis that was associated with cat scratch fever (AVMA 2004). The daycare center at the University of Hawaii in Manoa was closed for two weeks in 2002 because of concerns about potential transmission of murine typhus (*Rickettsia typhi*) and flea (*Ctenocephalides felis*) infestations afflicting 84 children and faculty. The fleas at the facility originated from a feral cat colony that had grown from 100 cats to over 1,000, despite a trap, neuter, and release effort (AVMA 2004).

A study in France determined that stray cats serve as major reservoirs for the bacterium *Bartonella* spp. Consequently, stray cats and their fleas (*Ctenocephalides felis*) are the only known vectors for infecting house bound cats and humans with this bacterium. Humans are not infected via the flea, but pet cats often are infected by fleabites. Human infections that may result from exposure of this bacterium via stray cats include cat scratch disease in immunocompetent patients, bacillary angiomatosis, hepatic peliosis in immunocompromised patients, endocarditis, bacteremia, osteolytic lesions, pulmonary nodules, neuroretinitis, and neurologic diseases (Heller et al. 1997). In areas where canine rabies has been eliminated, but rabies in wildlife has not, cats often are the primary animal transmitting rabies to humans (Vaughn 1976, Eng and Fishbein 1990, Krebs et al. 1996).

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

Disease transmission directly from wildlife to humans is uncommon. However, wildlife and feral animals are known carries of diseases infectious to people which can increase the risk of transmission directly through contact with infected wildlife or feral animals and through exposure from contact with livestock and pets that have been exposed to diseased wildlife or feral animals. Disease transmission to humans from wildlife is uncommon with few documented occurrences. However, the infrequency of such transmission does not diminish the concerns of those individuals requesting assistance that are fearful of exposure to a diseased animal since disease transmissions have been documented to occur. WS actively attempts to educate the public about the risks associated with disease transmission from wildlife to humans through technical assistance and by providing technical leaflets on the risks of exposure.

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

Beaver activity in certain situations can become a threat to public health and safety (*e.g.*, burrowing into or flooding of roadways and railroad beds can result in serious accidents) (Miller 1983, Woodward 1983). Increased water levels in urban areas resulting from beaver activity can lead to unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities (DeAlmeida 1987, Loeb 1994). Beaver damming activity also creates conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of these insects (Wade and Ramsey 1986). While the presence of these insects is largely a nuisance, mosquitoes can transmit diseases, such as encephalitis (Mallis 1982).

In addition, beaver, which are carriers of the intestinal parasite *Giardia lamblia*, can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). Giardiasis is an illness caused by a microscopic parasite that have become recognized as one of the most common causes of waterborne disease in people across the United States during the last 15 years (CDC 1999). Giardiasis can be contracted by swallowing contaminated water or putting anything in your mouth that has touched the fecal matter of an infected animal or person. Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 1999). Beaver are also known carriers of tularemia, a bacterial disease that is transmittable to humans through bites by insect vectors, bites of infected animals, or by handling animals or carcasses that are infected (Wade and Ramsey 1986). Skinner et al. (1984) found that in cattle-ranching sections of Wyoming the fecal bacteria count was much higher in beaver ponds than in other ponds, something that can be a concern to ranchers and recreationists.

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife has led to a decline in the fear wildlife have toward people. When wildlife species begin to habituate to the presence of people and human activity, a loss of apprehension occurs that can lead to threatening behavior toward people. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can be in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although wildlife attacking people occurs rarely, the number of attacks appears to be on the increase. Timm et al. (2004) reported that coyotes attacking people have increased in California and the recent, highly publicized coyote attacks, including a fatal attack on a 19-year old woman in Nova Scotia (Canadian Broadcast Company 2009), have only heightened people's awareness of the threat of such encounters. Although attacks on people associated with those species addressed in this EA occurs rarely, requests for assistance to lessen the threat of possible attack do occur from people in Rhode Island. Often, wildlife exhibiting threatening behavior or a loss of apprehensiveness to the presence of humans is a direct result and indication of an animal inflicted with a disease. So, requests for assistance can be caused by both a desire to reduce the threat of disease transmission and from fear of aggressive behavior either from an animal that is less apprehensive of people or induced as a symptom of disease.

As part of the proposed program, WS could provide mammal damage management assistance, upon request, involving those mammal species addressed in this EA that pose a threat to human health and safety to any requester experiencing such a threat throughout Rhode Island.

Disease Surveillance and Monitoring

Public awareness and health risks associated with zoonoses (*i.e*., diseases of animals that can be transmitted to humans) have increased in recent years. Several zoonotic diseases associated with mammals are addressed in this EA. Those zoonotic diseases remain a concern and continue to pose threats to human safety where people encounter mammals. WS has received requests to assist with reducing damage and threats associated with several mammal species in the State and could conduct or assist with disease monitoring or surveillance activities for any of the mammal species addressed in this EA. Most disease sampling would occur ancillary to other wildlife damage management activities (*i.e*., disease sampling occurs after wildlife have been captured or lethally taken for other purposes). For example, WS may sample or collect ticks from deer harvested during the annual hunting season or during other damage management programs for Chronic Wasting Disease (CWD), Lyme Disease, and ehrlichiosis or may collect blood samples from fox, coyotes, beavers, and muskrats that were lethally taken to alleviate damage occurring to property to test for tularemia. WS may also collect mammal samples for rabies testing (USDA 2005).

Need for Mammal Damage Management at Airports

Airports provide ideal conditions for many wildlife species due to the large open 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 would be insulated from many other human disturbances.

The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2001, Dolbeer 2009). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996, Thorpe 1997, Keirn et al. 2010). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover et al. 1995).

Between 1990 and 2010, there were 2,558 reported aircraft strikes involving terrestrial mammals in the United States (Dolbeer et al. 2012). The number of mammal strikes actually occurring is likely to be much greater, since Dolbeer (2009) estimated 39% of civil wildlife strikes are actually reported. Civil and military aircraft have collided with a reported 48 mammal species (35 terrestrial and 13 bat) and 15 mammal species groups (10 terrestrial and 5 bat) from 1990 through 2010 (FAA 2011). This includes 15 species of wild terrestrial mammals as well as five species of domestic mammals that are kept or occur as feral/free ranging animals. Wild terrestrial species include white-tailed deer, coyotes, gray fox, red fox, raccoons, opossums, mink, otter, striped skunks, beaver, porcupine, muskrat, Eastern cottontail rabbit, and woodchucks. Domestic species include domestic cats, domestic dogs, cattle, horses, and burros (FAA 2011).

Reported strikes involving terrestrial mammals in the United States caused an estimated $41,144,196 in damages from 1990 to 2010 (Dolbeer et al. 2012). Of the 2,558 reported terrestrial mammal strikes from 1990 to 2010 in the United States, 35.6% involved white-tailed deer and 13.1% involved coyotes (Dolbeer et al. 2012). Dolbeer et al. (2012) reported an estimated $30,653,456 due to white-tailed deer strikes and an estimated $2,776,040 in damages due to coyote strikes from 1990 to 2010 in the United States. Other mammal species that occur in Rhode Island have resulted in monetary damages to aircraft across the United States; these include domestic dogs ($311,000), Eastern cottontail rabbit ($78,000), red fox ($52,000), raccoon ($35,000), and gray fox ($186) (Dolbeer et al. 2012). Data also indicates that a much higher percentage of mammal strikes resulted in aircraft damage compared to bird strikes (Dolbeer et al. 2012). Costs of those collisions vary, but the Federal Aviation Administration (FAA) data reveals that mammal strikes in the United States cost the civil aviation industry approximately 275,290 hours of down time in addition to over $41.1 million in direct monetary losses between 1990 and 2010 (Dolbeer et al. 2012). For terrestrial mammals, the 21-year average of strikes causing damage is 37.1% based on 948 of 2,558 reported strikes resulting in damage (Dolbeer et al. 2012). This has declined from 79.6% in 1990 when 43 of 54 reported terrestrial mammal strikes resulted in damage to 10.8% in 2010 when only 27 or 249 terrestrial mammal strikes resulted in damage being reported (FAA 2011). In comparison, the 21-year average for bird strikes causing damage is 10.1%, based on 10,730 of 105,947 reported strikes resulting in damage (Dolbeer et al. 2012).

About 59% of mammal strikes in the United States have resulted in damage compared to 13% for birds from 1990 through 2010 (Dolbeer et al. 2012). In addition to direct damage, an aircraft striking a mammal can pose serious threats to human safety if the damage from the strike causes a catastrophic failure of the aircraft leading to a crash. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft, causing additional damage to the aircraft and increasing the threat to human safety. Nearly 63% of the reported mammal strikes from 1990 through 2010 occurred at night, with 63% occurring during the landing roll or the takeoff run (Dolbeer et al. 2012).

In Rhode Island, there were 16 reported strikes with mammals from 1990 through 2010 (FAA 2011). Of those 16 reported strikes, 15 were terrestrial mammals. There were five coyotes, five striped skunks, four white-tailed deer, and one Eastern cottontail rabbit struck. Monetary damages were only reported for the deer strikes in the State. Of the four reported deer strikes, two were not actual strikes but involved negative effects on flights due to the presence of deer on runways. The other two reported strikes indicated moderate and severe damage had occurred to the aircraft involved, respectively. The severely damaging strike reported $22,000 in damage and 60 hours of aircraft down time (FAA 2011). Preventing damage and reducing threats to human safety is the goal of those cooperators requesting assistance at airports in Rhode Island given that a potential strike can lead to the loss of human life and considerable damage to property.

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

Need for Mammal Damage Management to Protect Agricultural Resources

Coyotes, red fox, gray fox, bobcats, fisher, raccoons, deer, woodchucks, beaver, and other mammals can cause losses, injury, or disease to livestock (*e.g.*, sheep, goats, cattle, pigs, horses, llamas, alpacas), crops, and poultry (*e.g.*, chickens, turkeys, geese, ducks) through predation or close contact. During 2001, crop and livestock losses from wildlife in the United States totaled $944 million, with field crop losses totaling $619 million, livestock and poultry losses totaling $178 million, and losses of vegetables, fruits, and nuts totaling $146 million (USDA 2010*a*). 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). Deer were responsible for 58% of the total damage to field crops and 33% of the total damage to vegetables, fruits, and nuts in 2001 (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 $98.5 million in economic losses. Coyotes were indicated as the primary predator of livestock with 53.1% of cattle and calf losses attributed to coyotes. Cattle producers in the United States indicated mountain lions and bobcats[5] caused 7.8% of the cattle and calf losses attributed to animal predators in 2010 (NASS 2011). Bobcats are also known to predate on other livestock. Livestock and poultry losses are also attributed to bears, dogs, fox, skunks, opossums, fishers, mink, and weasels.

Producers spent nearly $188.5 million dollars on non-lethal methods to reduce cattle and calf losses from predation by animals in 2010 (NASS 2011). In Rhode Island, the NASS (2011) reported no cattle or calves were killed in 2010 by animal predators. Rhode Island cattle producers reported using a number of non-lethal methods to reduce losses due to predators. This included exclusion fencing reported used by 94.5% of survey respondents. In addition, livestock producers used frequent checks (18.5%), carcass removal (18.5%), night penning (13.1%), culling (13.1%), guard animals (10.9%), and herding (5.5%) (NASS 2011).

In 2009, the NASS (2010) reported sheep and lamb losses from animal predation totaled 247,200 head in the United States representing 39.0% of total losses and costing an estimated $20,500,000 according to livestock producers. Predation accounted for the loss of 180,000 goats and kids, representing 32.5% of total losses (NASS 2010). The NASS (2010) reported that 300 sheep and 400 lambs were lost to predation in the New England region, which includes Rhode Island during 2009, resulting in $93,000 in monetary losses. Sheep and lamb loss data specific for Rhode Island was not available.

River otters, mink, raccoons, and muskrats 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). Direct damage results when the fish or other cultured organism is killed or seriously maimed by the predator and is therefore lost from production. Indirect damage is highly variable, and includes non-lethal wounding of fish; chronic stress with a consequent reduction in feeding efficiency or health; transfer of harmful disease-causing organisms, including bacteria, viruses and parasites; and sometimes even physical damage to the animal enclosure system leading to escapement. Often, the indirect damage caused by a predator can result in a greater economic loss than that caused by direct damage. Therefore, the total extent of damage to an aquaculture stock by predators can be highly varied and extremely costly depending on many factors (Bevan et al. 2002). Since mammal depredation at hatcheries and aquaculture facilities has been documented, it could occur at such facilities in Rhode Island.

[5]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.

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. The authors also found *Sarcocystis* spp. contamination in the musculature of sheep. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *T. gondii* on swine farms in Illinois and the major reservoir for this disease. The main sources for infecting cats are thought to be birds and mice.

Diseases that may be communicable from feral cats to companion cats include feline panleukopenia infection, feline calicivirus infection, feline reovirus infection, and feline syncytium-forming virus infection (Gillespie and Scott 1973). Of the four feline diseases, feline panleukopenia is considered the most serious. Reif (1976) found that during the acute stages of feline panleukopenia, fleas were vectors of this disease to other cats. Feline panleukopenia infection is cyclic in nature, being more prevalent from July through September.

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

Beaver have been observed damaging field and sweet corn by WS' personnel in neighboring Massachusetts and have been reported feeding on other field crops (D. Wilda, WS pers. comm. 2012). They have also been observed by WS' personnel feeding on commercially grown standing timber and seedling trees. Beaver activities cause flooding of prime bottomland crop fields, causing severe economic losses to agricultural producers. Similar flooding and subsequent killing of trees occurs in some commercial forest tracts, killing harvestable trees or seedlings.

Rhode Island is the largest turf grass producing state in New England producing $14,332,575 worth of commercial sod in 2007 (NASS 2009). White-tailed deer damage commercially grown sod by overgrazing and by leaving holes in harvested sod created by hoof prints, which reduce the value of sod per square foot. Rhode Island also produced $16,259,497 in nursery stock and 19,251 Christmas tree in 2007 (NASS 2009). Browsing and gnawing by deer, rabbits, and voles can cause damage or destroy ornamental nursery plants and Christmas trees.

Need to Resolve Damage Occurring to Natural Resources

Natural resources may be described as those assets belonging to the public and often managed and held in trust by government agencies as representatives of the people. Such resources may be plants or animals, including threatened and endangered (T&E) species; historic properties; or habitats in general. Examples of natural resources include: parks and recreation areas; natural areas, including unique habitats or topographic features; threatened and endangered plants or animals; and any plant or animal populations which have been identified by the public as a natural resource.

Mammals causing damage are often locally overabundant at the damage site and threaten the welfare of a species population identified as a natural resource. An example of this would be nest predation of a local ground-nesting bird population by mammalian carnivores, such as raccoons, opossum, feral cats, fisher, skunks, coyotes, or fox. In 2011, predation of T&E species was documented and addressed by WS in Rhode Island. WS has received requests for assistance with coyotes, red fox, raccoons, skunks, feral cats, and fisher predation on federally and state threatened nesting piping plover in coastal Rhode Island. Other T&E species could be jeopardized by mammals in Rhode Island.

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 diversity (Warren 1991). By one count, 98 species of threatened and endangered plants, many of them orchids and lilies, are disturbed by deer browsing (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 1999). 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 three species of birds could no longer be found 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 a lower deer density. Waller and Alverson (1997) hypothesized that by competing with squirrels and other fruit-eating animals for oak mast, deer may further affect many other species of animals and insects.

Massey (1971) and Massey and Atwood (1981) found that predators can prevent endangered least terns (*Sterna antillarum*) from nesting or cause them to abandon previously occupied sites. In another study, mammalian predators were found to have adversely affected the nesting success of least terns on sandbars and sandpits (Kirsch 1996).

Beaver activities can also destroy habitat (*e.g.*, free-flowing water, riparian areas, and bird roosting and nesting areas) which are important to many species. Patterson (1950) and Avery (1992) reported that the presence of beaver dams could negatively affect fisheries. Beaver dams may adversely affect stream ecosystems by increasing sedimentation in streams, and thereby affecting wildlife that depend on clear water such as certain species of fish and mussels. Stagnant water impounded by beaver dams can increase the water temperature of water impounded upstream of the dam which can negatively affect aquatic organism. Beaver dams can also act as barriers that inhibit movement of aquatic organisms and prevent the migration of fish to spawning areas.

Scientists estimate that nationwide cats kill hundreds of millions of birds and more than a billion small mammals, such as rabbits, squirrels, and chipmunks, each year. The American Bird Conservancy (ABC) states that "*cats often kill common* [bird] *species such as cardinals, blue jays, and house wrens, as well as rare and endangered species such as piping plovers, Florida scrub-jays, and California least terns*" (ABC 2011). 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 (ABC 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 kill 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 similar-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. Churcher and Lawton (1989) estimated that 30% to 50% of the animals captured by cats were birds and that the cats had adversely affected house sparrow populations within the village. Based on information acquired in the study, Churcher and Lawton (1989) estimated that more than 20 million birds are killed by cats in Britain each year with more than 70 million animals overall being taken by cats annually.

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 is dependent on availability. Fitzgerald (1990) found that cats on the mainland fed most heavily on mammals; whereas, cats on islands fed almost exclusively on birds (particularly seabirds). Feral and free-ranging cats are known to prey on birds as large as mallard ducks (Figley and VanDruff 1982) and young brown pelicans (Anderson et al. 1989) along with mammals as large as hares and rabbits. Many cat populations rely heavily on humans, either for handouts and/or for garbage. Pearson (1971) found that cats were serious predators of California voles and that the greatest pressure on voles occurred when vole numbers were lowest. Liberg (1984) found that cats in southern Sweden fed predominantly on native mammals. Prey use was based more on availability than abundance. Langham (1990) found that mammals made up 74% of diets of New Zealand farmland feral cats, while 24% were birds. Cats fed most heavily on the most abundant species and groups. A study on a southern Illinois farmstead concluded that well-fed cats preferred microtine rodents; however, they also consumed birds (George 1974). Microtine rodents are 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 and red-tailed hawks.

Reptiles are thought to provide an important food source to cats when birds and mammals are less abundant, and in some situations, cats have been observed to prey on threatened species of reptiles. Domesticated cats have been identified as nest and/or hatchling predators of sea turtles. A study 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 have adverse effects on local wildlife populations, especially in habitat "*islands*", such as suburban and urban parks, wildlife refuges, and other areas surrounded by human development (Wilcove 1985). Nest predation is also an important cause of the decline of Neotropical migrants (Wilcove 1985). A two-year study was conducted 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. California thrasher and California quail, both ground-nesting birds, were seen during surveys in the no-cat area; whereas, they were never seen in the cat area. In addition, more than 85% of the native seer mice and harvest mice 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).

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

Impacts from cat predation are not always direct, but 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 microtine rodents).

Deer overabundance can affect native vegetation and natural ecosystems in addition to ornamental landscape plantings. White-tailed deer selectively forage on vegetation (Strole and Anderson 1992), and thus can 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 diversity (Warren 1991). By one count, 98 species of threatened and endangered plants, many of them orchids and lilies, are disturbed by deer browsing (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 1999). 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 three species of birds could no longer be found 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.

Need for Mammal Damage Management to Protect Property

Mammals cause damage to a variety of property types in Rhode Island each year. From FY 2006 through FY 2011, WS received reports of damages or threats of damage caused by mammals to aircraft, pets, residential buildings, and electrical utilities in the State. Damage and threats were caused by beaver, coyotes, red fox, gray fox, striped skunks, white-tailed deer, gray squirrels, and Norway rats. The most frequently reported damage type is the threat of aircraft striking mammals. The direct threat of aircraft strikes with mammals can cause substantial damage requiring costly repairs and aircraft downtime. Indirect threats to aircraft may result from large populations of small mammals such as rabbits, insectivores, mice, and voles attracting mammal and avian predators to the airfield and increasing the risk of a wildlife strike.

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). The Insurance Institute for Highway Safety (2005) estimated that 1.5 million deer-vehicle collisions occur annually in the United States causing approximately 150 fatalities and $1.1 billion in damage to property. In 1995, the damage to vehicles associated with vehicles striking deer was estimated at $1,500 per strike in damages (Conover et al. 1995). Damage costs associated with deer collisions in 2011 were estimated at $3,171 per incident, which was an increase of 2.2% over the 2010 estimate (State Farm Mutual Automobile Insurance Company 2011*a*). There were 1,667 deer-vehicle collisions reported in Rhode Island in calendar year 2011 up from 1,357 reported in 2010 (RIDEM 2011*a*). Based on the average repair costs associated with vehicle strikes estimated at $3,171 in 2010 and the number of strikes reported to have occurred in Rhode Island that year at 1,357, deer-vehicle collisions resulted in an estimated nearly $3.9 million in damage to property in the State in 2009. Often, deer-vehicle collisions in which a deer carcass was not recovered or little vehicle damage occurred go unreported. 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).

Beaver are generally considered beneficial where their activities do not compete with human land use or human health and safety (Wade and Ramsey 1986). The opinions and attitudes of individuals, organizations, and communities vary greatly and are primarily influenced and formed by the benefits and/or damage directly experienced by each individual (Hill 1982). Woodward et al. (1976) found that 24% of landowners who reported beaver activity on their property indicated benefits to having beaver ponds on their land and desired assistance with beaver pond management (Hill 1976, Lewis 1979, Woodward et al. 1985).

In some situations, the damage and threats caused by beaver outweigh the benefits (Grasse and Putnam 1955, Woodward et al. 1985, Novak 1987). Damage to resources associated with beaver are most often a result of their feeding, burrowing, and dam building behaviors. It is estimated that beaver cause $75 to $100 million dollars in economic losses annually in the United States, with total losses in the southeastern United States over the past 40 years estimated to be $4 billion (Novak 1987).

Beaver often will gnaw through trees and other woody vegetation for use in dam building, food caches, and the buildings of lodges. The girdling and felling of trees and other woody vegetation can cause economic losses, can threaten human safety and property when trees fall, and the loss of trees can be aesthetically displeasing to property owners. Timber resources have the highest recorded damage caused by beaver (Hill 1976, Lewis 1979, Hill 1982, Woodward et al. 1985). In some southeastern states, losses from beaver damage have been estimated at $3 million to $5 million dollars annually (Miller and Yarrow 1994), with timber losses as the most common type of damage (Hill 1982). Tracts of bottomland hardwood timber up to several thousand acres in size may be lost to beaver activity (Miller and Yarrow 1994). Timber damage caused by beaver activity in the southeastern United States has been estimated at $2.2 million annually in Mississippi (Arner and Dubose 1982), $2.2 million in Alabama (Hill 1976), $45 million in Georgia (Godbee and Price 1975), and $14.5 million in Louisiana in 1993 (Fowler et al. 1994).

In addition to damage associated with beaver feeding and gnawing on trees, damages and threats can also occur from dam building activities. Beaver dams impound water, which can flood property resulting in economic damage. Flooding from beaver dams can cause damage to roads, impede traffic, inundate timber, weaken earthen embankments, and cause damage to residential and commercial utilities. In addition, beaver dams constructed on one property can result in flooding of adjacent property, which often requires a response by the property owner where the dam is located.

Beaver often inhabit sites in or adjacent to near homes and cut or girdle trees and shrubs in yards, undermine yards and walkways by burrowing, flooding homes and other structures, destroying pond and reservoir dams by burrowing into levees, gnawing on boat houses and docks, and causing other damage to private and public property (Wade and Ramsey 1986). Additionally, roads and railroads may be damaged by saturation of the roadbed from beaver flooding or by beaver burrowing into the banks that comprise roadbeds and railroad beds.

Burrowing activities of woodchucks and muskrats can severely damage levees, dikes, earthen dams, landfills, and other structures (Federal Emergency Management Agency 2005). Woodchuck and muskrat burrowing into roadbeds and embankments could potentially weaken or cause the collapse of these structures. Woodchucks also cause damage by chewing underground utility cables, sometimes resulting in power outages. Additionally, woodchuck burrows may cause damage to property when tractors and other equipment drop into a burrow or roll over due to a burrow.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA evaluates the need for mammal damage management to reduce threats to human safety and to resolve damage to property, natural resources, and agricultural resources on federal, state, tribal, municipal, and private land within the State of Rhode Island wherever such management is requested by a cooperator.

This EA discusses the issues associated with conducting mammal damage management in the State to meet the need for action and evaluates different alternatives to meeting that need while addressing those issues.

The methods available for use or recommendation under each of the alternatives evaluated are provided in Appendix B[6]. The alternatives and Appendix B also discuss how methods would be employed to manage damage and threats associated with mammals in the State. Therefore, the actions evaluated in this EA are the use of those methods available under the alternatives and the employment 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.

Federal, State, Municipal, and Private Lands

Pursuant to the appropriate alternatives, WS could continue to provide assistance on federal, state, municipal, and private land in Rhode Island when a request is received for such services by the appropriate resource owner or manager. In those cases where a federal agency requests WS' assistance with managing damage caused by mammals, 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, actions taken on federal lands have been analyzed in the scope of this EA.

There are no county lands in Rhode Island. Although, the State is divided into counties, it does not have any local government at the county level. Counties in Rhode Island have had no governmental functions since 1846 other than as court administrative and sheriff corrections boundaries, which are part of state government.

Native American Lands and Tribes

The WS program in Rhode Island would only conduct damage management activities on Native American lands when requested by a Native American Tribe. Activities would only be conducted after a Memorandum of Understanding (MOU) or cooperative service agreement had been signed between WS and the Tribe requesting assistance. Therefore, the Tribe would determine when WS' assistance was required and what activities would be allowed. 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 be anticipated. 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 use of those methods had been approved for use by the Tribe requesting WS' assistance. Therefore, the activities and methods addressed under the alternatives would include those activities that could be employed on Native American lands, when requested and when agreed upon by the Tribe and WS.

Period for which this EA is Valid

If the analyses in this EA indicate an Environmental Impact Statement (EIS) is not warranted, this EA would remain valid until WS determined that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, this analysis and document would be reviewed and supplemented pursuant to the NEPA. Review of the EA would be conducted to ensure that activities conducted under the selected alternative occur within the parameters evaluated in the EA. If the alternative analyzing no involvement in mammal damage activities by WS were selected, no additional analyses would occur based on the lack of involvement by WS. The monitoring of

[6]A complete list of chemical and non-chemical methods available for use under the identified alternatives, except the alternative with no damage management (Alternative 3), can be found in Appendix B. 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.

activities by WS would ensure the EA remained appropriate to the scope of damage management activities conducted by WS in Rhode Island based on the alternative selected.

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

This EA analyzes the potential impacts of mammal damage management based on previous activities conducted on private and public lands in Rhode Island where WS and the appropriate entities have entered into a MOU, cooperative service agreement, or other comparable document. The EA also addresses the potential impacts of mammal damage management in areas where additional agreements may be signed in the future. Because the need for action is to reduce damage and because the program's goals and directives would be to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and analyzes the impacts of those efforts as part of the alternatives.

Many of the mammal species addressed in this EA can be found statewide and throughout the year in the State; therefore, damage or threats of damage can 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 and police departments, emergency clean-up organizations, and insurance companies. Although some locations where mammal damage could occur can be predicted, not all specific locations or times where such damage would occur in any given year can be predicted. 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 such a request for assistance would be received by WS is difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever mammal damage and the resulting management actions occurs and are treated as such.

Chapter 2 of this EA identifies and discusses issues relating to mammal damage management in Rhode Island. The standard WS Decision Model (Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS 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[7] and Standard Operating Procedures (SOPs) described in this EA as well as relevant laws and regulations.

The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within Rhode Island. In this way, WS believes it 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 its mission.

Summary of Public Involvement

Issues related to mammal damage management as conducted by WS in Rhode Island were initially developed by WS in consultation with the RIDEM. Issues were defined and preliminary alternatives were identified through the scoping process. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS' NEPA implementing regulations, this document will be noticed to the public for review and comment. The public will be noticed through legal notices published in local print media, through direct mailings to parties that have requested to be notified, or have been identified to

---

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

have an interest in the reduction of threats and damage associated with mammals in the State, and by posting the EA on the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml.

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. New issues or alternatives raised after publication of public notices would be fully considered to determine whether the EA should be revisited and, if appropriate, revised prior to issuance of a final Decision or publication of a notice of intent to prepare an EIS.

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Supplemental 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 Oral Rabies Vaccination programs to eliminate or stop the spread of raccoon rabies in a number of eastern states (including Rhode Island) and gray fox and coyote rabies in Texas (USDA 2005). The EA has been supplemented to analyze changes in the scope and analysis area of the ORV program. The most recent Decision/FONSI was signed in 2010. WS determined the proposed action alternative would not have any significant impact on the quality of the human environment. Pertinent information from that EA has been incorporated by reference into this EA.

1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES

The authorities of WS and other agencies as those authorities relate to conducting wildlife damage management activities are discussed by agency below:

WS' Legislative Authority

The primary statutory authority for the WS program is the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with wildlife. WS' directives define program objectives and guide WS' activities in managing wildlife damage.

United States Environmental Protection Agency (EPA)

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

Rhode Island Department of Environmental Management Legislative Authority over Fisheries and Wildlife

The Director of the RIDEM is granted authority over fish and wildlife by the Rhode Island General Assemble under State of Rhode Island General Laws Title 20 Fish and Wildlife and exercises this authority through the Division of Fisheries and Wildlife. This authority along with the ability to create and enforce rules and regulations for managing fish and wildlife are granted under § 20-1-2, § 20-1-4 and § 20-1-5 as follows.

§ 20-1-2 Authority Over Fish and Wildlife – The general assembly hereby vests in the director of the department of environmental management authority and responsibility over the fish and wildlife of the state and over the fish, lobsters, shellfish, and other biological resources of marine waters of the state".

§ 20-1-4. Rules and regulations – The director is authorized to promulgate, adopt, and enforce any and all rules and regulations deemed necessary to carry out duties and responsibilities under this title.

§ 20-1-5 General enforcement powers – The director and the director's authorized agents, employees, and designees shall protect the wild birds, wild animals, fisheries, and shell fisheries throughout the state and shall administer and enforce the provisions of this title and the rules and regulations adopted pursuant to this title and shall prosecute violations of these laws and rules and regulations.

Rhode Island Department of Environmental Management Legislative Authority over Pesticides

The Director of the RIDEM is granted authority over pesticide regulation by the Rhode Island General Assemble under State of Rhode Island General Laws Title 23 Health and Safety and exercises this authority through the Division of Agriculture. This authority along with the ability to create and enforce rules and regulations for managing fish and wildlife are granted under § 23-25-2 and § 23-25-9 as follows.

§ 23-25-2 Enforcing Official – The provisions of this chapter shall be administered by the director of environmental management of the state, referred to as the director.

§ 23-25-9 Authority of Director, Determinations, Rules and Regulations, Restricted Use and Limited Use of Pesticides and Uniformity – (a) The director is authorized after due notice and an opportunity for a hearing: (1) To declare as a pest any form of plant or animal life (other than humans and other than bacteria, viruses, and other micro-organisms on or in living humans or other living animals) which is injurious to health or the environment; (2) To determine whether pesticides registered under the authority of § 24(c) of FIFRA, 7 USC § 136v(c), are highly toxic to humans. The definition of highly toxic, as defined in title 40, Code of Federal Regulations 162.8, as issued or amended, shall govern the director's determination; and (3) To determine pesticides and quantities of substances contained in pesticides which are injurious to the environment. The director shall be guided by EPA regulations in this determination.

Rhode Island Department of Environmental Management Legislative Authority over Fresh Water Wetlands

§ 2-1-18 Declaration of intent – Whereas it is recognized that swamps, marshes, and other fresh water wetlands as defined in this chapter act as buffer zones and absorption areas for flood waters; and

> Whereas all flood plains for all rivers, streams, and other water courses are certain to be overflowed with water periodically in spite of all reasonable efforts to prevent those occurrences; and
>
> Whereas flood waters overflowing into marshes, swamps, and other fresh water wetlands are not only released more slowly downstream, thus reducing the damage they may cause, but flood waters tend to be absorbed into the ground water supply through swamps, marshes, and other fresh water wetlands, thus further reducing the flood hazard and recharging the vital ground water resource; and
>
> Whereas swamps, marshes, and other fresh water wetlands are among the most valuable of all wildlife habitats and are high value recreational areas as well, and wildlife and recreation are widely recognized as essential to the health, welfare, and general well-being of the general populace; and

Whereas swamps, marshes, and other fresh water wetlands are increasingly threatened by random and frequently undesirable projects for drainage, excavation, filling, encroachment or other form of disturbance or destruction and are currently inadequately protected from random and undesirable projects; and

Whereas the protection of swamps, marshes, and other fresh water wetlands from random, unnecessary, and/or undesirable drainage, excavation, filling, encroachment, or any other form of disturbance or destruction is recognized as being in the best public interest and essential to the health, welfare, and general well-being of the general populace and essential to the protection of property and life during times of flood or other disaster affecting water levels or water supply; Therefore, the provisions of the following sections are intended to preserve and regulate the use of swamps, marshlands and other fresh water wetlands.

§ 2-1-20.1 Rules and regulations – The director is authorized to adopt, modify, or repeal rules and regulations that are in accord with the purposes of §§ 2-1-18 – 2-1-24 and are subject to the administrative procedures act, chapter 35 of title 42, except for those wetlands located in the vicinity of the coast as set out in chapter 23 of title 46 of the general laws which shall be regulated consistent with the provisions of chapter 23 of title 46.

Rhode Island Coastal Resources Management Council Legislative Authority over Coastal Resources

§ 46-23-1 Legislative findings – (a) Under article 1, § 17 of the Rhode Island Constitution, the people shall continue to enjoy and freely exercise all the rights of fishery, and the privileges of the shore, to which they have been heretofore entitled under the charter and usages of this state, including, but not limited to, fishing from the shore, the gathering of seaweed, leaving the shore to swim in the sea and passage along the shore; and they shall be secure in their rights to use and enjoyment of the natural resources of the state with due regard for the preservation of their values; and it is the duty of the general assembly to provide for the conservation of the air, land, water, plant, animal, mineral and other natural resources of the state, and to adopt all means necessary and proper by law to protect the natural environment of the people of the state by providing adequate resource planning for the control and regulation of the use of the natural resources of the state and for the preservation, regeneration, and restoration of the natural environment of the state.

(2) The general assembly recognizes and declares that the coastal resources of Rhode Island, a rich variety of natural, commercial, industrial, recreational, and aesthetic assets, are of immediate and potential value to the present and future development of this state; that unplanned or poorly planned development of this basic natural environment has already damaged or destroyed, or has the potential of damaging or destroying, the state's coastal resources, and has restricted the most efficient and beneficial utilization of these resources; that it shall be the policy of this state to preserve, protect, develop, and, where possible, restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long range planning and management designed to produce the maximum benefit for society from these coastal resources; and that preservation and restoration of ecological systems shall be the primary guiding principle upon which environmental alteration of coastal resources will be measured, judged, and regulated.

(b) That effective implementation of these policies is essential to the social and economic well-being of the people of Rhode Island because the sea and its adjacent lands are major sources of food and public recreation, because these resources are used by and for industry, transportation, waste disposal, and other purposes, and because the demands made on these resources are increasing in number, magnitude, and complexity; and that these policies are necessary to protect the public health, safety, and general welfare. Pursuant to 16 U.S.C. § 1452 ("The Coastal Zone Management Act"), the general assembly hereby directs the council (referred to as "CRMC") to exercise effectively its responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone.

(2) Furthermore, that implementation of these policies is necessary in order to secure the rights of the people of Rhode Island to the use and enjoyment of the natural resources of the state with due regard for the preservation of their values, and in order to allow the general assembly to fulfill its duty to provide for the conservation of the air, land, water, plant, animal, mineral, and other natural resources of the state, and to adopt all means necessary and proper by law to protect the natural environment of the people of the state by providing adequate resource planning for the control and regulation of the use of the natural resources of the state and for the preservation, regeneration, and restoration of the natural environment of the state.

(c) That these policies can best be achieved through the creation of a coastal resources management council as the principal mechanism for management of the state's coastal resources.

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 all applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Those laws and regulations related to activities conducted to reduce mammal damage in the State are addressed below:

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. These laws, regulations, and guidelines generally outline five broad types of activities to be accomplished 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. Federal activities affecting the physical and biological environment are regulated in part by CEQ through regulations in 40 CFR, Parts 1500-1508. In accordance with CEQ and USDA regulations, APHIS guidelines concerning Implementation of the NEPA Procedures, as published in the Federal Register (44 CFR 50381-50384) provide guidance to APHIS regarding the NEPA process.

Pursuant to the NEPA and 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 the policies and goals of the NEPA are infused into federal agency actions. This EA was prepared by integrating as many of the natural and social sciences as warranted, based on the potential effects of the proposed action. The direct, indirect, and cumulative impacts of the alternatives are analyzed.

The NEPA requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes. The two primary objectives of the NEPA are: 1) agencies must have available and fully consider detailed information regarding environmental effects of federal actions and 2) agencies must make information regarding environmental effects available to interested persons and agencies before decisions are made and before actions are taken.

Endangered Species Act

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS conducts Section 7 consultations with the United

States Fish and Wildlife Service (USFWS) to use the expertise of the USFWS 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.

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

The NHPA and its implementing regulations (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 Sec. 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 mammal damage management methods described in this EA that might be used operationally by WS would cause major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor involves the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS under the alternatives would not generally be the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources were planned under an alternative selected because of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

Noise-making methods, such as firearms, that are used at or in close proximity to historic or cultural sites for the purposes of removing wildlife have the potential for audible effects on the use and enjoyment of historic property. However, such methods would only be used 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. Site-specific consultation as required by the Section 106 of the NHPA would be conducted as necessary in those types of situations.

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

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

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

Executive Order 12898 promotes the fair treatment of people of all races, income levels, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations. All activities are evaluated for their impact on the human environment and compliance with Executive Order 12898.

WS would use only legal, effective, and environmentally safe damage management methods, tools, and approaches. All chemicals that could be used by WS would be regulated by the EPA through the FIFRA, by the RIDEM, by the Drug Enforcement Agency (DEA), by MOUs with land managing agencies, and by WS' Directives. WS would properly dispose of any excess solid or hazardous waste. It is not anticipated that the proposed action or the alternatives would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. In contrast, the alternatives may benefit minority or low-income populations by reducing threats to public health and safety and property damage.

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

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. WS have considered the impacts that this proposal might have on children. The proposed activities would occur by using only legally available and approved methods where it would be highly unlikely that children would be adversely affected. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing the proposed action or the alternatives. Additionally, since the need for action identifies threats to human health and safety at locations where children could be present, it is expected that health and safety risks to children posed by mammals would be reduced under those alternatives where WS could provide assistance.

Invasive Species - Executive Order 13112

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

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal projects would discontinue work until a reasonable effort has been made to protect the items and the proper authority has been notified.

Occupational Safety and Health Act of 1970

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

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. All chemical methods that would be available for use by WS or could be recommended by WS under any of the alternatives would be registered with and regulated by the EPA and the RIDEM, and would be used or recommended by WS in compliance with labeling procedures and requirements. There are several products registered for the control of mammals (fumigants, toxicants, repellents) in Rhode Island listed in Appendix B.

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

This law places administration of pharmaceutical drugs, including those used in wildlife capture and handling, under the 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 DEA to possess controlled substances, including those that are used in wildlife capture and handling.

Animal Medicinal Drug Use Clarification Act of 1994

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

Clean Water Act (Section 404)

Section 404 (33 USC 1344) of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the United States without a permit from the United States Army Corps of Engineers unless the specific activity is exempted in 33 CFR 323 or covered by a nationwide permit in 33 CFR 330. The breaching of most beaver dams is covered by these regulations (33 CFR 323, 33 CFR 330).

Food Security Act

The Wetland Conservation provision (Swampbuster) of the 1985 (16 USC 3801-3862), 1990 (as amended by PL 101-624), and 1996 (as amended by Public Law 104-127) farm bills require all agricultural producers to protect wetlands on the farms they own. Wetlands converted to farmland prior to December 23, 1985 are not subject to wetland compliance provisions even if wetland conditions return because of lack of maintenance or management. If prior converted cropland is not planted to an agricultural commodity (crops, native and improved pastures, rangeland, tree farms, and livestock production) for more than 5 consecutive years and wetland characteristics return, the cropland is considered abandoned and then becomes a wetland subject to regulations under Swampbuster and Section 404 of the Clean Water Act. The Natural Resource Conservation Service is responsible for certifying wetland determinations according to this Act.

Memorandum of Understanding between the RIDEM and WS

A MOU between the RIDEM, RI Department of Public Health, University of Rhode Island Cooperative Extension Service, Rhode Island Airport Corporation, and WS was developed in 2002. The purpose was to establish a cooperative relationship between State Agencies and WS for planning, coordinating and implementing policies to prevent or minimize damage caused by wildlife to agriculture, property, and natural resources and to safeguard public health and safety; to facilitate an exchange of information; to encourage research on wildlife damage management; and to provide a basis for the establishment of cooperative agreements to conduct wildlife damage management activities.

State of Rhode Island General Laws Title 20 - Fish and Wildlife

§ 20-1-4: Rules and regulations – The director is authorized to promulgate, adopt, and enforce any and all rules and regulations deemed necessary to carry out duties and responsibilities under this title.

§ 20-1-12: Fixing of seasons and bag limits – (a) The director is authorized to adopt regulations fixing seasons, bag limits, size limits, possession limits, and methods of taking on any species of fish, game, bird, or other wild animal occurring within the state, other than marine species regulated by the marine fisheries council.

(1) These regulations may prohibit the taking, holding, or possession of any species, prohibit the taking, molestation, or disturbance in any way of nesting, breeding, or feeding sites of any species and/or prohibit, control, or regulate any commercial use, importation into the state, or exportation from the state of any species.
(2) These regulations may be of statewide applicability or may be applicable in any specified locality or localities within the state when the director shall find, after investigation, that the regulations are appropriate.

(a) Any person who violates any provision of this section or any rule or regulation made under the provisions of this section shall be guilty of a civil violation and subject to a fine of one hundred dollars ($100) for each offense.
(b) Notwithstanding any inconsistent provision of law, the traffic tribunal shall have jurisdiction to hear and determine all violations specified in this section.
(c) The regulations shall be adopted only after the holding of a public hearing subject to the provisions of the Administrative Procedures Act, chapter 35 of title 42.

§ 20-1-13: Publication and effective date of seasons and bag limits – Notice of the director's intention to adopt regulations pursuant to § 20-1-12 and the holding of a public hearing on these regulations shall be published in at least one newspaper of general statewide circulation, not less than twenty (20) days prior to the date of the public hearing. These regulations shall remain in effect not longer than one year following the date of their effectiveness.

§ 20-1-24: Wildlife Damage Act – (a) For purposes of this section, “wildlife population” includes, but is not limited to: deer; indigenous Canadian geese; mute swans; cormorants; wild turkeys; crows; coyotes and furbearers; (b) The department of environmental management shall establish a program of financial assistance to farmers, when state or federal funds become available, for the purpose of establishing preventive practices to protect damage to crops by wildlife. The director of the department is authorized and empowered to establish rules and regulations to enforce the provisions of this section.

§ 20-16-1: Protected Fur-bearers – No person shall hunt, pursue, shoot, or trap, or attempt so to do, fur-bearing mammals in this state, except in accordance with rules and regulations governing seasons, bag limits, and methods of taking adopted by the director pursuant to § 20-1-12. Protected furbearers would include raccoons, opossum, skunk, gray squirrel, rabbits, woodchucks, muskrats, beaver, weasels, fisher, mink, fox, coyotes, river otter, and bobcats.

§ 20-16-2: Nuisance Fur-bearers - Any person owning or leasing and operating any property and any employee of that person may, while on that person's premises, kill and take a fur-bearer which is worrying, wounding, or killing the domestic animals or livestock on the property, or destroying or mutilating agricultural crops or fruit trees on the property, or otherwise causing clear and immediate economic damage to any property belonging to that person or creating a potential health hazard; provided that, except in the case of rabbits, the carcass of the fur-bearer shall be presented to the department within twenty-four (24) hours of taking. The animal may then be possessed by the landowner or lessee for the use of the immediate family of the landowner or lessee, and shall not be sold or offered for sale, except by special permission of the director.

§ 20-16-8: Steel Jawed Leghold Traps - No person shall use, set, place, or maintain or tend any steel jawed leghold trap to capture any fur-bearing mammal or other animal; provided, however, that any person may apply in writing to the director of the department of environmental management for a special permit to use a steel jawed leghold trap to be used on his or her property when there exists on his or her property an animal nuisance which cannot be reasonably abated except by the use of the trap. If the director determines that this nuisance exists on the property of the applicant which cannot be reasonably abated by means not prohibited by this section, the director may then issue a permit to the applicant for a period not exceeding ninety (90) days to use, set, place, maintain, or tend any steel jawed leghold traps that the director may deem necessary to eliminate the nuisance.

§ 20-16-9: Setting of Traps - No trap shall be set by any person on the enclosed land of another without the written permission of the owner of the land. Every trap shall be placed in a hole, brush pile, stone wall, or other protected place, so situated as to be inaccessible to any domestic animal. No person setting a trap or traps shall fail to visit the traps at least once every twenty-four (24) hours.

§ 20-16-17: Prohibition against Killing Otter - No person shall hunt, trap, take, or kill an otter in this state.

§ 20-37-1: Endangered Species of Animals and Plants - It is the policy of this state to contribute to the maintenance of a high quality environment within the state and elsewhere for the benefit of the safety, health, and welfare of its citizens by forbidding the importation, sale, offering for sale, transportation, storage, traffic, ownership, or other possession or use of any dead or live animal or plant or any part of the skin, other tissues, or body, whether raw, manufactured, processed, or preserved, of any species of animal or plant considered by the United States secretaries of the interior or commerce to be under the provisions of the Federal Endangered Species Act of 1973, 16 USC § 1531 et seq.

State of Rhode Island General Laws Title 42 - State Affairs and Government

§ 42-17.1: Department of Environmental Management
§ 42-17.1-1 Department established – There is hereby established within the executive branch of the state government a department of environmental management. The head of the department shall be the director of environmental management, who shall be in the unclassified service and who shall be appointed by the governor, with the advice and consent of the senate, and shall serve at the pleasure of the governor.

§ 42-17.6: Administrative Penalties for Environmental Violations
§ 42-17.6-2 Authority of director to assess penalty – The director may assess an administrative penalty on a person who fails to comply with any provision of any rule, regulation, order, permit, license, or approval issued or adopted by the director, or of any law which the director has the authority or responsibility to enforce. Any such penalty shall be an alternative to any other civil penalty that may be prescribed by law.

§ 42-35: Administrative Procedures
§ 42-35-1.1 Bodies subject to chapter – Notwithstanding any other provision of the general laws or any public law or special act to the contrary, all agencies as defined in § 42-35-1(a) and all agencies, boards,

commissions, departments, and officers authorized by law to make rules or to determine contested cases, and all authorities as defined in § 42-35-1(b) are subject to the provisions of this chapter.

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. As the authority for the management of mammal populations in the State, the RIDEM 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 RIDEM is responsible for managing wildlife in the State, including those mammal species addressed in this EA. The RIDEM establishes and enforces regulated hunting and trapping seasons in the State as well as pesticide regulations for toxicants and repellents/aversive agents that may be registered for use to manage damage associated with mammals. WS' activities to reduce and/or prevent mammal damage in the State under the alternatives would be coordinated with the RIDEM, which would ensure WS' actions would be incorporated 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 mammal damage management to alleviate damage to agriculture, property, natural resources, and threats to human safety, 2) should WS conduct disease surveillance and monitoring in mammal populations when requested by the RIDEM and other agencies, 3) should WS implement an integrated wildlife damage management strategy, including technical assistance and direct operational assistance, to meet the need for mammal damage management in Rhode Island, 4) if not, should WS attempt to implement one of the alternatives to an integrated damage management strategy as described in the EA, and 5) would the proposed action or the other alternatives result in significant 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 that will not be considered 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 will be incorporated into the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

Damage, threats of damage, or other requests for assistance related to those mammal species addressed in this EA could occur statewide in Rhode Island wherever those mammals occur. However, mammal damage management and other activities would only be conducted by WS when requested by a landowner or manager and only on properties where a cooperative service agreement or other comparable document were signed between WS and a cooperating entity. Most species of mammals addressed in this EA can be found throughout the year across the State where suitable habitat exists for foraging and shelter. Those mammal species addressed in this EA are capable of utilizing a variety of habitats in the State. Since those mammal species addressed in this EA can be found throughout most of the State, requests for assistance to manage damage, threats of damage, or for other reasons could occur in areas occupied by those mammal species. Additional information on the affected environment for each species is provided in Chapter 4.

Upon receiving a request for assistance, activities to reduce mammal damage and other management activities could be conducted on federal, state, tribal, municipal, and private properties in Rhode Island. Areas where damage, threats of damage, or other requests for assistance 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, dikes, ditches, ponds, and levees; public and private properties in areas where mammals cause damage to landscaping and natural resources, property, and are a threat to human safety through the spread of disease. The area would also include airports and military airbases where mammals are a threat to human safety and to property; areas where mammals negatively affect wildlife, including T&E species; and public property where mammals are negatively affecting historic structures, cultural landscapes, and natural resources.

Environmental Status Quo

As defined by the NEPA implementing regulations, the "*human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment*" (40 CFR 1508.14). Therefore, when a federal action agency analyzes their potential impacts on the "*human environment*", it is reasonable for that agency to compare not only the effects of the federal action, but also the potential impacts that occur or could occur in the absence of the federal action by a non-federal entity. This concept is applicable to situations involving federal assistance to reduce damage associated with wildlife species.

Unprotected wildlife species, such as most non-native invasive species, are not protected under state or federal law. Most resident wildlife species are managed under state authority or law without any federal oversight or protection. In some situations, with the possible exception of restrictions on methods (*e.g.*, firearms restrictions, pesticide regulations), unprotected wildlife species and certain resident wildlife species are managed with little or no restrictions, which allows them to be killed or taken by anyone at any time when they are committing damage. For mammal damage management in Rhode Island, the RIDEM has the authority to manage and authorize the taking of mammals 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, 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 must be viewed as an environment that includes those resources as they are managed or impacted by non-federal entities in the absence of the federal action being proposed. 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 requestor conducts the action in the absence of WS' involvement in the action.

A non-federal entity could lethally take mammals to alleviate damage without the need for a permit when those species are non-native or are unregulated by the RIDEM. In addition, mammals could be removed to alleviate damage, without a permit if designated a "*nuisance furbearer*" as described under § 20-16-2 Landowners, Nuisance fur-bearers, during the hunting and/or trapping season, and/or through the issuance of permits by the RIDEM. In addition, most methods available for resolving damage associated with mammals would also be available for public use. 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 no action were taken by WS, the non-federal entity could take the action anyway using the same methods without the need for a permit, during the hunting or trapping season, or through the issuance of a permit by the RIDEM. Under those circumstances, WS would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of WS' direct involvement.

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

2.2 ISSUES ASSOCIATED WITH MAMMAL DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns of the public and/or professional community raised regarding potential adverse effects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. Issues related to managing damage and other issues associated with mammals in Rhode Island were developed by WS in consultation with the RIDEM. This EA will also be made available to the public for review and comment to identify additional issues.

The issues as those issues relate to the possible implementation of the alternatives, including the proposed action, are discussed in detail in Chapter 4. The issues analyzed in detail in Chapter 4 are the following:

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

A common issue when addressing damage caused by wildlife are the potential impacts of management actions on the populations of target species. Methods available to resolve damage or threats to human safety under the alternatives are categorized into lethal and non-lethal methods.

Non-lethal methods could disperse or otherwise make an area unattractive to target species causing damage, which would reduce the presence of those species at the site and potentially the immediate area around the site where non-lethal methods were employed. Lethal methods would be employed to remove a mammal or those mammals responsible for causing damage or posing threats to human safety. The use of lethal methods would therefore result in local population reductions in the area where damage or threats were occurring. The number of target species removed from the population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individuals involved with the associated damage or threat, and the efficacy of methods employed.

The analysis for magnitude of impact on the populations of those species addressed in the EA would be based on a measure of the number of individuals killed from each species in relation to that species' abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations would be based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations would be based on population trends and harvest trend data, when available. WS' take would be monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause adverse impacts to the viability of native species populations. Lethal take of mammals by WS under the alternatives would only occur at the request of a cooperator seeking assistance and only after the RIDEM authorized the lethal take, when required.

In addition, many of the mammal species addressed in this EA can be harvested in the State during annual hunting and/or trapping seasons and can be addressed using available methods by other entities in the State when those species cause damage or pose threats of damage when permitted by the RIDEM. 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.

Methods available under each of the alternatives to resolve damage and reduce threats to human safety would be employed targeting an individual of a mammal species or a group of individuals after applying the WS' Decision Model (Slate et al. 1992) to identify possible techniques. The effects on the populations of target mammal populations in the State from implementation of the alternatives addressed in detail, including the proposed action, are analyzed in Chapter 4. Information on mammal populations and trends are often derived from several sources including the fur harvest reports, damage complaints, and published literature.

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

The issue of non-target species effects, including effects on T&E species arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. Methods available for use under the alternatives are described in Appendix B.

Concerns have also been raised about the potential for adverse effects to occur to non-target wildlife from the use of chemical methods. Chemical methods being considered for use to manage damage or threats associated with those mammal species addressed in this EA include immobilizing drugs, euthanasia chemicals, reproductive inhibitors, fumigants, rodenticides, and repellents.

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 Section 7 consultations with the USFWS to ensure compliance with the ESA and 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)].

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. As part of the scoping process for this EA and to facilitate interagency cooperation, WS contacted the USFWS during the development of this EA regarding compliance with Section 7 of the ESA. Procedures for compliance with the ESA provided by the USFWS are further discussed in Chapter 4.

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

An additional issue often raised is the potential risks to human safety associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. WS' employees would use and 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. WS' employees would potentially be exposed to damage management methods, as well as, subject to workplace accidents. Selection of methods, under the alternatives, would include consideration for public and employee safety.

Safety of Chemical Methods Employed

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

Immobilizing drugs would include ketamine and telazol, which are anesthetics (*i.e.*, general loss of pain and sensation) used during the capture of wildlife to eliminate pain, calm fear, and reduce anxiety in wildlife when handling and transporting wildlife. Xylazine is a sedative that is often used in combination with ketamine to calm nervousness, irritability, and excitement in wildlife during the handling and transporting of wildlife. Euthanasia chemicals would include sodium pentobarbital, Beuthanasia®-D, Fatal-Plus™ and potassium chloride, which would be administered after an animal has been anesthetized.

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

Rodenticides would include products containing the active ingredient zinc phosphide, warfarin, brodifacoum, or diphacinone, which could be available to address damage and threats associated with those small rodent species addressed in this EA. Rodenticides are pesticides that require a restricted-use pesticide applicators license from the RIDEM. 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). Warfarin, brodifacoum, and diphacinone are anticoagulant rodenticides that prevent the clotting of blood. Products containing the active ingredients, warfarin, brodifacoum, or diphacinone are not currently registered for use in Rhode Island. Rodenticides containing those active ingredients are generally restricted-use pesticides, which, if available, can be purchased and applied by appropriately licensed people, and are not products that are restricted to use by WS only. Those active ingredients are discussed in this EA as possible methods that could be available under the alternatives, since products are available containing those active ingredients and could be registered for use in the State in the future.

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 are generally restricted-use products that can only be purchased and applied by licensed applicators. Repellents are generally applied directly to affected resources and elicit an adverse taste response when ingested or cause temporarily sickness (*e.g.*, nausea). Products containing coyote urine or other odors associated with predatory wildlife are intended to elicit a fright response in target wildlife by imitating the presence of a predatory animal (*i.e.*, wildlife tend to avoid areas where predators are known to occur).

Gas cartridges would be available to fumigate burrows and den sites 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. The cartridges would be placed inside active burrows and dens at the entrance, the cartridge would be ignited, and the entrance to the burrow or den would be sealed with dirt, which allows the burrow or den to fill with carbon monoxide. WS would only employ or recommend for use those chemical methods that are registered for use pursuant to the FIFRA with the EPA and are registered for use in the State by the RIDEM. Gas cartridges are not currently registered for use in Rhode Island; however, products registered with the EPA are generally restricted-use products that can be purchased and applied by licensed applicators.

Products containing the active ingredient aluminum phosphide are used either as a fumigant or as a rodenticide. Fumigants containing aluminum phosphide as the active ingredient are formulated as tablets, which are placed inside rodent burrows and the burrows are sealed up. The aluminum phosphide in the table reacts with the moisture in the soil releasing phosphine gas. Since burrows are sealed after placing the tablets, the burrow fills with toxic phosphine gas. When used as a rodenticide, products containing aluminum phosphide are formulated as pellets and are present as bait for ingestion. When the pellet is ingested, the aluminum phosphide reacts with the acid in the stomach releasing phosphine gas. Products containing the active ingredient aluminum phosphide are registered for use in the State, primarily as fumigants. Products containing aluminum phosphide are restricted use pesticides and would be available to any licensed applicator.

The issue of the potential for drugs used in animal capture, handling, and euthanasia to cause adverse health effects in humans that hunt and consume the species involved has been raised. Among the species to be captured and handled under the proposed action, this issue is expected to be of concern for wildlife that are hunted and sometimes consumed by people as food. Chemical methods available for use under the relevant alternatives would be regulated by the EPA through FIFRA, by State laws, by the DEA, by the United States Food and Drug Administration (FDA), and by WS' Directives.

Safety of Non-Chemical Methods Employed

Most methods available to alleviate damage and threats associated with mammals are considered 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 very localized area, such as removing bushes to eliminate shelter locations or planting vegetation that are less palatable to mammals. 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 live-traps, body-gripping traps, cannon nets, shooting, or the recommendation that a local population of mammals be reduced using hunting and/or trapping.

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 Rhode Island would be available for use under any of the alternatives and could be employed by any entity, when permitted. Risks to human safety from the use of non-chemical methods will be further evaluated as this issue relates to the alternatives in Chapter 4. A complete list of non-chemical methods available to alleviate damage associated with mammals is provided in Appendix B of this EA.

Effects of Not Employing Methods to Reduce Threats to Human Safety

An issue identified is the concern for human safety from not employing methods or not employing the most effective methods to reduce the threats that mammals can pose. The risks to human safety from diseases associated with certain mammal populations were addressed previously in Chapter 1 under the need for action. 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 concern is raised with 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. This issue will be fully evaluated in Chapter 4 in relationship to the alternatives.

Issue 4 - Effects on the Socio-cultural Elements of the Human Environment

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. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The public share a similar bond with animals and/or wildlife in general and in modern societies, a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals and mammals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing wildlife. Therefore, the public reaction can be variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between humans and wildlife.

Wildlife populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals and may take the form of direct consumptive use (*i.e*., 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 come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as 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 wildlife vary considerably. Some people believe that all wildlife should be captured and translocated to another area to alleviate damage or threats to protected resources. Some people directly affected by the problems caused by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations or sites. Some people totally opposed to wildlife damage management want WS to teach tolerance for damage and threats caused by wildlife, and that wildlife should never be killed. Some of the people who oppose removal of wildlife do so because of human-affectionate bonds with individual wildlife. Those human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Some individuals are offended by the presence of overabundant mammal species, such as raccoons, deer, 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 humans or other wildlife. Their overall enjoyment of other animals is diminished by what they view as a destructive presence of such species. They are offended because they feel that those mammal species proliferate in such numbers and appear to remain unbalanced.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that can be interpreted 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."*

According to the AVMA (1987), suffering is described 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 occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain, and identifying the causes that elicit pain responses in humans would "…*probably be causes for pain in other animals*…" (AVMA 1987). 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 states "*...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 AVMA accepted methods of euthanasia to be used when killing all animals, including wild animals. The AVMA states "[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 wildlife has both a professional and lay point of arbitration. Wildlife managers and the public would be better served to 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 some methods can cause "*stress*" (Kreeger et al. 1988). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness.

The decision-making process involves trade-offs 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.

The issue of humanness and animal welfare concerns will be further discussed in Chapter 4. SOPs to alleviate pain and suffering are discussed in Chapter 3.

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

Another issue commonly identified is a concern that damage management activities conducted by WS would affect the ability of persons to harvest those species during the regulated hunting and trapping seasons either by reducing local populations through the lethal removal of mammals or by reducing the number of mammals present in an area through dispersal techniques. Those species that are addressed in this EA that also can be hunted and/or trapped during regulated seasons in the State include the Eastern and New England cottontail, snowshoe hare, gray fox, red fox, gray squirrel, raccoon, coyote, mink, muskrat, striped skunk, Virginia opossum, short-tailed and long-tailed weasel, beaver, fisher, and white-tailed deer.

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

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Wetlands are a valuable component of land-based ecosystems that provide numerous direct and indirect benefits to people and wildlife (*e.g*., see Costanza et al. 1997, Millennium Ecosystem Assessment 2005).

Between the 1780s and the 1980s, Dahl (1990) estimated 53% of the original wetland acres in the lower 48 states were lost, primarily from human development. Over that 200-year time span, Dahl (1990) estimated the wetland acres in Rhode Island decreased from 102,690 acres to 65,154 acres, which represented a 37% decline. Beaver, through their building of dams and impounding water can have a unique role in establishing wetlands that not only provide benefit to the beaver, but to people and other wildlife. Beaver are often considered a "*keystone*" species for their ability to manipulate and create their own habitats, which can also provide benefits to other wildlife and people. Beaver may also be an inexpensive way of restoring wetlands or creating new wetlands (*e.g.*, see Hey 1995, Muller-Schwarze and Sun 2003, Buckley et al. 2011).

The issue of WS' potential impacts to wetlands could occur from activities conducted to alleviate damage or threats of damage associated with beaver, primarily from the breaching or removal of beaver dams. Beaver dam breaching or removal during activities to manage damage caused by beaver sometimes occurs in areas inundated by water from water impounded by beaver dams. Dam material usually consists of mud, sticks, and other vegetative material. Beaver dams obstruct the normal flow of water, which can change the preexisting hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment over time. The depth of the bottom sediment depends on the length of time an area is covered by water and the amount of suspended sediment in the water.

Beaver dams, over time, can establish new wetlands. The regulatory definition of a wetland stated by the United States Army Corps of Engineers and the EPA (40 CFR 232.2) is:

"Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Therefore, the breaching or removal of a beaver dam could result in the degrading or removal of a wetland, if wetland characteristics exist at a location where a beaver dam occurs. The preexisting habitat (prior to the building of the dam) and the altered habitat (areas flooded by impounded water) have different ecological values to the fish and wildlife native to the area. Some species may benefit by the addition of a beaver dam that creates a wetland, while the presence of some species of wildlife may decline. For example, darters listed as federally endangered require fast moving waters over gravel or cobble beds, which beaver dams can eliminate; thus, reducing the availability of habitat. In areas where bottomland forests were flooded by beaver dams, a change in species composition could occur over time as trees die. Hardwood trees are often killed when flooding persists for extended periods, as soils become saturated. Conversely, beaver dams could be beneficial to some wildlife such as river otter, neotropical migratory birds, and waterfowl that require aquatic habitats.

If a beaver dam was not removed and water was allowed to stand, hydric soils and hydrophytic vegetation could eventually form. This process could take anywhere from several months to many years depending on preexisting conditions. Hydric soils are those soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. In general, hydric soils form much easier where wetlands have preexisted. Hydrophytic vegetation includes those plants that grow in water or on a substrate that is at least periodically deficient in oxygen because of excessive water content. If those conditions were met, then a wetland has developed that would have different wildlife habitat values than an area that has been more recently impounded by beaver dam activity.

In addition, concerns are often raised regarding the use of lethal methods to remove beaver to alleviate damage or threats. If beaver were lethally removed from an area and any associated beaver dam was removed or breached, the manipulation of water levels by removing/breaching the dam could prevent the establishment of wetlands in areas where water has been impounded for an extended period by beaver dams. If beaver were removed but the beaver dam was left undisturbed, the lack of maintenance to the dam by beaver would likely result in the eventual recession of the impounded water as weathering eroded the dam.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

Additional issues were also identified by WS and the RIDEM during the scoping process of this EA. Those additional issues were considered but detailed analyses will not occur for the reasons provided. The following issues were considered but were not analyzed in detail:

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

A concern was raised that an EA for an area as large as the State of Rhode Island would not meet the NEPA requirements for site specificity. Wildlife damage management falls within the category of federal or other regulatory agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to describe accurately such locations or times in an EA or EIS. Although WS can predict some of the possible locations or types of situations and sites where some kinds of wildlife damage could occur, the program cannot predict the specific locations or times at which affected resource owners would determine a damage problem has 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 APHIS procedures implementing the NEPA, WS' individual wildlife damage management actions could be categorically excluded (7 CFR 372.5(c)). The intent in developing this EA was to determine if the proposed action would 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 a determination were made through this EA that the proposed action or the other alternatives might have a significant impact on the quality of the human environment, then an EIS would be prepared. Based on previous requests for assistance, the WS program in Rhode Island would continue to conduct mammal damage management in a very small area of 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. Methods available are employed 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. WS operates on a small percentage of the land area of Rhode Island and only targets those mammals identified as causing damage or posing a threat. 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 a threshold of loss should be established before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. Some damage and economic loss would likely be tolerated by cooperators until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking mammals can lead to property damage and can threaten passenger safety if a catastrophic failure of the aircraft occurs because of the strike. Therefore, addressing the threats of wildlife strikes prior to an actual strike occurring would be appropriate.

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

Mammal Damage Management Should Not Occur at Taxpayer Expense

An issue identified is the concern that wildlife damage management should not be provided at the expense of the taxpayer or that activities should be fee-based. Funding for activities would be derived from federal appropriations and through cooperative funding. Activities conducted in the State for the management of damage and threats to human safety from mammals would be funded through cooperative service agreements with individual property owners or managers. A minimal federal appropriation is allotted for the maintenance of a WS program in Rhode Island. The remainder of the WS program would mostly be fee-based. Technical assistance would be provided to requesters as part of the federally funded activities, but the majority of direct assistance in which WS' employees perform damage management activities would be funded through cooperative service agreements between the requester and WS.

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 being considered. 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. The cost effectiveness of methods and the effectiveness of methods would be linked. The issue of cost effectiveness as it relates to the effectiveness of methods is discussed in the following issue.

Effectiveness of Mammal Damage Management Methods

The effectiveness of any damage management program could be defined in terms of losses or risks potentially reduced or prevented. The effectiveness can also be dependent upon how accurately practitioners diagnose the problem, the species responsible for the damage, and how actions were implemented to correct or mitigate risks or damages. To determine that effectiveness, WS must be able to complete management actions expeditiously to minimize harm to non-target animals and the environment, while at the same time, using methods as humanely as possible. The most effective approach to resolving any wildlife damage problem would be to use an adaptive integrated approach, which may call for the use of several management methods simultaneously or sequentially (Courchamp et al. 2003).

The purpose behind integrated management is to implement methods in the most effective manner while minimizing the potentially harmful effects on humans, target and non-target species, and the environment[8].

[8] The cost of management may sometimes be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of the personnel using the method and, for WS' personnel, the guidance provided by WS' directives and policies.

The goal would be to reduce damage, risks, and conflicts with wildlife as requested and not to reduce/eliminate populations. Localized population reduction could be short-term with new individuals immigrating into the area or born to animals remaining at the site (Courchamp et al. 2003). The ability of an animal population to sustain a certain level of removal and to eventually return to pre-management levels does not mean individual management actions were unsuccessful, but that periodic management may be necessary. The return of wildlife to pre-management levels also demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

Comments are often received that lethal methods would be ineffective because additional mammals would likely to return to the area. In addition, comments also claim that because mammals return to an area after initial removal efforts were complete, the use of lethal methods gives the impression of creating a financial incentive to continue the use of only lethal methods. Those statements assume mammals only return to an area where damage was occurring if lethal methods were used. However, the use of non-lethal methods would also often be temporary, which could result in mammals returning to an area where damage was occurring once those methods were no longer used. The common factor when employing any method would be that mammals would return if suitable conditions continue to exist at the location where damage was occurring and mammal densities were sufficient to occupy all available habitats to the extent that damage occurs. Therefore, any reduction or prevention of damage from the use of methods addressed in Appendix B would be temporary if habitat conditions continue to exist that attract mammals to an area where damage was occurring.

Therefore, any method that disperses or removes mammals from areas would only be temporary if habitat containing preferred habitat characteristics continues to exist. Dispersing mammals using non-lethal methods addressed in Appendix B often requires repeated application to discourage mammals from returning to locations, which increases costs, moves mammals to other areas where they could cause damage, and would be temporary if habitat conditions that attracted those mammals to damage areas remained unchanged. Dispersing and translocating mammals could be viewed as moving a problem from one area to another, which would require addressing damage caused by those mammals at another location, which increases costs and could be perceived as creating a financial incentive to continue the use of those methods since mammals would have to be addressed annually and at multiple locations. WS' recommendation of or use of techniques to modify existing habitat or making areas unattractive to mammals is discussed in Appendix B. WS' objective would be to respond to requests for assistance with the most effective methods and to provide for the long-term solution to the problem using WS' Decision Model.

Managing damage caused by mammals can be divided into short-term redistribution approaches and long-term population and habitat management approaches. Short-term approaches focus on redistribution and dispersal of mammals to limit use of an area where damage or threats were occurring. Short-term redistribution approaches may include prohibiting feeding, the use of pyrotechnics, propane cannons, effigies, and other adverse noise, erecting access barriers such as fencing, and taste aversion chemicals. Population reduction by limiting survival or reproduction, removing mammals, and habitat modification would be considered long-term solutions to managing damage caused by wildlife.

Redistribution methods would often be employed to provide immediate resolution to damage occurring until long-term approaches can be implemented or have had time to reach the desired result. Dispersing mammals can often be a short-term solution that moves those mammals to other areas where damages or threats could occur. Some short-term methods may become less effective in resolving damage as a mammal population increases, as mammals become more acclimated to human activity, and as mammals become habituated to harassment techniques. Non-lethal methods often require a constant presence at locations when mammals are present and must be repeated every day or night until the desired results are achieved, which can increase the costs associated with those activities. Non-lethal methods may also require constant monitoring and maintenance to insure proper results. For example, fencing could be used to prevent access to a resource; however, constant monitoring of the fencing would be required and necessary repairs completed to ensure the use of fencing would be successful in preventing access to resources. Long-term solutions to resolving mammal damage often require management of the population and identifying the habitat characteristics that attract mammals to a particular location.

Based on the evaluation of the damage situation, the most effective methods would be employed individually or in combination based on prior evaluations of methods or combinations of methods in other damage management situations. Once employed, methods would be further evaluated for effectiveness based on a continuous evaluation of activities by WS. Therefore, the effectiveness of methods would be considered as part of the decision making-process under WS' use of the Decision Model described in Chapter 3 for each damage management request based on the continual evaluation of methods and results.

Mammal Damage Should Be Managed By Private Nuisance Wildlife Control Specialists

Wildlife control specialists and private entities could be contacted to reduce mammal damage when deemed appropriate by the resource owner. The RIDEM maintains a website of wildlife control specialists in the State[9]. In addition, WS could refer persons requesting assistance to specialists and/or private trappers 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 would only respond to requests for assistance received. When responding to requests for assistance, WS would inform requesters that other service providers, including wildlife control specialists and private entities, might be available to provide assistance.

Effects from the Use of Lead Ammunition in Firearms

WS' personnel would use non-toxic shotgun shot whenever possible; however, some lead shot could still be used. Lead rifle and air rifle ammunition could also be utilized. Efforts to eliminate the use of lead are currently being investigated by WS in Rhode Island but may not be implemented until suitable replacement materials are commonly available.

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms. 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, air 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 take of mammals by WS using firearms in the State would occur primarily from the use of rifles. However, the use of shotguns or handguns could be employed. To reduce risks to human safety and property damage from bullets passing through mammals, the use of rifles would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to ensure the bullet does not pass through mammals. Mammals that are removed using rifles would occur within areas where retrieval of all 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 or being exposed to lead that may be contained within the carcass.

However, deposition of lead into soil could occur if, during the use of a rifle, the projectile passes through a mammal, if misses occur, or if the mammal carcass was not retrieved. 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 is generally retained 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 that was subjected directly to high concentrations of lead

[9]The website can be accessed at http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/relok8rs.pdf; accessed February 19, 2013.

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 transport of lead from bullets or shot distributed across the landscape was reduced once the bullets and shot formed crusty lead oxide deposits on their surfaces, which served to reduce naturally the potential for ground or surface water contamination (Craig et al. 1999). Those studies suggest that, given the very low amount of lead being deposited 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.

A secondary concern surrounding lead ammunition surrounds the issue of lead deposition in meat, particularly meat that is donated to various charities. Stewart and Veverka (2011) documented that white-tailed deer that were shot with lead ammunition in the head or extreme upper neck in sharpshooting situations showed no deposition of lead fragments in the meat of the animals that would have been processed for human consumption. Lower neck shots do frequently experience lead fragmentation in the loin muscle and the authors recommend removing the loins prior to processing to ensure that these fragments are not ingested. WS' personnel would be trained to shoot and target the head and upper neck of white-tailed deer. Any deer that were shot in the lower neck would not be donated but would be disposed of properly to avoid potential human ingestion of lead fragments.

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 amount of lead deposited into the environment could be lowered by WS' involvement in damage management activities due to efforts by WS to ensure projectiles do no pass through but are contained within the mammal carcass, which limits the amount of lead potentially deposited into soil from projectiles passing through the carcass. The proficiency training received by WS' employees in firearm use and accuracy 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. In addition, WS' involvement ensures mammal carcasses lethally removed using firearms would be retrieved and disposed of properly to limit the availability of lead in the environment and ensures mammal carcasses were removed from the environment to prevent the ingestion of lead in carcasses by scavengers. Based on current information, the risks associated with lead bullets that could be deposited into the environment from WS' activities due to misses, the bullet 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 adverse contamination of water.

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, were 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 analysis in this EA was driven by the issues raised during the scoping process during the development of the EA. 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 used by WS' personnel for evaluating and responding to requests for assistance.

As discussed previously, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. In addition, one EA allows for a better cumulative impact analysis. If a determination were made 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.

Effects on Human Health from Consumption of Meat Donated by WS

Of concern under this issue would be the consumption of deer and other mammal meat, such as rabbit, donated to a charitable organization after being lethally taken by WS. Of recent concern is the potential for lead and other contaminants to be present in meat that has been processed for human consumption. The potential for the spreading of zoonotic diseases in deer and other mammal meat processed and donated for human consumption is also a concern. Under the proposed action alternative, meat from game or furbearer species that are traditionally eaten and that may be legally hunted or trapped in Rhode Island including deer, rabbit, hare, and gray squirrel, lethally taken during damage management activities could be donated to charitable organizations for human consumption. WS could recommend the donation or consumption of meat under the technical assistance only alternative but would not be directly involved with damage management activities under that alternative.

If WS donated deer or other mammal meat for human consumption, WS' policies pertaining to the testing or labeling of meat would be followed in order to address potential health concerns. Mammal meat donated for human consumption may be tested for exposure to substances such as organophosphate and carbamate insecticides, lead, mercury, arsenic, organochlorines, and organic chemicals prior to distribution. The entity selecting the capture/euthanize (and donation for charitable consumption) program would be responsible for all costs associated with legal and appropriate donation for human consumption.

Rhode Island allows for donation of meat under the Rhode Island Hunters and Fishermen for the Hungry program adopted under the Bill Emerson Good Samaritan Food Donation Act (10/1/1996), which limits liability for legally harvested game donated to Rhode Island food banks in good faith. The meat must be legally harvested, properly processed, packaged, refrigerated, and labeled to be acceptable.

Deer and other mammals immobilized using immobilizing drugs or euthanized using euthanasia chemicals would not be donated for human consumption with disposal of carcasses occurring by deep burial or incineration. Mammals taken by any method solely 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 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 meat.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives that were developed to meet the need for action discussed in Chapter 1 and to address the identified issues discussed in Chapter 2. Alternatives were developed for consideration 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). Chapter 3 also discusses alternatives considered but not analyzed in detail, with rationale. SOPs for mammal damage management in Rhode Island are also discussed in Chapter 3.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed 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 Mammal Damage Management Program (No Action/Proposed Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, when requested, as deemed appropriate using the WS Decision Model, to reduce damage and threats caused by mammals in Rhode Island. 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, in consultation the RIDEM, would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding was available, operational damage management. Funding could occur through federal appropriations or from cooperative funding.

The adaptive approach to managing damage associated with mammals would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by a site-specific evaluation to reduce damage or threats to human safety for each request. City/town managers, agricultural producers, property owners, and others requesting assistance would be provided 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 take of many of the mammal species native to Rhode Island can only legally occur through regulated hunting and trapping seasons or through the issuance of a permit by the RIDEM and only at levels specified in the permit. Under the Rhode Island General Laws § 20-16-2, "*any person owning or leasing and operating any property and any employee of that person may, while on that person's premises, kill and take a fur-bearer which is worrying, wounding, or killing the domestic animals or livestock on the property, or destroying or mutilating agricultural crops or fruit trees on the property, or otherwise causing clear and immediate economic damage to any property belonging to that person or creating a potential health hazard; provided that, except in the case of rabbits, the carcass of the fur-bearer shall be presented to the department within twenty-four (24) hours of taking. The animal may then be possessed by the landowner or lessee for the use of the immediate family of the landowner or lessee, and shall not be sold or offered for sale, except by special permission of the director*." Activities conducted under this alternative would occur in compliance with the Rhode Island General Laws and the MOU signed between the RIDEM and WS.

Property owners or managers requesting assistance from WS could be provided with information regarding the use of effective and practical non-lethal and lethal techniques. Preference would be given 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 in addressing those mammals responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should begin as soon as mammals begin to cause damage. Mammal damage that has been ongoing can be difficult to resolve using available methods since mammals would be conditioned to an area and would be familiar with a particular location. Subsequently, making that area unattractive using available methods could be difficult to achieve once damage was ongoing. 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.

WS' Decision Model would be the implementing mechanism for a damage management program under the proposed action alternative that would be adapted to an individual damage situation that allows for the broadest range of methods to be used to address damage or the threat of damage in the most effective, most efficient, and most environmentally conscious way available. When WS receives a request for direct operational assistance, WS would conduct site visits to assess 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. The use of the Decision model by WS' employees under the proposed action is further discussed below. In addition, preference would be given to non-lethal methods when practical and effective (see WS Directive 2.101).

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, nets, cage traps, foothold traps[10], translocation, exclusionary devices, frightening devices, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods that would be available to WS under this alternative include body-gripping traps, the recommendation of take during hunting and/or trapping seasons, shooting, euthanasia chemicals, fumigants, and rodenticides. In addition, 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.

Listing 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 those methods were proven 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 are employed. Long-term solutions to managing mammal damage would include limited habitat manipulations and changes in cultural practices, which are 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. Non-lethal methods would be given priority when addressing requests for assistance (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model, especially when the requesting entity has used non-lethal methods previously and found those methods to be inadequate to resolving the damage or threats of damage. Non-lethal methods would be

[10]As discussed in Section 1.6 of the EA, the use of foothold traps in Rhode Island is prohibited; however, the RIDEM can authorize the use of foothold traps under certain circumstance (Rhode Island Common Law Section 20-16-8). WS would only use foothold traps when a permit had been issued by the RIDEM to WS or had been issued to a cooperator where WS was working as an agent of the property owner.

used to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from an area resulting in a reduction in the presence of those mammals at the site where those methods were employed. 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, 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 by 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 requestor, 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.

Lethal methods could be employed to resolve damage associated with those mammals identified by WS as responsible for causing damage or threats to human safety under this alternative; however, WS would only employ lethal methods after receiving a request for the use of those methods. The use of lethal methods would result in local population reductions in the area where damage or threats were occurring since mammals would be removed from the population. Lethal methods would often be employed to reinforce non-lethal methods and to remove mammals that were identified as causing damage or posing a threat to human safety. The use of lethal methods would result in local reductions of mammals in the area where damage or threats were occurring. 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 taken 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, the use of lethal methods would not be used as population management tools over broad areas. The use of lethal methods would be intended to reduce the number of mammals present at a specific location where damage was occurring by targeting those mammals causing damage or posing threats. WS would use lethal methods to manage only those mammals causing damage; therefore, the intent of using lethal methods to alleviate damage is not to manage entire mammal populations.

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

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

A complete list of chemical and non-chemical methods available for use under the identified alternatives, except the alternative with no damage management (Alternative 3), can be found in Appendix B. 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.

Technical Assistance Recommendations

Under the proposed action, WS would provide technical assistance to those persons requesting assistance with managing damage as part of an integrated approach. Technical assistance would occur as described in Alternative 2 of this EA. From FY 2006 through FY 2011, WS has conducted 41 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety (see Table 1.1).

Operational Damage Management Assistance

Operational damage management assistance would include damage management activities that were directly conducted by or supervised by personnel of WS. Operational damage management assistance could be initiated when the problem could not be effectively be resolved through technical assistance alone and there was a written MOU, cooperative service agreement, 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 effectively resolve problems, especially if chemical methods were necessary or if the problems were complex.

Educational Efforts

Education is an important element of activities because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations, WS provides lectures, courses, and demonstrations to producers, homeowners, state and municipal agents, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, technical papers have been and would continue to be presented at professional meetings and conferences so that other wildlife professionals and the public were periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies.

Research and Development

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

WS' Decision Making Procedures

WS' personnel would use a thought process for evaluating and responding to damage complaints that is depicted by the WS Decision Model (see WS Directive 2.201) and described by Slate et al. (1992). 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, methods deemed practical for the situation would be incorporated into a damage management strategy. After this strategy was implemented, monitoring would be conducted and evaluation would continue to assess the effectiveness of the strategy. If the strategy were effective, the need for further management would be ended. In terms of the WS Decision Model, most efforts to resolve wildlife damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

Community-based Decision-makers

WS could receive requests for assistance from community leaders and/or representatives. In those situations, the WS program in Rhode Island under this alternative would follow the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997) when receiving a request for assistance from a community leader or representative. 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 could facilitate discussions at local community meetings when resources were available. Resource owners and others directly affected by mammal damage or conflicts 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, or private businesses or organizations.

Under a community based decision-making process, WS would provide information, demonstration, and discussion on available methods to the appropriate representatives of the community for which services were requested to ensure a community-based decision was made. By involving decision-makers in the process, damage management actions could be presented to allow decisions on damage management to involve those individuals that the decision-maker(s) represents. As addressed in this EA, WS would provide technical assistance to the appropriate decision-maker(s) to allow for information on damage management activities to be presented to those persons represented by the 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 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 decisions on damage management activities to be made 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.

The decision-maker for the local community would be elected officials or representatives of the communities. The elected officials or representatives would be popularly elected residents of the local community or appointees who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. Identifying the decision-maker for local business communities can be more complex because building owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board. WS could provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Direct assistance could be provided by WS only if requested by the local community decision-maker, funding is provided, and if the requested direct control was compatible with WS' recommendations.

Private Property Decision-makers

WS could also receive requests for assistance from private property owners. In the case of private property owners, the decision-maker would be the individual that owns or manages the affected property. The decision-maker would have 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. Direct operation assistance could be provided by WS if requested, funding was provided, and the requested management was in accordance with WS' recommendations.

Public Property Decision-makers

Request for WS' assistance could originate from public property owners or managers. 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 recommendations to reduce damage. Direct control could be provided by WS if requested, funding provided, and the requested actions were within the recommendations made by WS.

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, several management strategies would be described to the requester for short and long-term solutions to managing damage; those strategies would be based 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. Preference would be given to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Recommendation of methods and techniques by WS to resolve damage would be based on information provided by the individual seeking assistance using the WS Decision Model. In some instances, wildlife-related information provided to the requestor by WS would result in tolerance/acceptance of the situation. In other instances, damage management options would be discussed and recommended. Only those methods legally available for use by the appropriate individual would be recommend or loaned by WS. 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 except for immobilizing drugs, euthanasia chemicals, and reproductive inhibitors.

Immobilizing drugs and euthanasia chemicals would only be available to WS or appropriately licensed veterinarians. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the RIDEM or those persons under the supervision of the RIDEM. At the time this EA was developed, Gonacon™ was not registered for use in the State.

The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing mammal damage. Technical assistance would include collecting information about the species involved, the extent of 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 2006 and FY 2011, WS has conducted 41 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 be involved with any aspect of mammal damage management in the State. All requests for assistance received by WS to resolve damage caused by mammals would be referred to the RIDEM, 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 take of mammals to alleviate damage or threats can occur despite the lack of involvement by WS. The take of mammals by other entities could occur through the issuance of permits by the RIDEM, when required, and during the hunting and/or trapping seasons. Norway rats and black rats are considered invasive exotic species in the State and can be lethally taken at any time and by any method that is legal under state and local laws. All methods described in Appendix B would be available for use by those persons experiencing damage or threats except for the use of Gonacon™, immobilizing drugs, and euthanasia chemicals. Gonacon™ is not registered for use in Rhode Island and if registered would only be available for use by WS and the RIDEM. Immobilizing drugs and euthanasia chemicals could only be used by WS or appropriately licensed veterinarians.

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

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

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

Non-lethal Methods Implemented Before Lethal Methods

This alternative would require that non-lethal methods or techniques described in Appendix B be applied to all requests for assistance to reduce damage and threats to safety from mammals in the State. If the use of non-lethal methods fails to resolve the damage situation or reduce threats to human safety at each damage situation, lethal methods would be employed to resolve the request. Non-lethal methods would be applied 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 non-lethal methods had been employed.

Those persons 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, only the presence or absence of non-lethal methods can be evaluated. The proposed action (Alternative 1) and the technical assistance only alternative (Alternative 2) are similar to a non-lethal before lethal alternative because WS would use or recommend 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. Only those methods discussed in Appendix B that were considered non-lethal would be employed by WS. No intentional lethal take of mammals would occur by WS. The use of lethal methods could continue to be used 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 RIDEM, local animal control agencies, or private businesses or organizations. Under this alternative, however, property owners/managers might be limited to using non-lethal methods only as they may have difficulty obtaining permits for lethal methods.

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 those methods would be used or recommended 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 mammals that could be lethally removed by WS under any of the alternatives could be removed by those persons experiencing damage or threats even if WS was not involved.

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. 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. In those situations where damage could be alleviated using non-lethal methods deemed effective, those methods would be employed or recommended as determined by the WS Decision Model. Therefore, this alternative was not considered in detail.

Trap and Translocate Mammals Only

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Mammals would be live-captured using immobilizing drugs, live-traps, or nets (*e.g.*, cannon nets, rocket nets, or drop nets). All mammals live-captured through direct operational assistance by WS would be translocated.

Translocation of all mammals is currently prohibited by RIDEM regulations, without prior approval of the RIDEM. Translocation sites would be identified and have to be pre-approved by the RIDEM and the property owner where the translocated mammals would be placed prior to live-capture and translocation. Live-capture and translocation could be conducted as part of the alternatives analyzed in detail. However, the translocation of mammals could only occur under the authority of the RIDEM. The translocation of mammals by WS would only occur as directed by the RIDEM. When requested by the RIDEM, WS could translocate mammals or recommend translocation under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, other entities could translocate mammals under Alternative 3.

The translocation of mammals to other areas following live-capture generally 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, habitats in other areas are generally already occupied, and translocation would most likely result in mammal damage problems at the new location. In addition, hundreds of mammals would need to be captured and translocated to solve some damage problems (*e.g.*, deer confined within a perimeter fence); therefore, translocation would be unrealistic. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, the potential for spreading diseases, poor survival rates, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988). Since WS does not have the authority to translocate mammals in the State unless permitted by the RIDEM and translocation could occur under the other alternatives, this alternative was not considered 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. Reproductive inhibitors are often considered for use where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). Use and effectiveness of reproductive control as a wildlife population management tool is limited by 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.

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

Population modeling indicates that reproductive control is more efficient than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998). Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproduction control technologies as a wildlife management tool for some species.

Currently, chemical reproductive inhibitors are not available for use to manage most mammal populations. Given the costs associated with live-capturing and performing sterilization procedures on mammals and the lack of availability of chemical reproductive inhibitors for the management of most mammal populations, this alternative was not evaluated in detail. If a reproductive inhibitor becomes available to manage a large number of mammal populations that proves to be effective in reducing localized mammal populations, the use of the inhibitor could be evaluated under the proposed action as a method available that could be used in an integrated approach to managing damage. This EA would be reviewed and supplemented to the degree necessary to evaluate the use of the reproductive inhibitor as part of an integrated approach described under the proposed action. Currently, the only reproductive inhibitor that is registered with the EPA is Gonacon™, which is registered for use on white-tailed deer only. However, Gonacon™ was not registered for use in the State during the development of this EA. Reproductive inhibitors for the other mammal species addressed in this EA do not currently exist.

Compensation for Mammal Damage

The compensation alternative would require WS to establish a system to reimburse persons impacted by mammal damage and to seek funding for the program. Under such an alternative, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. Evaluation of this alternative indicates that a compensation only alternative has many drawbacks. Compensation would: 1) require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation, 2) compensation most likely would be below full market value, 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies, and 4) 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 cooperative program was initiated in Rhode Island. Eradication as a general strategy for managing mammal damage was not considered in detail because 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 damage can be attributed to localized populations of mammals, WS could decide to implement local population suppression using the WS' Decision Model. However, it is not realistic or practical to consider large-scale population suppression as the basis of the WS' program. Problems with the concept of suppression would be similar to those described above for eradication. Typically, WS' activities in Rhode Island would be conducted on a very small portion of the sites or areas inhabited or frequented by problem species.

Bounties

Payment of funds (bounties) for killing some mammals suspected of causing economic losses have not been supported by state fish and game agencies, such as the RIDEM, as well as most wildlife professionals for many years (Latham 1960, Hoagland 1993). WS concurs with those agencies and wildlife professionals 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 take of animals are typically arbitrary and completely unregulated because it is difficult or impossible to assure animals claimed for bounty were not taken from outside the area where damage was occurring. In addition, WS does not have the authority to establish a bounty program.

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

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

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

The National Association of State Public Health Veterinarians and the AVMA oppose TNR programs based on health concerns and threats (AVMA 2003). Of major concern would be the potential for disease and parasite transmission to humans from direct contact during 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 animals to the facility. Once the surgical procedure was completed, the animal would have to be held to ensure recovery and transported back to the area where capture occurred.

TNR programs are often not as successful as desired and needed to reduce immediate threats posed by wildlife, especially when human safety is a concern (AVMA 2003, Barrows 2004, Levy and Crawford 2004, Jessup 2004, Winter 2004, AVMA 2009). Feral animals subjected to a TNR program would continue to cause the same problems[11] they caused before the TNR program was initiated because of slow attrition. TNR programs can take a decade or longer to reduce target species populations (Barrows 2004, Winter 2004); especially, when acute issues need rapid solutions (Levy and Crawford 2004, Stoskopf and Nutter 2004). Several studies report that target species' populations often remain stable or increase following TNR programs due to immigration and reproduction from other members of the groups (Castillo and Clarke 2003, Levy and Crawford 2004, Winter 2004) with little to no resolution of threats to human safety or damages (Barrows 2004, Slater 2004, Winter 2004).

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

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

Use of Regulated Hunting and Trapping as a Management Tool

Sport hunting and trapping by private individuals regulated by wildlife management agencies can be an effective population management tool and can be one of the most efficient and least expensive techniques for managing populations over broad areas. However, regulated hunting with firearms and trapping is often not allowed in some areas because of safety concerns and local ordinances. In agricultural areas, regulated hunting and trapping may not reduce the wildlife populations sufficiently to reduce damage or the regulated hunting or trapping season may not coincide with seasonal damage (*e.g.*, hunting normal occurs after the period when harvest of agricultural crops occur). Additionally, airports are often not accessible to the public for hunting and trapping.

In areas where traditional hunting with firearms is not applicable because of public safety concerns, state hunting laws, and local ordinances restricting the use of firearms, archery hunting may provide an alternative method for managing wildlife populations. Archery hunting may be used as an effective management tool to reduce deer populations (Kilpatrick and Walter 1999). However, it may be difficult to remove a sufficient number of deer using archery hunting alone. Ver Steeg et al. (1995) found that a controlled archery hunt did not sufficiently reduce the deer population in a suburban park in Illinois. Although some deer were removed by archery hunters, sharpshooting was used after the archery hunts were completed to ensure that the annual deer herd reduction goals were reached. Sharpshooting was nearly twice as efficient as archery hunting, with an overall removal rate of 3.76 deer per day for sharpshooting and 1.95 deer per day for archery hunting (Ver Steeg et al. 1995). Simard et al. (2013) concluded that the control of abundant white-tailed deer populations in localized areas through hunting could be difficult to achieve.

None of the alternatives analyzed in detail would prevent regulated hunting and trapping, but could be used as an additional method of reducing certain wildlife in areas where hunting or trapping is legal and practical.

3.3 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of activities intended to resolve wildlife damage. The WS program in Rhode Island 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 the altenratives include the following:

- The WS Decision Model, which is designed to identify effective strategies to managing wildlife damage and their potential impacts, would be consistently used and applied when addressing mammal damage.
- EPA-approved label directions would be followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects occur to the environment when chemicals are used in accordance with label directions.
- Immobilizing and euthanasia drugs would be used according to the DEA, FDA, and WS' directives and procedures.
- All controlled substances would be registered with the DEA or the FDA.
- 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 be trained to use each material and would be certified to use controlled substances.

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

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

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

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

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

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

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

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

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

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

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

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

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

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

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

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

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

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

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

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

- Live-traps would be checked frequently (at a minimum of once every 24 hours) to ensure non-target species would be released in a timely manner to ensure survival.

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

- WS has consulted with the USFWS and the RIDEM 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 are determined to have no significant impact on the environment and an EIS is not required, to ensure those activities do not negatively impact non-target species.

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

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

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

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

- All chemical methods used by WS or recommended by WS would be registered with the EPA, DEA, FDA, and/or the RIDEM, as appropriate.

- WS would adhere to all established withdrawal times for mammals when using immobilizing drugs for the capture of mammals that are agreed upon by WS, the RIDEM, and veterinarian authorities. Although unlikely, if WS were requested to immobilize mammals, either during an open harvest season 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 labeled with a "*do not eat*" warning and appropriate contact information.

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

Issue 4 - Effects on the Socio-cultural Elements of the Human Environment

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

- All methods or techniques applied to resolve damage or threats to human safety would be agreed upon by entering into a cooperative service agreement, MOU, or comparable document prior to the implementation of those methods.

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

- Norway rats, black rats, feral/free ranging cats, and feral/free ranging dogs are non-native, invasive species in the State that can cause harm to native flora and fauna. Any reduction in those populations could be viewed as benefiting the aesthetic value of a more native ecosystem. Feral/free ranging cats and dogs would only be live captured and turned over to animal shelters licensed by the RIDEM for health evaluation and return to owners or adoption, at the discretion of the shelter.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

- WS' personnel would check methods frequently (at a minimum of once every 24 hours) to ensure mammals captured would be addressed in a timely manner to minimize the stress of being restrained.

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

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

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

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

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

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

- WS' lethal take (killing) of mammals would be reported to and monitored by the RIDEM to ensure WS' take has been considered as part of management objectives for those mammal species in the State.

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

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

- WS' personnel would remove beaver dams in accordance with federal and state laws and regulations for environmental protection. Beaver dam removal would be conducted to restore drainage or the stream channel for an area, or if an area has an established silvicultural or other agricultural, commercial/industrial activity, and where such an area has not become an established wetland.

- Upon receiving a request to remove beaver dams, WS would visually inspect the dam and the associated water impoundment to determine if characteristics exist at the site that would meet the definition of a wetland under section 404 of the Clean Water Act (40 CFR 232.2; see Issue 5 in Section 2.2 of this EA). If wetland conditions were present at the site, the entities requesting assistance from WS would be notified that a permit might be required to remove the dam and to seek guidance from the RIDEM and the United States Army Corps of Engineers pursuant to Rhode Island State Law and the Clean Water Act.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

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

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

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

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

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

A common issue is whether damage management actions would adversely affect the populations of target mammal species, especially when lethal methods were employed. As discussed previously, the analysis for magnitude of impact from lethal take 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.

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 not be available for use by other entities under Alternative 2 and Alternative 3 would be immobilizing drugs, euthanasia chemicals, and Gonacon™. 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, exclusionary devices, frightening devices, nets, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods).

Non-lethal methods that would be available under all of the alternatives 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. Non-lethal methods would be given priority by WS when addressing requests for assistance under Alternative 1 and Alternative 2 (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed or recommended 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.

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

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.

In addition to non-lethal methods that would be used to disperse, exclude, or harass wildlife, another non-lethal method available under the alternatives would be the reproductive inhibitor commonly known as Gonacon™. Scientists with the NWRC have developed Gonacon™, a new single dose immunocontraceptive vaccine. Recent studies have demonstrated the efficacy of this single-shot Gonadotropin-releasing hormone (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 agency or persons under their authority. Additionally, in order for Gonacon™ to be used in any given state, the product must also be registered with the state and approved for use by the appropriate state agency responsible for managing wildlife. Gonacon™, when injected into the body, elicits an immune response that neutralizes the GnRH hormone being produced naturally by deer. The GnRH hormone in deer stimulates the production of other sexual hormones, which leads to the body reaching a reproductive state. The vaccine neutralizes the GnRH hormone being produced, which then prevents the production of other sexual hormones in the deer vaccinated; thereby, preventing the body of the deer from entering into a reproductive state (USDA 2010*b*).

The reproductive inhibitor Gonacon™ is currently not registered for use in Rhode Island. However, the product is discussed in this assessment to evaluate the potential use of the chemical if it becomes registered for use in the future. Gonacon™ has been classified as a restricted-use pesticide by the EPA. Restricted-use pesticides can only be purchased and/or applied by those persons who have successfully completed an applicators course to use restricted-use pesticides. The RIDEM administers training and testing requirements for applicators to purchase and apply restricted-use pesticides in the State. Under Alternative 1, Gonacon™, if registered for use, would be available for use by WS, the RIDEM, or persons under their supervision. Under Alternative 2, WS could recommend the use of Gonacon™ but would not be involved with the direct use of the product; however, the RIDEM or persons under their supervision could use Gonacon™, if a product was registered in the State. Under Alternative 3, no involvement by WS would preclude the use and recommendation of Gonacon™; however, similar to Alternative 2, Gonacon™ would be available for use by the RIDEM and persons under the supervision, if the product were registered for use in the State.

In addition to non-lethal methods, lethal methods would also be available for use under all the alternatives by WS and/or by other entities. Lethal methods that would be available to address mammal damage include live-capture followed by euthanasia, shooting, body gripping traps, fumigants, rodenticides, and the recommendation of hunting and/or trapping, where appropriate. All of those methods would be available for use by WS or for recommendation by WS under Alternative 1. Lethal methods could be employed by WS under Alternative 1 to resolve damage only 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 taken under Alternative 1, take would occur pursuant to WS Directive 2.505 and WS Directive 2.430. Under alternative 2, WS would recommend the use of methods to lethally take 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 take 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 mammals 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 take that could occur under Alternative 1.

Chemical methods that could be available under the alternatives to manage damage associated with certain mammal species would include zinc phosphide, aluminum phosphide, gas cartridges, warfarin, brodifacoum, and diphacinone. In most cases, those chemical methods would not be restricted to use by WS only; therefore, when registered for use in the State as a restricted-use pesticide, those products would be available for use by licensed pesticide applicators under any of the alternatives. Rodenticides containing warfarin, brodifacoum, and diphacinone are not currently registered for use in the State. However, products containing those active ingredients have been registered with the EPA and could be registered for use in the State in the future. Similarly, gas cartridges are not currently registered for use in the State; however, gas cartridges have been registered for use with the EPA and could be registered for use in the State in the future.

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

Although the use of firearms can reduce the number of mammals using a location (similar to dispersing mammals), the use of a firearm is most often used to supplement and reinforce the noise associated with non-lethal methods. The capture of mammals using live-traps and subsequently euthanizing those mammals would be employed to target specific animals using a particular area where damage is 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.

Rodenticides and gas cartridges could also be employed to target specific or localized populations where damage or threats of damage were occurring. Determination of the number of individuals from a species killed from the use of rodenticides and gas cartridges can be difficult since most targeted species killed by those methods would die underground or in structures. Removal of targeted rodent species using rodenticides by WS would be done at specific isolated sites (*e.g.*, airports, orchards, islands). WS would only use rodenticides and gas cartridges to target those species listed on the labels of the products available for use.

Often of concern with the use of lethal methods is that mammals that were lethally taken 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 mammals present at a location where damage was occurring by targeting those mammals 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 predation was occurring or could occur at the time those methods were employed.

Most lethal methods would be employed to reduce the number of mammals present at a location since a reduction in the number of mammals at a location can lead to a reduction in damage, which is 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 could disperse those mammals to other areas leading to a reduction in damage at the location where those mammals were dispersed. 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.

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

WS may recommend under Alternative 1 and Alternative 2 that property owners or managers, that request assistance, allow mammals to be harvested 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 take during those seasons is the responsibility of the RIDEM. 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 take that could occur by WS under the alternatives or recommended by WS. In addition, mammals could also be lethally removed by other entities to alleviate damage or threats of damage under all the alternatives. The total number of individuals from each species that were lethally removed by other entities to alleviate damage or threats of damage is currently not available.

The issue of the potential impacts of conducting the alternatives on the populations of those target mammal species addressed in this EA are analyzed for each alternative below.

Alternative 1 - Continue the Current Adaptive Integrated Mammal Damage Management Program (No Action/Proposed Action)

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

WS would maintain ongoing contact with the RIDEM to ensure activities occurred within management objectives for those species. The RIDEM monitors the total take of mammals from all sources by factoring in survival rates from predation, disease, and other mortality data. Ongoing contact with the RIDEM would assure local, state, and regional knowledge of wildlife population trends would be considered.

As discussed previously, the analysis to determine the magnitude of impact from lethal take 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. WS' take that could occur to alleviate damage or threats of damage under the proposed action would be monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take was maintained below the level that would cause significant 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.

Virginia Opossum Population Information and Effects Analysis

Opossums are the only marsupials (*i.e.*, animals that possess a pouch in which young are reared) found north of Mexico (Seidensticker et al. 1987). They frequent most of the eastern and central United States extending west to Wyoming, Colorado, and central New Mexico (National Audubon Society 2000). They are also found in parts of the southwestern United States, California, Oregon, and Washington (Jackson 1994*a*). Adults range in size from less than 1 kg (2.2 lbs) to about 6 kg (13 lbs), depending on sex and time of year. They grow throughout life (Seidensticker et al. 1987). They have a broad range of pelage colors, but opossum are usually considered as a "*gray*" or "*black*" phase. Their fur is grizzled white above; long white hairs cover black tipped fur below. They climb well and feed on a variety of foods, including carrion, which forms much of their diet. In addition, opossum eat insects, frogs, birds, snakes, small mammals, earthworms, and berries and other fruits; apples, and corn are favorite foods (National Audubon Society 2000). They use a home range of 4 to 20 ha (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).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude (Gardner 1982). Gestation is short (average of 12.8 days) with 1 to 17 young born in an embryonic state which climb up the mothers belly to the marsupium (pouch), attach to teats, and begin to suckle (Gardner 1982, National Audubon Society 2000). Those young remain in the pouch for about 2 months at which time they will begin to explore outside the pouch. Young can often be found traveling on their mother's back with their tails grasping hers (Whitaker, Jr., and Hamilton, Jr. 1998). Opossums live for only 1 to 2 years, with as few as 8% of a population of those animals surviving into the second year in a study in Virginia conducted by Seidensticker et al. (1987). In the five-year study conducted by Seidensticker et al. (1987), there was a wide variation in opossum numbers, in what was considered excellent habitat for the species. Those variations were observed seasonally and in different years. However, the mean density during the study was 10.1 opossum per square mile with a range of 1.3 opossum per square mile to 20.2 opossum per square mile (Seidensticker et al. 1987). This was comparable to other opossum population densities in similar habitats in Virginia. Verts (1963) found a density estimate of 10.1 opossum per square mile in farmland areas in Illinois while Wiseman and Hendrickson (1950) found a density of 6.0 opossum per square miles in mixed pasture and woodlands in Iowa. However, VanDruff (1971) found opossum densities in waterfowl nesting habitat as high as 259 opossum per square miles.

Opossum are common throughout Rhode Island in appropriate habitat. They occur on the larger islands of Narragansett Bay; however, they are not found on Prudence Island or the other smaller Bay islands, nor do they occur on Block Island. Prior to the early 1960s, opossums were not found in Rhode Island, but arrived as part of a wider northward range expansion. Population estimates 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 take proposed by WS to alleviate damage and threats of damage. The State of Rhode Island covers 1,545 square miles with 1,034 square miles being land area (United States Census Bureau 2012). If opossum were only found on 50% of the land area of the State and using a mean density of 10.1 opossum per square mile, found by Seidensticker et al. (1987) in Virginia, the Rhode Island opossum population would be estimated at over 5,200 opossum. Using the range of opossum found by Seidensticker et al. (1987) estimated at 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 672 opossum to a high of nearly 10,443 opossum.

Opossum can be found in a variety of habitats, so opossum occupying only 50% of the land area of the State is unlikely since opossum can be found almost statewide with the exception of Block Island and some off shore islands. However, opossum occupying only 50% of the land area was used to provide a minimum population estimate to determine the magnitude of the proposed take by WS to alleviate or prevent damage.

Opossum are considered a furbearing species in the State and can be harvested during annual trapping season (RIDEM 2011*b*). During the development of the EA, opossum could be harvested during the trapping season with no limit on the number that could be taken during those seasons. In addition, opossum can be lethally taken by landowners or leasee in the State when causing damage or posing a threat of damage or when permitted by the RIDEM. According to mandatory fur harvest reports, nuisance wildlife control permits, and WS' take, 265 opossum were harvested and taken as a nuisance in Rhode Island from 2006 through 2011 as shown in Table 4.1 (RIDEM 2012*c*). Based on a total harvest and nuisance take of 265 opossum from 2006 through 2011, the annual harvest has averaged 44.2 opossum.

As part of damage management activities conducted by WS in the State to reduce threats to T&E species, only one opossum has been lethally taken by WS from FY 2006 through FY 2011. Based on previous requests for assistance received by WS and in anticipation of additional efforts, WS could lethally remove up to 50 opossum annually in the State as part of efforts to reduce or eliminate damage under the proposed action alternative. Based on a statewide population estimate ranging from 672 opossum to 10,443 opossum, the lethal take of up to 50 opossum annually by WS under the proposed action alternative, would represent 0.5% to 7.4% of the estimated statewide population if the overall population remains at least stable. If the statewide population was 5,200 opossum using the mean density found by Seidensticker et al. (1987) and opossum occupying 50% of the land area in the State, the cumulative WS' take of 50 opossum would represent 1.0% of the statewide population.

Table 4.1 - Cumulative Virginia opossum take from known sources in Rhode Island, 2006-2011

Year	Harvest Take[1]	Nuisance Take[2]	WS' Take[3]	Total
2006	13	23	0	36
2007	8	30	0	38
2008	39	17	0	56
2009	18	21	0	39
2010	12	65	0	77
2011	18	N/A[†]	1	19
TOTAL	**108**	**156**	**1**	**265**

[1]Harvest take includes those Virginia opossums reported during the trapping season
[2]Nuisance take reported by calendar year
[3]WS' take is reported by federal fiscal year
[†]N/A=information is currently unavailable

As shown in Table 4.1, 264 opossum have been lethally taken in the State during the annual harvest season and pursuant to nuisance wildlife control permits between 2006 and 2011; however, the number of opossum taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable. If the average number of opossum lethally taken under nuisance wildlife control permits per year between 2006 and 2010 of 32 opossum is substituted for the actual take of opossum during 2011, the total take under nuisance wildlife control permits would be estimated at 188 opossum from 2006 through 2011. Therefore, the total cumulative take by all entities from 2006 through 2011 would be 297 opossum, which is an average take of nearly 50 opossum annually. If WS' estimated take of up to 50 opossum per year is combined with the average take of opossum of 50 opossum during the harvest season and lethally taken under nuisance wildlife control permits, the cumulative take would be 100 opossum per year.

If the statewide population of opossum were 672 individuals, the cumulative take of 100 opossum would represent 14.9% of the estimated population. If the highest level of annual take during the harvest season of 39 opossum is combined with the highest annual take of 65 opossum taken under nuisance wildlife control permits and the estimated annual take by WS of 50 opossum, the cumulative take would be 154 opossum. The cumulative take of 154 opossum would represent 22.9% of a statewide population estimated at 672 opossum. Since the statewide population is likely higher than 672 opossum, cumulative take is likely a much smaller percentage of the actual statewide population.

The unlimited harvest allowed by the RIDEM during the harvest seasons provides an indication that the RIDEM believes that population densities of opossum in the State are sufficient that overharvest is not likely to occur, including lethal take to alleviate or prevent damage from occurring.

Raccoon Population Information and Effects Analysis

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

The raccoon is omnivorous, including carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, and a wide variety of grains, various fruits, other plant materials, and most or all foods prepared for human or animal consumption (Sanderson 1987). They occasionally kill poultry (Boggess 1994*a*).

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*, National Audubon Society 2000). Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains (Boggess 1994*a*), and are frequently found in cities or suburbs as well as rural areas (National Audubon Society 2000). Movements and home ranges of raccoons vary according to sex, age, habitat, food sources, season, and other factors. In general, males have larger home ranges than females. Home range diameters of raccoons have been reported as being 1 to 3 km (0.6 to 2.9 mi) maximum, with some home range diameters of dense suburban populations to be 0.3 to 0.7 km (0.2 to 0.4 mi).

Absolute raccoon population densities are difficult or impossible to determine because of the difficulty in knowing what percentage of the population has been counted and knowing how large of 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. Relative raccoon population densities have been variously inferred by take of animals per unit area. For instance, Twichell and Dill (1949) reported removing 100 raccoons from tree dens in a 41 ha (101 acres) waterfowl refuge area, while Yeager and Rennels (1943) studied raccoons on 881 ha (2,177 acres) in Illinois and reported trapping 35 to 40 raccoons in 1938-1939, 170 in 1939-1940, and 60 in 1940-1941. In New Jersey, Slate (1980) estimated one raccoon per 7.8 hectares (19.3 acres) in predominantly agricultural land on the inner coastal plain. Raccoon densities of 100 per square mile (1 raccoon per 6.4 acres) have been attained around abundant food sources (Kern 2002). Based on published literature, Riley et al. (1998) summarized rural raccoon densities as two to 650 raccoons per square mile with an average of 10 to 80 raccoons per square mile.

Population estimates for raccoons in the State are not available. Similar to the opossum analysis, a population estimate will be derived based on the best available information for raccoons to provide an indication of the magnitude of take proposed by WS to alleviate damage and threats of damage. The State of Rhode Island covers 1,545 square miles with 1,034 square miles being land area (United States Census Bureau 2012). If raccoons were only found on 50% of the land area of the State and using densities of 10 to 80 raccoons per square mile found by Riley et al. (1998), the population could range from a low of 5,170 raccoons to nearly 41,360 raccoons.

In Rhode Island, raccoons 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*a*). Raccoons also cause damage to natural resources through predation on species of concern or T&E species.

The public are also concerned about health and safety issues associated with raccoons. Those diseases include, but are not limited to, canine distemper, 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 humans (Davidson 2006; see Table 1.3).

Raccoons are classified as both a small game and a furbearer species in Rhode Island with a regulated annual hunting and trapping season with unlimited take allowed during the length of those seasons (RIDEM 2011*b*). At the time this EA was developed in 2012, the annual hunting season for raccoons ran from October 1, 2011 to February 29, 2012 and the trapping season ran from November 1, 2011 to January 31, 2012 (RIDEM 2011*b*). In addition, raccoons can be lethally taken as a nuisance by landowners or leasee in the State when causing damage or posing a threat of damage or when permitted by the RIDEM.

The number of raccoons reported as harvested and taken under nuisance permits in the State from 2006 through 2011 are shown in Table 4.2. Reported take of raccoons during the hunting and trapping seasons is based on mandatory trapping reports (RIDEM 2011c). There is no mandatory reporting of raccoons harvested during the annual hunting season; therefore, take is considered as minimum take that likely occurred. As with other furbearing species, raccoons can also be lethally taken to alleviate damage or threats of damage when authorized by the RIDEM.

Table 4.2 - Cumulative raccoon take from known sources in Rhode Island, 2006-2011

Year	Harvest Take[1]	Nuisance Take	Total
2006	67	72	**139**
2007	62	84	**146**
2008	82	57	**139**
2009	82	79	**161**
2010	47	106	**153**
2011	70	N/A[†]	**70**
TOTAL	**410**	**398**	**808**

[1]Harvest during the annual trapping season only; data does not include the harvest of raccoons during the hunting season

[†]Data is not currently available

From FY 2006 through FY 2011, WS dispersed one raccoon during all damage management activities in Rhode Island. The average number of raccoons reported harvested in the State during the annual trapping season from 2006 through 2011 has been 68.3 raccoons per year while nuisance take has averaged 79.6 raccoons per year. As stated preciously, harvest figures are based on mandatory trapper harvest reports and do not include hunter harvested raccoons.

Based on previous requests for assistance received by WS and in anticipation of additional efforts with managing raccoon damage, up to 50 raccoons could be lethally removed by WS annually when requested under the proposed action. Using the statewide population estimates ranging from 5,170 raccoons to nearly 41,360 raccoons, the lethal take of up to 50 raccoons annually by WS under the proposed action alternative, would represent 0.1% to 1.0% of the estimated statewide population if the overall population remains at least stable.

As shown in Table 4.2, 808 raccoons have been lethally taken in the State during the annual trapping season and pursuant to nuisance wildlife control permits between 2006 and 2011; however, the number of raccoons taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable. If the average number of raccoons lethally taken under nuisance wildlife control permits per year between 2006 and 2010 of 80 raccoons were substituted for the actual take of raccoons during 2011, the total take under nuisance wildlife control permits would be estimated at 478 raccoons from 2006 through 2011. Therefore, the total cumulative take by all entities from 2006 through 2011 would be 888 raccoons, which is an average take of 148 raccoons annually. If WS' estimated take of up to 50 raccoons per year is combined with the average take of raccoons during the harvest season and lethally taken under nuisance wildlife control permits, the cumulative take would be nearly 200 raccoons per year.

If the statewide population of raccoons were 5,170 individuals, the cumulative take of 200 raccoons would represent 3.9% of the estimated population. If the highest level of annual take during the harvest season of 82 raccoons were combined with the highest annual take of 106 raccoons lethally taken under nuisance wildlife control permits and the estimated annual take by WS of 50 raccoons, the cumulative take would be 238 raccoons. The cumulative take of 238 raccoons would represent 4.6% of a statewide population estimated at 5,170 raccoons. Since the statewide population is likely higher than 5,170 raccoons, cumulative take is likely a much smaller percentage of the actual statewide population.

Although the number of raccoons harvested annually during the hunting season is currently unknown, the unlimited harvest allowed by the RIDEM during the harvest seasons provides an indication that population densities of raccoons in the State are sufficient that overharvest is not likely to occur, including lethal take to alleviate or prevent damage from occurring.

River Otter Population Information and Effects Analysis

Historically, river otters inhabited aquatic ecosystems throughout much of North America, excluding the frozen Arctic and arid Southwest (Hall and Kelson 1959). Information on historic numbers and distribution is limited. As its broad geographic distribution suggests, the river otter is able to adapt to diverse aquatic habitats. Otters 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, present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987). River otter are known to occur throughout Rhode Island where habitat exists.

The statewide otter population is currently unknown. Otter population densities in linear waterways have been reported ranging from one otter per 0.7 miles in southeast Alaska (Woolington 1984) to one otter per 10.6 miles (Reid 1984) in northeastern Alberta. 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). The results of a Missouri study found one otter per 2.5 to 5.0 miles of linear waterways (Erickson et al. 1984). There are approximately 2,410.8 km (1,498 miles) of rivers and streams, over 8,464.8 ha (20,917 acres) of lakes and ponds and over 50,181 ha (124,000 acres) of wetlands in Rhode Island (Colt 2008). As was discussed previously, otter are closely associated with aquatic habitats where they forage and den along shorelines of rivers and streams. If 50% of the 2,410.8 km (1,498 miles) of rivers and streams in Rhode Island were acceptable river otter habitat and the range of 1 otter per 4 to 8 km (2.5 to 5.0 miles) of rivers and streams would result in a statewide population estimate ranging from 151 otter to 301 otter in rivers and streams. If 50% of the 50,181 ha (124,000 acres) of wetlands in Rhode Island are acceptable river otter habitat and the range of one otter per 70.8 to 101.2 ha (175 to 250 acres) of wetlands would result in a statewide population estimate ranging from 248 to 354 in wetlands. Combining riverine and wetland population estimates provide total statewide population estimates for Rhode Island ranging from a low of 399 to a high of 655, without accounting for lakes and ponds.

River otters are classified as a furbearer species in Rhode Island and harvest is currently prohibited under Rhode Island General Law § 20-16-17. The Rhode Island State Legislature passed this law after a well-publicized incident in 1970, in which an otter was shot. Shooting otter was already an illegal activity at the time. Today, Rhode Island is the only state in the northeast that does not allow a regulated trapping season for otter (Brown 2009).

In 1978, 23 otters were harvested and in 1979 and 1980, five otter were taken in Rhode Island. No incidental take of otter was reported to the RIDEM from 1981 until 1997. Starting in 1998, a small number of otters were reported taken accidentally by beaver trappers and turned over to the RIDEM. During the 2006 to 2011 Rhode Island, 10 otter were incidentally taken in Rhode Island, averaging 1.7 otters per year.

WS has never lethally taken river otters in Rhode Island or received requests for assistance to alleviate damage or threats caused by otter to property, agricultural resources such as fish hatcheries or commercial aquaculture in Rhode Island, natural resources or human health and safety. At least one otter has been observed by WS on a Rhode Island airport representing a potential threat to aviation safety (J. Streeter, WS pers. comm. 2012). In anticipation of receiving requests for assistance, WS reasonably expects the total take of otter would not exceed 10 otters annually in Rhode Island to resolve requests to manage damage to resources and threats to human health and safety. As was discussed previously, river otters may be lethally removed by WS as unintentional non-targets during other damage management activities, particularly when requested to alleviate damage caused by beaver. Intentional take of otter by WS to alleviate damage would only occur after the RIDEM had issued a permit allowing the take of otter causing damage.

Any direct damage management actions by WS to address river otter damage or threats to aviation and human health and safety in Rhode Island in future programs would be conducted as part of an informed wildlife management activity coordinated with the RIDEM for the purpose of meeting state wildlife resource management objectives. Such projects may involve harassment with a variety of non-lethal methods, live-capture and translocation of otters causing damage or otters could be killed to protect property, natural resources, human health and safety or agricultural resources, only with prior approval and/or permitting by RIDEM.

As previously stated, the total number of river otter unintentionally taken from 2006 through 2011 was 10, which is an average of 1.7 otter per year (RIDEM 2011*c*). Based on non-target take occurring previously by licensed trappers in Rhode Island and to evaluate cumulative impacts on the river otter population, WS will evaluate cumulative take based on the highest single year non-target take of otter, which was six otter taken during the trapping season in 2006 (RIDEM 2011*c*).

Based upon the aforementioned population estimate, WS' limited lethal take of 10 river otters annually under the proposed action would represent 2.5% of the otter population in Rhode Island estimated at 399 otters and 1.5% of a statewide population estimated at 655 otters. When the average annual unintentional take of otter from 2006 through 2011 is combined with the proposed take evaluated in this EA, the cumulative take of otters would represent 3.0% of a statewide population estimated at 399 otter. In addition, the cumulative take of otter would represent 1.8% of a statewide population estimated at 655 otter. If the highest unintentional take of otter that occurred during the trapping season in 2006 were used to evaluate cumulative effects, the combined take would represent 4.0% of a population estimated at 399 otters.

Fisher Population Information and Effects Analysis

The fisher is a medium-sized member of the weasel family and the largest member of the genus *Martes* in the family Mustelidae (Powell and Zielinski 1994). It has the body build of a stocky weasel, a pointed face, rounded ears, a long and slender body, short legs, and a well-furred tail about one-third its total length (Lewis and Hayes 2004). Fishers have claws that can be partially retracted, which allow them to climb and move through trees, and descend in a headfirst position (Powell 1993).

Fishers are found from the Pacific shore of British Columbia and Alaska to Nova Scotia and throughout New England in the east. They can be found as far north as Great Slave Lake in the North West Territories and as far south as the mountains of Oregon. There are isolated populations in the Sierra Nevada of California and the Appalachians of West Virginia (Powell et al. 2003). Fishers inhabit a variety of forest types; however, key forest habitat features that fishers require include canopy cover generally greater than 50%; large trees with cavities sufficiently large enough to provide denning sites; and large limbs, snags, and logs for resting sites (Lewis and Hayes 2004). Fishers are most often associated with late-successional forests. However, recent population expansion into Southern New England does not support the sensitivity to forest fragmentation and preference for landscapes comprised of large, contiguous patches of late-successional forest over more fragmented landscapes containing patches of late-successional forest suggested by Jones (1991).

Population densities for fisher were estimated by Koen (2005) at 0.326 fisher per km^2 (0.844 fisher per mi^2) in Eastern Ontario, Canada in recently recolonized fisher habitat with a maximum population density of resident fishers in this same area, assuming that the area is saturated by fishers, irrespective of habitat, is 0.632 per km^2 (1.637 per mi^2). Thompson (2008) found female fisher densities ranging from 0.050 to 0.220 fisher per km^2 (0.129 to 0.570 per mi^2) and male fisher densities ranging from 0.050 to 0.090 fisher per km^2 (0.129 to 0.233 per mi^2) in Northern coastal California.

Population estimates for fisher in Rhode Island are currently not available. Fisher can be found statewide with the exception of the Narragansett Bay islands and Block Island. The land area of Rhode Island is 2,678 km^2 (1,034 mi^2). If fishers only inhabited 50% of the land area of the State and densities occurred between 0.050 and 0.326 fisher per km^2, the statewide population could be conservatively estimated at between 67 and 437 fishers. However, given the harvest levels of fisher in the State during annual trapping season since 2006, the population is likely greater than 67 fishers and is likely higher than 437 fishers. Similar to other furbearing species, fishers can be found throughout the State, with the exception of Block Island, and the estimate is intended to evaluate the magnitude of take proposed under the proposed action.

Fishers are classified as regulated furbearers in Rhode Island and seasons and limits on take are set by the RIDEM (2011*b*). At the time this EA was developed, there was a bag limit of four fisher per season, the season is limited to only 24 days per year and all pelts must be tagged (RIDEM 2011*b*). There were 449 fisher harvested during the annual trapping season from 2006 to 2011 (see Table 4.3). There was no nuisance take reported from 2006 to 2010 and no nuisance take data was available for 2011 during the preparation of this EA. During FY 2010, one fisher was lethally taken by WS to alleviate predation on the nests of T&E species nesting along coastal beaches.

Most requests for assistance associated with fisher would involve nest predation on T&E species; however, WS could receive request for assistance associated with agricultural resources and property, along with threats to human safety. In June 2009, a fisher was reported in an unprovoked attack on a 6-year old boy in Hopkinton, Rhode Island who was waiting for a school bus (WPRI 2009). Based upon an anticipated increase for requests for WS' assistance, as many as 10 fishers could be killed each year by WS to address such damage or threats.

Table 4.3 - Cumulative fisher take from known sources in Rhode Island, 2006-2011

Year	Harvest Take[1]	WS' Take[2]	Total
2006	49	0	**49**
2007	83	0	**83**
2008	97	0	**97**
2009	100	0	**100**
2010	66	1	**67**
2011	54	0	**54**
TOTAL	**449**	**1**	**450**

[1]Harvest take includes those fishers reported during the trapping season

[2]Reported by federal fiscal year

Take of up to 10 fishers by WS would represent 14.9% of the statewide population estimated at 67 individuals. Since an average of 75 fishers have been harvested or taken in Rhode Island annually from 2006 to 2011, the statewide population exceeds 67 fishers. Take of up to 10 fishers by WS would represent 2.3% of the statewide population estimated at 437 individuals. If WS' take of up to 10 fishers were combined with the highest level of harvest from 2006 through 2011, the cumulative take of 110 fishers would represent 25.2% of the estimated population of 437 fishers.

Fisher damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced because of WS' activities aimed at reducing damage at a local site. Based upon the above information, WS' limited lethal take of fisher would have no adverse impacts on overall populations of the species in Rhode Island.

The harvest bag limit (4 fisher per trapper) allowed by the RIDEM during the 24-day harvest season provides an indication that the RIDEM is closely managing the fisher population in the State making overharvest unlikely to occur, even when lethal take to alleviate or prevent damage from occurring is included. WS' take would only occur when permitted by the RIDEM; therefore, take would only occur by WS at the discretion of the RIDEM.

Mink Population Information and Effects Analysis

The mink is a member of the weasel family and is about 46 to 61 cm (18 to 24 inches) in length, including the somewhat bushy tail. These animals weigh about 0.7 to 1.4 kg (1.5 to 3 lbs). Females are about three-fourths the size of males. Both sexes are a rich chocolate-brown color, usually with a white patch on the chest or chin, and scattered white patches on the belly. The fur is relatively short with the coat consisting of a soft, dense under fur concealed by glossy, lustrous guard hairs. Mink also have anal musk glands common to the weasel family, and can discharge a disagreeable musk if frightened or disturbed (Boggess 1994*b*).

They also mark their hunting territory with musk, which is as malodorous as a skunk's musk, although it does not carry as far (National Audubon Society 2000).

Mink are found throughout North America, with the exception of the desert southwest and tundra areas (Eagle and Whitman 1987). 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 muskrat houses, bank burrows, holes, crevices, logjams, or lodges abandoned by beaver. They are active mainly at night and are active throughout the year except for brief intervals during periods of low temperature or heavy snow (Boggess 1994*b*). However, they may adjust hunting times to prey availability (National Audubon Society 2000).

Population densities for mink vary spatially according to habitat and densities may be influenced temporally by weather, trapping, and intraspecific aggression. Generally, populations are most dense in those states and provinces with abundant, stable aquatic habitat. In general, population densities typically range from 0.025 to 0.247 mink per acre (McVey et al. 1993). 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). Marshall (1936) estimated densities from mink tracks in snow in Michigan, reporting 0.6 females in one km^2 (1.5/mi^2) of riverbank and a 1:1 sex ratio following heavy trapping. 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 ha (1,100 acres) refuge in Wisconsin during 1944, a density of 1 mink per 18.8 ha (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. Gerell (1971) worked in two study areas in Sweden. In a 10,000-ha (25,000 acres) area, Gerell (1971) estimated that there were 11 and 16 summer residents during two years, one mink per 909 ha (2,245 acres) in year 1 and one mink per 625 ha (1,545 acres) in year 2. In the second area, Gerell (1971), which included 10 km (6 miles) of riverbank, estimated three and six summer residents in two years. In interior British Columbia, Ritcey and Edwards (1956) caught 11, six, and five mink on 1.9 km (1.2 miles) of stream during three years. Densities calculated by Ritcey and Edwards (1956) were similar to the estimate of 1.5 to 3 mink per km (2.5 to 5 mink per mile) of shoreline reported by Hatler (1976) for a coastal area of Vancouver Island. Mitchell (1961) reported that a turnover of the population occurred during a 3-year period, and Gerell (1971) concurred (Eagle and Whitman 1987).

No population estimates were available for mink in Rhode Island. Therefore, the best available information was used to estimate statewide populations. There are approximately 2,410.8 km (1,498 miles) of rivers and streams, over 8,464.8 ha (20,917 acres) of lakes and ponds, and over 50,181 ha (124,000 acres) of wetlands in Rhode Island (Colt 2008). If 50% of the 2,410.8 km (1,498 miles) of rivers and streams and 50% of the wetlands, lakes and ponds in Rhode Island are acceptable mink habitat and the range of 1.5 mink per km of river and stream and 0.06 mink per ha, the statewide population of mink could be estimated at 3,568 mink.

Mink are classified as regulated furbearers in Rhode Island with an annual trapping season (RIDEM 2011*b*). During the open trapping season, there is no limit on the number of mink that can be harvested (RIDEM 2011*b*). There were 428 mink harvested during the annual trapping seasons and six taken under nuisance permits in Rhode Island from 2006 to 2011 (see Table 4.4; RIDEM 2011*c*). The number of mink lethally taken pursuant to nuisance permits issued by the RIDEM for 2011 is currently unavailable.

WS has not previously received requests for direct operational assistance associated with mink from FY 2006 to FY 2011; however, WS has provided technical assistance to address mink threats to T&E species. Mink have also been reported struck by aircraft in Rhode Island. In future programs, WS may be requested to address damage being caused by mink anywhere in Rhode Island to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, as many as 50 mink each year could be killed by WS to address such damage. Take of up to 50 mink would represent 1.4% of the estimated statewide population of 3,568 mink in Rhode Island.

Table 4.4 - Cumulative mink take from known sources in Rhode Island, 2006-2011

Year	Harvest Take[1]	Nuisance Take	Total
2006	86	0	**86**
2007	82	0	**82**
2008	114	2	**116**
2009	63	1	**64**
2010	34	3	**37**
2011	49	N/A[†]	**49**
TOTAL	**428**	**6**	**434**

[1]Harvest take includes those minks reported during the trapping season

[†]Data is currently unavailable

As shown in Table 4.4, 434 mink have been lethally taken in the State during the annual trapping season and pursuant to nuisance wildlife control permits between 2006 and 2011; however, the number of mink taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable. If the average number of mink lethally taken under nuisance wildlife control permits per year between 2006 and 2010 of 1.2 mink were substituted for the actual take of mink during 2011, the total take under nuisance wildlife control permits would be estimated at seven mink from 2006 through 2011. Therefore, the total cumulative take by all entities from 2006 through 2011 would be 435 mink, which is an average take of 73 mink annually. If WS' estimated take of up to 50 mink per year is combined with the average take of mink during the harvest season and lethally taken under nuisance wildlife control permits, the cumulative take would be nearly 123 mink per year.

If the statewide population of mink were 3,568 individuals, the cumulative take of 123 mink would represent 3.5% of the estimated population. If the highest level of annual take during the harvest season of 114 mink were combined with the highest annual take of three mink lethally taken under nuisance wildlife control permits and the estimated annual take by WS of 50 mink, the cumulative take would be 167 mink. The cumulative take of 167 mink would represent 4.7% of a statewide population estimated at 3,568 mink. Since the statewide population is likely higher than 3,568 mink, cumulative take is likely a much smaller percentage of the actual statewide population.

Activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced because of WS' activities aimed at reducing damage at a local site. Based upon the above information, WS' limited lethal take of mink would have no adverse impacts on overall populations of the species in Rhode Island.

Long-tailed Weasel Population Information and Effects Analysis

Long-tailed weasels are small members of the mustelid family in the genus *Mustela*. They exhibit sexual dimorphism; the males are larger than females. Long-tailed weasel males measure 330 to 420 mm (13.0 to 16.5 inches) and weigh 160 to 450 g (5.6 to 15.9 ounces) while females measure 280 to 350 mm (11.0 to 13.8 inches) and weigh 80 to 250 g (2.8 to 8.8 ounce) (Smithsonian National Museum of Natural History 2012). They exhibit the typical mustelid form, which is a long, slender body with short legs. The tail is 44 to 70% of the length of the head and body (Sheffield and Thomas 1997). Northern long-tailed weasels have white winter coats and a brown summer coat with light-colored underparts from the chin to the inguinal region, with lateral margins tinged with buff or yellow. Long-tailed weasels have single annual litters averaging four to five with a maximum of nine after a 205- to 337-day gestation period due to delayed implantation of embryos. The long-tailed weasel has the widest distribution of any mustelid in the Western Hemisphere from Canada south to Venezuela, Ecuador, Peru, and Bolivia (Eisenberg 1989, King 1989, Emmons and Feer 1990). The long-tailed weasel inhabits all life zones, with the exception of desert throughout its range (Hall 1981). Long-tailed weasel population densities range from as low as 0.004 to as high as 0.38 per ha (Glover 1943, Quick 1951) and populations occasionally crash, requiring several years to recover (Osgood 1935).

Population estimates for long-tailed weasels in Rhode Island are currently not available. Based on the land area of Rhode Island, there are over 267,805 ha of land in the State. If 50% of the land area of the State has sufficient habitat to support long-tailed weasels and weasel densities are between 0.004 and 0.38 long-tailed weasels per ha (Glover 1943, Quick 1951), a statewide long-tailed weasel population could be estimated at between 536 and 50,883 long-tailed weasels. The population of long-tailed weasels within the State is likely higher than 536 long-tailed weasels since weasels can be found statewide, with the exception of Block Island.

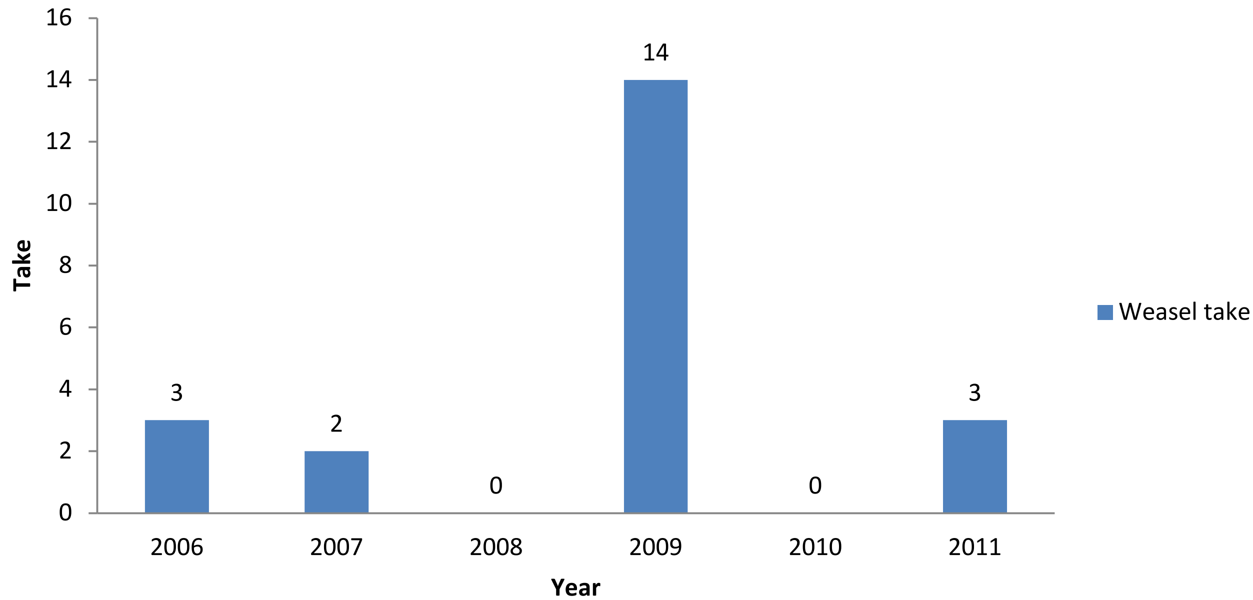
No long-tailed weasels were taken by WS in Rhode Island from FY 2006 to FY 2011. However, WS has provided technical assistance to address weasel threats to T&E species. In future programs, WS may be requested to address damage being caused by long-tailed weasel anywhere in Rhode Island to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, as many as 25 long-tailed weasels could be killed each year by WS to address such damage. Weasel damage management activities 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.

Long-tailed weasel densities are sufficient to allow for an annual trapping season within the State. During the length of the annual trapping season, there are currently no harvest limits. Harvest data for long-tailed weasels is combined with short-tailed weasels and is not reported to the species level. From 2006 to 2011, 22 weasels were reported harvested in Rhode Island during the annual trapping season (see Table 4.5; RIDEM 2011*c*). No weasels were reported taken from 2006 to 2010 pursuant to nuisance wildlife control permits and the number of weasels taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable; however, based on previous nuisance reports, it could reasonably be concluded that no long-tailed weasels were taken under nuisance permits in 2011.

If all 22 weasels taken during annual trapping seasons from 2006 to 2011 were long-tailed weasels, the average cumulative take by all entities from 2006 through 2011 would be 3.7 long-tailed weasels. If WS' estimated take of up to 25 long-tailed weasels per year were combined with the average take of long-tailed weasels during the harvest season the cumulative take would be nearly 30 long-tailed weasels per year.

If the statewide population of long-tailed weasel were estimated at 536 individuals, the cumulative take of 30 long-tailed weasels would represent 5.6% of the estimated population. If the highest level of annual take during the harvest season of 14 weasels, if all weasels were long-tailed weasels, were combined with the estimated annual take by WS of 25 long-tailed weasels, the cumulative take would be nearly 40 long-tailed weasels. The cumulative take of 40 long-tailed weasels would represent 7.5% of a statewide population estimated at 536 long-tailed weasels. Since the statewide population could be higher than 536 long-tailed weasels, cumulative take could actually be a smaller percentage of the actual statewide population.

Figure 4.1 - Weasel take from known sources in Rhode Island, 2006-2011[†]



[†]Harvest of weasels is not reported to species and may include any combination of long-tailed and short-tailed weasels.

If the statewide population of long-tailed weasel were estimated at 50,883 individuals, the cumulative take of 30 long-tailed weasels would represent 0.06% of the estimated population. If the highest level of annual take during the harvest season of 14 weasels, if all weasels were long-tailed weasels, were combined with the estimated annual take by WS of 25 long-tailed weasels, the cumulative take would be nearly 40 long-tailed weasels. The cumulative take of 40 long-tailed weasels would represent 0.08% of a statewide population estimated at 50,883 long-tailed weasels.

Activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced because of WS' activities under this alternative aimed at reducing damage at a local site. All take by WS would occur pursuant to permits issued by the RIDEM, which ensures any take by WS occurs within allowable harvest limits established.

Short-tailed Weasel Population Information and Effects Analysis

Short-tailed weasels are also small members of the mustelid family in the genus *Mustela*. Like long-tailed weasels, they exhibit sexual dimorphism; the males are larger than females. Short-tailed weasel males measure 219 to 343 mm (8.6 to 13.5 inches) and weigh 67 to 116 g (2.4 to 4.1 ounces) while females measure 190 to 292 mm (7.5 to 11.5 inches) and weigh 25 to 80 g (0.9 to 2.8 ounces) (Smithsonian National Museum of Natural History 2012). They also exhibit the typical mustelid form only on a smaller scale. The tail is more than 25% of the length of the head and body with a black tip on the end (Hall 1951). Short-tailed weasels also have a white winter coat and a reddish brown summer coat with a creamy white underbelly. Short-tailed weasels have single annual litters averaging four to 13 (Stubbe 1973). The short-tailed weasel ranges from Alaska and most of Canada, the Pacific Northwest, upper Midwest, and the Northeastern United States. The short-tailed weasel prefers successional or forest edge habitats in scrub, alpine meadows, marshes, riparian woodlands, hedgerows, and riverbanks (Vaisfeld 1972, Erlinge 1977*a*, Erlinge 1977*b*, Fitzgerald 1977, Simms 1979*a*, Erlinge 1981). Short-tailed weasel population densities range from a low of 0.02 to as high as 0.059 weasels per ha (Simms 1979*b*).

Although reported by Cronan and Brooks (1968) in the Mammals of Rhode Island, the RIDEM reports no specimen record for this species in the State (C. Brown, RIDEM pers. comm. 2012) nor are any population estimates currently available for short-tailed weasel in Rhode Island. Short-tailed weasels are known to occur in neighboring Massachusetts and Connecticut. A Connecticut Department of Energy and Environmental Protection study conducted in 2007 and 2009 found short-tailed weasels were most common in the north and northwestern portions of Connecticut (Kocer 2010). During the study, short-tailed weasels were reported from the town of Ashford in Windham County within 35 km (22 miles) of the Rhode Island border (Kocer 2010). Based on the land area of Rhode Island and if only 25% of the land area of the State had sufficient habitat to support short-tailed weasels based on lack of specimens and weasel densities were between 0.02 and 0.059 short-tailed weasels per ha (Simms 1979*b*), a statewide short-tailed weasel population could be estimated at between 1,339 and 3,950 short-tailed weasels. The population of short-tailed weasels within the State is likely higher than 1,339 short-tailed weasels since short-tailed weasels could be found statewide, with the exception of the Narragansett Bay islands and Block Island.

No short-tailed weasels were taken by WS in Rhode Island from FY 2006 to FY 2011. WS has provided technical assistance to address weasel threats to T&E species. In future programs, WS may be requested to address damage being caused by short-tailed weasel anywhere in Rhode Island to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, as many as 25 short-tailed weasels could be killed each year by WS to address such damage.

Similar to long-tailed weasels, short-tailed weasels can also be harvested in the State during annual trapping seasons, which allow for an unlimited number of weasels to be harvested during the length of the season. The annual harvest of short-tailed weasels is not reported to the species level but is combined with long-tailed weasels. From 2006 to 2011, 22 weasels were reported harvested in Rhode Island during the annual trapping season (see Figure 4.1; RIDEM 2011*c*). No weasels were reported taken from 2006 to 2010 pursuant to nuisance wildlife control permits and the number of weasels taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable; however, based on previous nuisance reports, it could reasonably be concluded that no short-tailed weasels were taken under nuisance permits in FY 2011.

If all 22 weasels taken during annual trapping seasons from 2006 to 2011 were short-tailed weasels, the total cumulative take by all entities from 2006 through 2011 would be 22 short-tailed weasels, which is an average take of 3.7 short-tailed weasels annually. If WS' estimated take of up to 25 short-tailed weasels per year were combined with the average take of short-tailed weasels during the harvest season the cumulative take would be nearly 30 short-tailed weasels per year.

If the statewide population of short-tailed weasel were estimated at 1,339 individuals, the cumulative take of 30 short-tailed weasels would represent 2.2% of the estimated population. If the highest level of annual take during the harvest season of 14 weasels, if all weasels were short-tailed weasels, were combined with the estimated annual take by WS of 25 short-tailed weasels, the cumulative take would be nearly 40 short-tailed weasels. The cumulative take of 40 short-tailed weasels would represent 3.0% of a statewide population estimated at 2,678 short-tailed weasels.

If the statewide population of short-tailed weasel were estimated at 3,950 individuals, the cumulative take of 30 short-tailed weasels would represent 0.8% of the estimated population. If the highest level of annual take during the harvest season of 14 weasels, if all weasels were short-tailed weasels, were combined with the estimated annual take by WS of 25 short-tailed weasels, the cumulative take would be nearly 40 short-tailed weasels. The cumulative take of 40 short-tailed weasels would represent 1.0% of a statewide population estimated at 3,950 short-tailed weasels. Since the statewide population could be higher than 3,950 short-tailed weasels, cumulative take could actually be a smaller percentage of the actual statewide population.

All take by WS would occur pursuant to permits issued by the RIDEM, which ensures any take by WS occurs within allowable harvest limits established. The unlimited take allowed by the RIDEM during the length of the annual trapping seasons, provides some indication the statewide population of short-tailed weasels is not likely to be harvested. The take of short-tailed weasels by WS would only occur when permitted by the RIDEM and only at levels permitted. Therefore, take would only occur when authorized by the RIDEM, which ensures take levels occur within allowable harvest limits.

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). Striped skunks are primarily nocturnal and do not have a true hibernation period, although during extremely cold weather it may become temporarily dormant. The striped skunk is an omnivore, feeding heavily on insects such as grasshoppers, crickets, beetles, bees, and wasp (Chapman and Feldhamer 1982). The striped skunk's diet also includes small mammals, the eggs of ground-nesting birds, reptiles, and amphibians. Striped skunks are typically non-aggressive and likely to flee when approached by humans (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 (Chapman and Feldhamer 1982).

Adult skunks begin breeding in late February. Yearling females (born in the preceding year) mate in late March. Gestation usually lasts about seven to 10 weeks. Litters commonly consist of five to nine young with two litters per year possible (Hall and Kelson 1959). The home range of striped skunks is usually not consistent. It appears to be in relation to life history requirements such as winter denning, feeding activities, dispersal, and parturition (Rosatte 1987). 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 have been reported to range from 0.013 to 0.1 skunks per acre (Rosatte 1987).

Population estimates for striped skunks in Rhode Island are currently not available. Striped skunks can be found in a variety of habitats across the State. The land area of Rhode Island is 1,034 square miles, which is 661,760 acres. If skunks only inhabit 50% of the land area of the State and densities occurred at one skunk per 77 acres or 0.013 skunks per acre, the statewide population could be estimated at nearly 4,300 skunks. If skunks only inhabit 50% of the land area of the State and densities occur at one skunk per 10 acres or 0.1 skunks per acre, the statewide population could be estimated at nearly 33,088 skunks. Similar to other furbearing species, skunks can be found throughout the State, excluding Block Island, and the estimate is intended to evaluate the magnitude of take proposed under the proposed action.

Skunks can be trapped during an annual season, which places no limit on the number of skunks that can be harvested daily and no limit on the number of skunks that can be possessed throughout the trapping season. Mandatory trapper report data indicates that 82 striped skunks were harvested in Rhode Island from 2006 through 2011 averaging 13.7 per year (see Table 4.5; RIDEM 2011*c*). In addition, 550 skunks were taken under nuisance permits between 2006 and 2010 averaging 110 per year. WS dispersed two skunks using non-lethal methods between FY 2006 and FY 2011; however, no lethal take occurred by WS. In addition, skunks can be lethally taken as a nuisance by landowners or leasee in the State when causing damage or posing a threat of damage or when permitted by the RIDEM; however, the number of skunks lethally taken by landowners to alleviate damage is unknown.

Table 4.5 - Cumulative striped skunk take from known sources in Rhode Island, 2006-2011

Year	Harvest Take	Nuisance Take	Total
2006	7	71	78
2007	4	108	112
2008	30	99	129
2009	19	138	157
2010	10	134	144
2011	12	N/A†	12
TOTAL	**82**	**550**	**632**

†take data for 2011 is currently unavailable

Based on previous requests for assistance received by WS and in anticipation of additional efforts with managing striped skunk damage in Rhode Island, up to 100 skunks could be lethally removed by WS annually under the proposed action, when requested.

As shown in Table 4.5, 632 skunks have been lethally taken in the State during the annual trapping season and pursuant to nuisance wildlife control permits between 2006 and 2011; however, the number of skunks taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable. If the average number of skunks lethally taken under nuisance wildlife control permits per year between 2006 and 2010 of 110 skunks were substituted for the actual take of skunks during 2011, the total take under nuisance wildlife control permits would be estimated at 660 skunks from 2006 through 2011. Therefore, the total cumulative take by all entities from 2006 through 2011 would be 742 skunks, which is an average take of 124 skunks annually. If WS' estimated take of up to 100 skunks per year is combined with the average take of skunks during the harvest season and lethally taken under nuisance wildlife control permits, the cumulative take would be nearly 225 skunks per year.

If the statewide population of skunks were estimated at 4,300 individuals, the average cumulative take of 225 striped skunks would represent 5.2% of the estimated population. If the highest level of annual take during the harvest season of 30 skunks is combined with the highest annual take under nuisance permits of 138 skunks and estimated annual take by WS of 100 striped skunks, the high cumulative take would be nearly 270 skunks. The cumulative take of 270 skunks would represent 6.3% of a statewide population estimated at 4,300 striped skunks.

If the statewide population of skunks were estimated at 33,088 individuals, the average cumulative take of 225 striped skunks would represent 0.7% of the estimated population. The highest cumulative take of 270 skunks based on the highest harvest and nuisance take from 2006 to 2011 would represent 0.8% of a statewide population estimated at 33,088 skunks. Since the statewide population could reasonably be expected to be higher than 33,088 striped skunks, cumulative take could actually be a smaller percentage of the actual statewide population.

The unlimited take allowed by the RIDEM provides an indication that skunk densities in the State are sufficient to maintain a sustain harvest level and adverse effects from harvest and damage management purposes would not likely cause overharvest of the species leading to population declines.

Coyote Population Information and Effects Analysis

Coyotes are a familiar mammal to most people. Their coloration is blended, primarily gray mixed with a reddish tint. The belly and throat are a paler color than the rest of the body (Beckoff 1982). Coyotes have long rusty or yellowish legs with dark vertical lines on the lower foreleg. They are similar in appearance to gray and red wolves (National Audubon Society 2000). Color varies greatly from nearly black to red or nearly white in some individuals and local populations. Most have dark or black guard hairs over their back and tail (Green et al. 1994). They sometimes breed with domestic dogs producing hybrids called "*coydogs*" (National Audubon Society 2000). The size of coyotes varies from about 20 to 40 lbs (9 to 18 kg) (Voigt and Berg 1987). Some individuals may exceed 50 lbs (23 kg).

Coyotes range throughout the United States with the highest densities occurring on the Plains and in the south-central United States, including Texas. The distribution of coyotes in eastern North America began to expand beginning around 1900 to 1920. Now, all eastern states and Canadian provinces have at least a small population of coyotes (Voigt and Berg 1987).

Coyotes often include many items in their diet. Rabbits are one of the most common prey species of coyotes. Other items in the coyote's diet include carrion, rodents, deer, 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 take small domestic pets such as cats and dogs (Voigt and Berg 1987).

Coyotes breed between January and March and are able to breed prior to reaching one year of age (Kennely and Johns 1976), but the percentage of yearlings having litters varies from zero to 80% in different populations (Gier 1968). This variation can be influenced by a number of factors, which can cause large annual variations in the 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. Gier (1968) reported average litter sizes of 4.8 to 5.1 in years with low rodent numbers, but litters of 5.8 to 6.2 during years with high rodent numbers. Litter sizes of one to 19 pups have been reported (National Audubon Society 2000).

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

The coyote is probably the most extensively studied carnivore (Beckoff 1982), and considerable research has been conducted on population dynamics. Coyote densities as high as 2 per square kilometer (5 per square mile) have been reported in the southwestern and west-central United States, but are lower in other portions of the country including eastern North America, although few studies have accurately determined densities (Voigt and Berg 1987). Although coyote densities vary based on local habitat quality, Knowlton (1972) published that density estimates of 0.5 to 1.0 coyotes per square mile would likely be applicable to coyote densities across much of their range. However, methods for estimating carnivore populations are crude and often produce estimates with broad confidence intervals (Crawford et al. 1993).

Actual population estimates for coyotes in Rhode Island are not available. Coyotes are common throughout the State and inhabit a variety of habitats. 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, USDI 1979, Pyrah 1984). The cost to determine absolute coyote densities accurately over large areas can be prohibitive (Connolly 1992) and would not appear to be warranted given the coyote's overall relative abundance. The presence of unusual food concentrations and the assistance provided to a breeding pair by non-breeding coyotes at the den can influence coyote densities and complicate efforts to estimate abundance (Danner and Smith 1980). Coyote densities are lowest in late winter prior to whelping, highest immediately after whelping, followed by a continued decline to the next whelping season (Parker 1995).

Predator abundance indices suggest that densities of coyotes in North America increase from north to south (Knowlton and Stoddart 1985, Parker 1995). Coyote densities range from 0.2 per square mile when populations are low (pre-whelping) to 3.6 coyotes per square mile when populations are high (post-whelping) (Knowlton 1972, USDI 1979). Although coyote densities vary considerably between habitat types and vary based on numerous environmental variables, Knowlton (1972) concluded that coyote densities might approach a high of five to six coyotes per square mile under extremely favorable conditions with densities of 0.5 to 1.0 per square mile possible over the entire range of the coyote in the United States. Such an estimate is speculative but represents some the best available information for estimating coyote populations.

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

If coyotes only occupy 50% of the land area of Rhode Island and the density of coyotes in the State ranges from 0.5 coyotes per square mile to five coyotes per square mile, the statewide population could be estimated to range from 260 coyotes to a high of 2,600 coyotes. Based on mandatory reporting, approximately four coyotes are harvested annually through trapping in the State (see Table 4.6). No reporting is required for coyotes taken through hunting.

Coyotes are classified as both a game and a furbearer species in Rhode Island with no limit on possession and no closed season on private property. They may be taken through hunting on public land from the beginning of September until the end of February and there is no reporting requirement. Coyotes can be harvested through trapping with no closed season on private property and from November 1 to January 31 each season on public lands with no limit on the number of coyotes that can be harvested daily or possessed during the length of the season, as with all furbearers, trapping harvest reporting is mandatory (RIDEM 2011*b*). There were 23 coyotes reported as harvested by trapping from 2006 through 2011 (RIDEM 2011*c*). There were five coyotes reported taken from 2006 to 2010 pursuant to nuisance wildlife control permits (C. Brown, RIDEM, unpublished data). The number of coyotes taken pursuant to nuisance wildlife control permits during 2011 is currently unavailable. If the average number of coyotes lethally removed annually through nuisance take of one were substituted for the actual take for 2011, the total nuisance take would be six coyotes. Based on this, the average annual known non-WS take of coyote in Rhode Island would be 4.8 coyotes. In addition, coyotes can be lethally taken as a nuisance by landowners or leasee in the State when causing damage or posing a threat of damage or when permitted by the RIDEM. The number of coyotes lethally removed by landowners to alleviate damage is unknown.

Table 4.6 - Cumulative coyote take from known sources in Rhode Island, 2006-2011

Year	Harvest Take[1,2]	Nuisance Take[1,3]	WS Take[4]	Total
2006	1	0	0	1
2007	1	3	0	4
2008	6	1	0	7
2009	3	1	1	5
2010	10	0	3	13
2011	2	N/A[†]	3	5
TOTAL	**23**	**5**	**7**	**35**

1Take reported by calendar year

[2]Harvest take includes those coyotes reported during the trapping season

[3]Nuisance take of fox is not reported to species, fox take is being analyzed here as if all fox take was gray fox

[4]Reported by federal fiscal year

[†]Data is currently unavailable

From FY 2006 through FY 2011, seven coyotes were lethally taken by WS in the State during activities to reduce threats to aviation safety and predation of T&E nesting shorebirds. The highest annual level of take occurred in FY 2010 and FY 2011 when three coyotes were taken each year to alleviate damage and threats. WS' total take from FY 2006 through FY 2011 represents 20.0% of the total known take of coyotes in the State from 2006 through 2011.

Based on the number of requests for assistance received previously and the number of coyotes killed by WS to resolve damage, WS could take up to 50 coyotes annually under the proposed action to alleviate damage.

Although exact population estimates for coyotes in Rhode Island are not available, unlimited take allowed by the RIDEM for the species during hunting and trapping seasons and as a nuisance species indicates the species is not at risk of overharvesting.

Using a statewide coyote population ranging from 260 to 2,600 coyotes, take of up to 50 coyotes annually would represent from 1.9% to 19.2% of the estimated population. Nearly five coyotes have been lethally taken annually in the State during the annual trapping season and under nuisance control permits. If the statewide population of coyotes were estimated at 260 individuals, the average cumulative take of 55 coyotes would represent 21.2% of the estimated population. If the highest level of annual take during the harvest season of 10 coyotes is combined with the highest annual take under nuisance permits of three coyotes and estimated annual take by WS of 50 coyotes, the high cumulative take would be nearly 65 coyotes. The cumulative take of 65 coyotes would represent 25.0 % of a statewide population estimated at 260 coyotes.

If the statewide population of coyotes were estimated at 2,600 individuals, the average cumulative take of 55 coyotes would represent 2.1% of the estimated population. The highest cumulative take of 65 coyotes based on highest harvest and nuisance take from 2006 to 2011 would represent 2.5% of a statewide population estimated at 2,600 coyotes. Since the statewide population could reasonably be expected to be higher than 2,600 coyotes, cumulative take could actually be a smaller percentage of the actual statewide population.

Feral/Free Ranging Dog Population Information and Effects Analysis

Feral or free ranging dogs may occur wherever people are present and permit dogs to roam free or abandon unwanted dogs. Feral dogs probably occur in all of the 50 states of the United 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, which is likely influenced by the availability of food.

Feral dogs are very rare and free-roaming dogs are rare in Rhode Island due to Rhode Island General Laws § 4-13 and § 4-19, local ordinances and animal control officers and associated licensing requirements, vaccination, and leash laws. Feral dogs are dogs raised without human contact and are essentially wild. Free-ranging dogs can be strays, abandoned, or lost dogs without known owners, or dogs with owners that are either intentionally allowed to roam free or that have escaped from their property or their owner's immediate control. Feral or free-ranging domestic dogs can create a variety of problems. They may attack and/or kill livestock, poultry, or pets. They may harass or kill native wildlife such as deer, rabbits, or T&E birds such as piping plovers (Lowry 1978, Green and Gipson 1994). Domestic dogs may also access airports and create a threat to aviation safety. WS has not received any requests for assistance associated with domestic dogs in Rhode Island previously. Because all of Rhode Island falls within a municipality and all municipalities have a dog or animal control officer, these officers have primary responsibility for managing issue regarding domestic dogs. However, if WS encounters feral or free-ranging domestic dogs as a primary damage agent or while conducting other control operations, all reasonable attempts would be made to capture the dog(s) and turn them over to local animal control or shelter. If capture were not possible, information on the dog(s) would be provided to the local animal control officer. WS would not intentionally lethally remove feral or free-ranging domestic dogs in Rhode Island. It is anticipated that no more than 10 feral or free-ranging domestic dogs could be live captured in Rhode Island annually and either turned over to local animal control officers, licensed animal shelters, or their rightful owners.

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 this secretive carnivore is seldom seen. This species is somewhat smaller in stature than the red fox, having shorter legs and extremities. Gray fox exhibit striking pelage that has grizzled upper parts resulting from individual guard hairs 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 about 3 to 7 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 North America, north and east from southern California, Arizona, and central Texas (Fritzell 1987).

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

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

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

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

Gray fox feed on a wide variety of plant and animal matter, but feed on a wider variety of plant and animal matter than other North American canids (Fritzell 1987). Although active primarily at twilight and at night, the gray fox is sometimes seen foraging by day in brush, thick foliage, or timber. The only American canid with true climbing ability, gray fox occasionally forage in trees and often 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 (National Audubon Society 2000).

Gray fox can be found statewide in Rhode Island with the exception of Prudence Island, the smaller islands of Narragansett Bay, and Block Island. If gray fox only occupy 50% of the land area of the State and the density of gray fox in the State ranges between 1.2 to 2.1 gray fox per km^2, the statewide population could be estimated between 1,607 and 2,812 gray fox. Gray fox can be found in a variety of habitats, so gray fox occupying only 50% of the land area of the State is unlikely since fox can be found almost statewide. However, similar to the other furbearing species, gray fox occupying only 50% of the land area was used to provide a minimum population estimate to evaluate the magnitude of the proposed take by WS.

Gray fox can be harvested during annual hunting and trapping seasons in the State. During development of the EA, there was no limit to the number of fox that could be harvested (RIDEM 2011*b*). Between 2006 and 2011, a minimum of 60 gray fox were harvested by trapping in the State during hunting and trapping seasons (see Table 4.7; RIDEM 2011*c*), averaging 10 gray fox per year. The highest annual take occurred in 2008 when 20 gray fox were reported harvested. As with other furbearing species, the reporting of gray fox take by trapping is mandatory and there is no reporting requirement of gray fox harvested by hunting.

Fox can be taken to alleviate damage and threats of damage in Rhode Island; however, the number of gray fox lethally taken annually to alleviate damage or threats of damage is currently unknown because nuisance take is not reported to species. From 2006 to 2010, 17 fox were reported taken as nuisance animals in Rhode Island (C. Brown, RIDEM, unpublished data), an average of 3.4 fox per year. Nuisance take of fox for 2011 was not available at the time this EA was prepared. For analysis purposes, all fox taken under nuisance permits will be presumed to be gray fox. Since the reporting of hunter harvest is not required and since nuisance take of fox is not reported to species, the actual number of gray fox harvested is currently unknown.

From FY 2006 through FY 2011, WS removed one gray fox during damage management activities. Based on the number of requests for assistance received previously and anticipated future requests, WS could remove up to 25 gray fox under the proposed action to alleviate damage, threats of damage and threats to human health and safety.

Using a statewide gray fox population ranging from 1,607 to 2,812 gray fox, WS take of up to 25 gray fox annually would represent from 0.9% to 1.6% of the estimated population. If the average number of fox taken annually under nuisance permits of three were substituted for the actual take that occurred in 2011, the average annual harvest and nuisance take of gray fox from 2006 to 2011 would be 13.3 gray fox. When combined with WS' estimated take of 25 gray fox, cumulative estimated annual take of gray fox in Rhode Island would be nearly 40 gray fox. The highest total reported harvest of gray fox occurred in 2009 when 20 gray fox were harvested. The highest take of fox under nuisance permits occurred in 2010 when nine fox were lethally taken.

Table 4.7 - Known cumulative take of gray fox in Rhode Island, 2006-2011

Year	Harvest Take[1,2]	Nuisance Take[1,3]	WS' Take[4]	Total Take
2006	5	0	0	**5**
2007	8	1	0	**9**
2008	10	2	0	**12**
2009	20	5	0	**25**
2010	9	9	1	**19**
2011	8	N/A[†]	0	**8**
TOTAL	**60**	17	**1**	**78**

1Take reported by calendar year
[2]Harvest take includes those gray fox reported during the trapping season
[3]Nuisance take of fox is not reported to species, fox take is being analyzed here as if all fox take was gray fox
[4]Reported by federal fiscal year
[†]Data is currently unavailable

If the statewide population of gray fox were estimated at 1,607 individuals, the average cumulative take of 40 gray fox would represent 2.5% of the estimated population. If the highest level of annual take during the harvest season of 20 gray fox were combined with the highest annual take under nuisance permits of nine fox and estimated annual take by WS of 25 gray fox, the cumulative take would be nearly 55 gray fox. The cumulative take of 55 gray fox would represent 3.4% of a statewide population estimated at 1,607 gray fox.

If the statewide population of gray fox were estimated at 2,812 individuals, the average cumulative take of 40 gray fox would represent 1.4% of the estimated population. The highest cumulative take of 55 gray fox based on highest harvest and nuisance take from 2006 to 2011 would represent 2.0% of a statewide population estimated at 2,812 gray fox. Since the statewide population could reasonably be expected to be higher than 2,812 gray fox, cumulative take could actually be a smaller percentage of the actual statewide population.

Like other mammal species addressed in this EA, the unlimited take allowed by the RIDEM during the hunting and trapping seasons and the permitting of take to alleviate damage by the RIDEM provides an indication the RIDEM believes that gray fox populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest would be unlikely.

Red Fox Population Information and Effects Analysis

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

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

Red fox are adaptable to most habitats within their range, but usually prefer open country with moderate cover. Some of the highest fox densities reported are in the north-central United States in areas 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 food resources and the presence or absence of other canids. Because those two factors strongly influence red fox survival, habitat limits fox numbers but seldom limits distribution (Voigt 1987).

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

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

Schmidt 1994). They also feed on squirrels, woodchucks, crayfish, and even grasses (National Audubon Society 2000).

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). In Great Britain, where food is abundant in many urban areas, densities as high as 30 fox per km^2 (78 per mi^2) have been reported (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986), while in southern Ontario, Voigt (1987) reported densities from 0.1 to 3.0 fox per km^2 (0.26 to 7.8 per mi^2) occur during spring. This includes both kits 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). Phillips (1970) reported red fox bounties were paid in central and northeastern Iowa for harvest densities of 0.75 and 2.5 red fox per mi^2, respectively, which would be lower than population densities. 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 ha (1,235 to 4,940 acres) in rural settings such as farmland (Voigt and Tinline 1980), but such sizes may not apply among fox populations in urban settings. Red fox can be found statewide in Rhode Island with the exception of Block Island. If red fox only occupied 50% of the land area of the State and the density of red fox in the State was between 0.1 and 3.0 red fox per km^2, the statewide population could be estimated between 134 and 4,017 red fox.

Red fox can be harvested during annual hunting and trapping seasons with no limit to the number of fox that can be harvested (RIDEM 2011*b*). Between 2006 and 2011, a minimum of 40 red fox were harvested by trapping in the State during hunting and trapping seasons (see Table 4.8; RIDEM 2011*c*), averaging 6.7 red fox per year. The highest annual take occurred in 2008 when 13 red fox were reported harvested. As with other furbearing species, the reporting of red fox take by trapping is mandatory and there is no reporting requirement of red fox harvested by hunting.

Foxes can also be taken to alleviate damage and threats of damage in Rhode Island; however, the number of red fox lethally taken annually to alleviate damage or threats of damage is currently unknown because nuisance take is not reported to species. From 2006 to 2010, 17 fox were reported taken as nuisance animals in Rhode Island (C. Brown, RIDEM, unpublished data), which is an average of 3.4 fox per year. For this analysis, all fox taken under nuisance permits will be considered red fox. Since the reporting of hunter harvest is not required and since nuisance take of fox is not reported to species, the actual number of red fox lethally taken in the State is currently unknown.

As shown in Table 4.8, WS has lethally taken four red fox in the State during all damage management activities from FY 2006 through FY 2011, with the highest level of take occurring in FY 2011 when three red fox were taken during damage management activities. Of those four red fox lethally removed by WS, three red fox were lethally removed during predator management activities to protect nesting piping plovers and least terns and one was removed from an airport.

Based on the number of requests for assistance received previously and based on the number of red fox addressed as part of those requests for assistance, WS could take up to 50 red fox annually under the proposed action. Using a statewide population estimate of 134 red fox, take of up to 50 red fox annually would represent 37.3% of the estimated population. While using a statewide population estimate of 4,017 red fox, take of up to 50 red fox annually would represent 1.2% of the estimated statewide population.

Table 4.8 - Known cumulative take of red fox in Rhode Island, 2006-2011

Year	Harvest Take[1,2]	Nuisance Take[1,3]	WS' Take[4]	Total
2006	4	0	0	**4**
2007	1	1	0	**2**
2008	12	2	0	**14**
2009	13	5	0	**18**
2010	11	9	1	**21**
2011	3	N/A[†]	3	**6**
TOTAL	**40**	**17**	**4**	**65**

[1]Take reported by calendar year

[2]Harvest take includes those gray fox reported during the trapping season

[3]Nuisance take of fox is not reported to species, fox take is being analyzed here as if all fox take was gray fox

[4]Reported by federal fiscal year

[†]Data is currently unavailable

When combined, the average annual harvest (6.7), nuisance take (3.4), and WS' estimated annual take of 50 red fox would be approximately 60 red fox. If the statewide population of red fox were estimated at 134 individuals, the average cumulative take of 60 red fox would represent 44.8% of the estimated population. If the highest level of annual take during the harvest season (13) and under nuisance permits (9) is combined with the estimated annual take by WS of 50 red fox, the highest cumulative take would be 72 red fox. The cumulative take of 72 red fox would represent 52.7% of a statewide population estimated at 134 red fox.

If the statewide population of red fox were estimated at 4,017 individuals, the average cumulative take of 60 red fox would represent 1.5 % of the estimated population. The highest cumulative take of 72 red fox based on highest harvest and nuisance take from 2006 to 2011 would represent 1.8% of a statewide population estimated at 4,017 red fox. Since the statewide population could reasonably be expected to be higher than 4,017 red fox, cumulative take could actually be a smaller percentage of the actual statewide population.

Like other mammal species addressed in this EA, the unlimited take allowed by the RIDEM during the hunting and trapping seasons and the permitting of take to alleviate damage by the RIDEM provides an indication the RIDEM believes that red fox populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely. Despite previous levels of take, the red fox population appears to be at least stable based on harvest reports and the RIDEM (C. Brown, RIDEM pers. comm. 2012) which provides an indication that the cumulative take of red fox has not reached a level where declining trends have been observed. The proposed take of red fox to alleviate damage would be higher than the overall harvest of red fox in the State. However, the overall take would be of low magnitude when compared to the estimated statewide population.

Bobcat Population Information and Effects Analysis

The bobcat is the most common wildcat in North America. Their fur is dense, soft, short and generally yellowish to reddish-brown in color with numerous black spots and black-tipped guard hairs on the back and white with black spots on the belly. Forelegs are tawny with black bars. The species gets its common name from its characteristic stubby or "*bobbed*" tail. The tail is generally only 9 to 20 cm (3.5 to 8 inches) in length with two or three black bars and a black tip above, while the underside is pale or white (Larivière and Walton 1997). Their upper legs have dark horizontal bands. The face has thin, black lines stretching onto broad cheek ruff and their ears are tufted. Males are larger than females and bobcats total length ranges from 47.5 to 125 cm (19 to 49 inches) weigh ranges between 4.1 and 18.3 kg (9 to 40 pounds) (Larivière and Walton 1997).

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, porcupines, and ground hogs comprise most of their diet. Opossums, raccoon, grouse, wild turkey, and other ground nesting birds are also eaten. Occasionally, insects and reptiles can be part of a bobcat's diet. They also resort to scavenging. They are opportunistic predators, and may feed on livestock and domestic animals such as poultry, sheep, goats, house cats, small dogs, exotic birds and game animals, and rarely, calves (Virchow and Hogeland 1994). McCord and Cardoza (1982) reported the cottontail rabbit to be the principal prey of bobcats throughout their range.

Bobcats can be found statewide in Rhode Island with the exception of Aquidneck Island, Conanicut Island, other Narragansett Bay islands, and Block Island. The statewide bobcat population is currently unknown. Ruell et al. (2009) reported bobcat population 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 developments. Lawhead (1984) reported bobcat densities of 0.66 per square mile (0.26 bobcats per km^2) in Arizona with a preference for riparian habitat. Bobcats in southern Illinois were reported to have a population density of 0.70 bobcats per square mile (0.27 bobcats per km^2) (Nielsen and Woolf 2001), while Anderson (1987) provided population density estimates of 0.13 to 0.26 bobcats per square mile (0.05 to 0.10 bobcats per km^2).

If bobcats only occupied 50% of the land area of the State and the density of bobcat in the State was estimated at a low of 0.13 bobcats per square mile to a high of 1.09 bobcats per square mile, the statewide population could be estimated at between approximately 25 and 560 individuals. Bobcats can be found in a variety of habitats, including developed areas, so bobcat occupying only 50% of the land area of the State is unlikely since bobcats can be found almost statewide. However, similar to the other furbearing species, bobcat occupying only 50% of the land area was used to provide a minimum population estimate to determine the magnitude of the proposed take by WS.

Bobcats are classified as a furbearer species and are listed as state threatened in Rhode Island and there is currently no open season for trapping or hunting bobcat in Rhode Island. WS has not previously received requests for assistance to alleviate damage or threats caused by bobcats to property, agricultural resources such as sheep or poultry, natural resources or human health and safety. In anticipation of receiving requests for assistance, WS reasonably expects the total take of bobcat would not exceed five bobcats annually in Rhode Island to resolve requests to manage damage to resources and threats to human health and safety. The analysis of WS' take of five bobcats would include intentional and unintentional take.

Any direct damage management actions by WS to address bobcat damage or threats to aviation and human health and safety in Rhode Island in future programs would be conducted as part of an informed wildlife management activity coordinated with the RIDEM for the purpose of meeting state wildlife resource management objectives. Such projects may involve harassment with a variety of non-lethal methods, live-capture and translocation of bobcats causing damage or bobcats could be killed to protect property, natural resources, human health and safety or agricultural resources, only with prior approval and/or permitting by RIDEM.

Based upon the aforementioned population estimate, WS' limited lethal take of five bobcats annually under the proposed action would represent 0.9% to 20.0% of estimated bobcat population in Rhode Island of between 25 and 560 individuals. The proposed take of bobcats by WS in the State would be of low magnitude when compared to the statewide population estimates. The lack of open hunting or trapping seasons for bobcats further ensures that there would be no overharvest of bobcats in Rhode Island.

Feral and Free-ranging Cat Population Information and Effects Analysis

Feral cats are domesticated cats living in the wild that are not socialized for human contact. They are generally small in stature, weighing from 1.4 to 3.6 kg (3 to 8 lbs), standing 20 to 30.5 cm (8 to 12 inches) high at the shoulder, and 35.5 to 61 cm (14 to 24 inches) 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). Free-ranging cats are socialized and can be strays, lost or abandoned pets, or pets with homes that are allowed to roam outside.

Feral cats are found in commensal relationships wherever people are found. In some urban and suburban areas, cat populations equal human populations. In many suburban and eastern rural areas, feral cats are the most abundant predators. They are opportunistic predators and scavengers that feed on rodents, rabbits, shrews, moles, birds, insects, reptiles, amphibians, fish, carrion, garbage, vegetation, and leftover pet food (Fitzwater 1994).

Feral cats produce two to 10 kittens during any month of the year. An adult female may produce three litters per year where food and habitat are sufficient. Cats may be active during the day but typically are more active during twilight or night. Domestic 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 four km^2 (1.5 mi^2). After several generations, feral cats can be considered wild in habits and temperament (Fitzwater 1994).

Where it has been documented, the impact of feral cats on wildlife populations in suburban and rural areas, directly by predation, and indirectly by competition for food, has been enormous (Coleman and Temple 1989). In the United Kingdom, one study determined that house cats might take an annual toll of some 70 million animals and birds (Churcher and Lawton 1987). American birds face an estimated 117 to 157 million exotic predators in the form of free-ranging domestic cats, which are estimated to kill at least one billion birds every year in the United States. Cats have contributed to declines and extinctions of birds worldwide. Feral or free-ranging cats 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 (FIV), feline leukemia (FeLV), feline panleukopenia virus (FPV) also known as feline distemper, and rabies. All of these diseases can be transmitted to unvaccinated pet cats allowed to free-range. FPV can be highly contagious and may survive in the environment for up to a year. In addition, FPV may be transmitted to indoor cats through indirect routes, such as on shoes (Berthier et al. 2000, Truyen et al. 2009). In addition, feral and free-ranging cats serve as a reservoir for wildlife and human diseases, including cat scratch fever, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various parasites (Fitzwater 1994).

The number of feral cats in Rhode Island is unknown. PawsWatch, a non-profit organization with six chapters in Rhode Island, reports they provide veterinary care under a trap, neuter/spay/vaccinate, release and monitor program to approximately 1,000 cats across Rhode Island annually (PawsWatch 2012).

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

In future programs, WS may be requested to address damage or threats to human health and safety being caused by feral or free-ranging cats anywhere in Rhode Island to protect any resource being damaged or threatened. Cats, including feral and free-ranging cats, are not regulated by the RIDEM (C. Brown, RIDEM per. comm. 2012), but are regulated by the RIDEM Division of Agriculture and at the municipal level under Rhode Island General Laws (§4-19-16, and §4-22-1 to §4-22-10). The RIDEM Division of Agriculture regulates licensed pet shops and animal shelters that sell, adopt out, or accept abandoned or unwanted cats; other enforcement actions are generally handled at the municipal level by local animal control officers. All cats, including those being treated under a trap, neuter/spay/vaccinate, release, and monitor program must be marked for identification. Feral and free-ranging cats captured and turned over to an animal control officer or state licensed animal shelter may not be euthanized until after a prescribed waiting period, except under certain conditions.

Control efforts by WS would be limited to live-trapping, primarily using cage traps, with subsequent transport and transfer of custody to a local animal control officer. After relinquishing the feral cats to a local animal control officer or animal shelter, the care and the final disposition of the cat would be the responsibility of the animal control officer and animal shelter. It is possible that WS could live capture as many as 200 feral cats each year in Rhode Island to alleviate damage and threats of damage. Feral cats would be removed in projects aimed at protecting human safety and alleviating damage or threats of damage to agricultural resources, property, and natural resources.

Based upon the above information, WS' limited removal of feral cats would have minimal effects on local or statewide populations of this species in Rhode Island. Some local populations may be temporarily reduced because of live-capturing and removing feral cats at a local site. In those cases where feral cats were causing damage or where feral cats were a nuisance and complete removal of the local population could be achieved, this would be considered as providing a benefit to the native environment since feral cats are a non-native species.

White-tailed Deer Population Information and Effects Analysis

When compared to other land mammals in North America, the white-tailed deer currently occupies the largest geographic range of any other mammal (Pagel et al. 1991). Rural areas containing a matrix of forest and agricultural crops can contain the highest deer densities (Roseberry and Woolf 1998). Biologists and resource managers in Rhode Island have been challenged with managing escalating populations of deer in many urban/suburban areas and in some rural areas. As deer populations increase, there is an increasing occurrence of damage from white-tailed deer to agricultural crops (DeVault et al. 2007), increasing incidences of Lyme disease (Fernandez 2008), 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 the second most hazardous species to aviation according to the percentage of strikes that caused damage from 1990 through 2009 (Dolbeer and Wright 2009).

The authority for management of resident wildlife species is the responsibility of the RIDEM. The RIDEM collects and compiles information on white-tailed deer population trends and harvest and uses this information to manage deer populations. The primary tool for the management of deer populations in Rhode Island is through adjusting the allowed lethal take during the deer harvest season in the State. Where deer damage to agricultural resources is severe, the RIDEM, Division of Agriculture also issues kill permits for the take of deer outside of the regulated season to reduce damage. These permits are issued pursuant to Sections 20-1.4, 20-1.12, and 20-1.13; in accordance with Chapters 42-17.1, 42-17.6, and 42-35 of the Rhode Island General Laws. Additionally, the RIDEM, Division of Fisheries and Wildlife may issue permits to allow take of deer outside of established seasons in areas with unique deer management needs, such airports.

Mortality can also occur from vehicle collisions, dogs, illegal take, tangling in fences, disease, and other causes (Crum 2003). Annual deer mortality in Rhode Island from other sources (*e.g.*, illegal take, disease, and predation) is currently unknown. From July 1, 2010 through June 30, 2011, State Farm Mutual Automobile Insurance Company (2011*b*) estimated 1,667 deer-vehicle collisions would occur in Rhode Island while RIDEM reported that 1,357 deer were killed by vehicle collisions in calendar year 2011(see Table 4.9). From FY 2006 through FY 2011, WS did not lethally remove deer in Rhode Island. During this period, WS non-lethally dispersed 62 deer to reduce threats to aviation safety at airports.

The annual total known take of deer in the State (*i.e.*, harvest take, take under depredation permits, vehicle collisions) has ranged from 23.6% to 27.5% of the estimated statewide deer population of 15,000 deer (RIDEM 2011*a*).

WS has seen an increase in requests to assist with managing deer threats to aviation safety in Rhode Island and WS anticipates the number of requests for assistance to increase in the future (D. Wilda, WS pers. comm. 2012). An increasing number of requests for assistance would likely result in the escalated lethal take of deer to resolve damage and threats. After review of previous activities conducted by WS and in anticipation of a gradual increase in requests for lethal take, WS anticipates that future lethal take would not exceed 100 deer annually. In addition, WS may be requested by the RIDEM to assist with sampling and managing the spread of diseases found in free-ranging deer populations. In the case of a disease outbreak, WS could lethally take white-tailed deer for sampling and/or to prevent further spread of diseases. However, WS' total annual take would not exceed 100 deer annually under the proposed action and all take would be conducted under permits issued by RIDEM.

Table 4.10 - Known cumulative take of white-tailed deer in Rhode Island, 2006-2011

Year	Harvest Take	Depredation Permit Take	Vehicle Strikes	Total
2006	2,675	156	1,213	**4,044**
2007	2,315	86	1,095	**3,856**
2008	2,591	56	1,118	**3,765**
2009	2,945	55	1,224	**4,224**
2010	2,422	17	953	**3,392**
2011	2,569	44	1,357	**3,970**
TOTAL	**13,202**	**258**	**5,747**	**23,251**

If requested, WS could also assist with sampling and/or removing deer from captive facilities where deer are confined 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 these facilities is often increased due to their close contact with one another. Often, once a disease is detected in a confined deer herd, the entire herd is destroyed 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 RIDEM and/or the Rhode Island Department of Health. In those cases where WS is requested to assist with the removal of a captive deer herd in Rhode Island, the take would not exceed 100 deer for purposes of disease monitoring or surveillance. Deer confined inside perimeter fences for the purposes of non-traditional farming, including confined for hunting, are not included in statewide deer population estimates. However, since take of deer by WS for disease surveillance or monitoring could occur in free-ranging or captive herds, the potential take of up to 100 deer for disease surveillance and monitoring by WS would be considered as part of the impact analysis on the statewide free-ranging deer population.

From 2006 through 2011, the highest combined deer harvest, depredation take, and vehicle mortality (4,224) in Rhode Island occurred in 2009. During the same period, the lowest combined deer harvest, depredation take, and vehicle mortality (3,392) in Rhode Island occurred in 2010. If WS' take reached 100 deer during the highest known mortality of deer in the State that occurred in 2009, WS' take of 100 deer would represent 2.4% of the total known mortality in the State. If WS' take reached 100 deer during the lowest known mortality of deer in the State that occurred in 2010, WS' take of 100 deer would represent 3.0% of the total statewide mortality.

The deer population in Rhode Island has been estimated at 15,000 (RIDEM 2011*a*). If the deer population estimate provided by the RIDEM included recruitment of deer born that year, then the take of deer from all known sources in 2011 would represent 26.5% of the deer population. If WS had taken 100 deer in FY 2011, the total known mortality of deer would have been 4,070 deer. WS' take of up to 100 deer, when combined with the total known mortality in the State during 2011, would have represented 27.1% of the population. WS' take of 100 deer would have represented an increase of 0.6% when compared to the total mortality in 2011 if no take by WS had occurred (*i.e.*, 26.4% without take by WS compared to 27.1% if WS' take had been 100 deer in 2011).

The take of deer unintentionally during other activities conducted by WS is not expected to increase the potential impacts on the deer population in Rhode Island. With oversight of the RIDEM, the magnitude of take of deer by WS annually to resolve damage and threats would be low. All take by WS would continue to be reported to the RIDEM to ensure WS' activities were incorporated into deer population objectives for the State. Deer could be taken to alleviate damage through the issuance of depredation permits by the RIDEM; therefore, those deer taken by WS would likely be removed by those persons experiencing damage or threats since they could obtain permits for the lethal take of deer. Damage management activities conducted by WS would be carried out under a depredation permit issued by the RIDEM to a property owner and/or manager or directly to WS to conduct damage management activities for a property owner and/or manager. Therefore, WS' activities would be removing deer that the property owner and/or manager could remove themselves under depredation permits. Even in the event of a disease threat, those deer that would be taken by WS would likely be taken whether WS was directly involved or not. Therefore, WS' activities under the proposed action would not likely be additive to the mortality that already occurs under depredation 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 substantial increase the take that could occur in the absence of WS' direct involvement since take could occur when permitted by the RIDEM. The deer that could be taken by WS under the proposed action are likely those deer that would be taken by other entities when permitted by the RIDEM in the absence of WS' direct involvement in the activities.

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. 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 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. The reproductive inhibitor Gonacon™ is currently not registered for use in Rhode Island. Given this information and the costs associated with administering Gonacon™, WS does not anticipate the use of reproductive inhibitors for white-tailed deer in Rhode Island. However, if Gonacon™ becomes available to manage deer in the State, the use of the inhibitor could be evaluated under the proposed action as a method available that could be used in an integrated approach to managing damage. This EA would be reviewed and supplemented to the degree necessary to evaluate the use of the reproductive inhibitor as part of an integrated approach described under the proposed action.

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 RIDEM. If take by WS had reached 100 deer during 2007 when the lowest known deer harvest occurred in the State, WS' take would have represented 4.3% of the statewide harvest and 2.6% when compared to total known mortality. Based on the 2011 deer population estimate, take of up to 100 by WS would have represented 0.7% of the estimated population. WS would annually report to the RIDEM the number of deer taken. The permitting of all WS' take by the RIDEM ensures WS' take would meet the objectives of the statewide deer management plan.

Eastern Cottontail Rabbit Population Information and Effects Analysis

There are nine species of cottontail rabbits in North America, north of Mexico. Of those nine species, two species, the Eastern cottontail and New England cottontail, occur in Rhode Island. Although not native to Rhode Island, the Eastern cottontail is the most abundant and widespread of all these and is found across Rhode Island with the exception of Block Island.

Cottontails have longs ears, large hind feet, and short, fluffy tails. The coloration of the coat can range from reddish-brown to black to grayish-brown while the undersides are white. Eastern and New England cottontails look almost identical except for a slight variation in their coat colors. About half the population of Eastern cottontails possesses a small white spot on their foreheads (RIDEM 2012). The Eastern cottontail is approximately 37 to 48 cm (15 to 19 inches) in length and weighs 0.9 to 1.8 kg (2 to 4 lbs).

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, or landscaped backyards where food and cover are suitable. Eastern cottontails are rarely found in dense forest or open grasslands, but fallow crop fields may provide suitable habitat. Within these habitats, rabbits spend their entire lives in an area of 10 acres or less. Occasionally they may move a mile or so from a summer range to winter cover or to a new food supply. In suburban areas, Eastern cottontails 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). Eastern cottontails live only 12 to 15 months, yet make the most of time available reproductively. Eastern cottontails can raise as many as six litters per year of one to nine young (usually four to six), having a gestation period of 28 to 32 days. If no young were lost, a single pair together with their offspring could produce 350,000 rabbits in five years (National Audubon Society 2000).

No population estimates are available for Eastern cottontails in Rhode Island. Based on the land area of Rhode Island, there are over 267,805 ha of land in the State. If only 25% of the land area of the State has sufficient habitat to support rabbits, home ranges of rabbits do not overlap, and rabbit densities average 2.47 rabbits per ha (one rabbit per acre) (Craven 1994), a statewide rabbit population could be estimated at 165,370 rabbits. The population of rabbits within the State is likely higher than 165,370 rabbits given that rabbits occur at higher densities and rabbits can be found statewide. Therefore, the population estimated at 165,370 rabbits would be considered a minimum population estimate.

Eastern cottontails are considered a small game and furbearing animals by the RIDEM and can be harvested during the regulated hunting and trapping seasons in the fall and winter, with a daily bag limit of three cottontails, with no limit on the number of cottontails that can be possessed during the length of the season. There is no hunter or nuisance take information available for cottontails in Rhode Island. WS has not previously been requested to provide assistance associated with cottontail rabbits. Although strike risks directly associated with rabbits at airports are minimal, the presence of rabbits in areas of operations at an airport can act as attractants for other wildlife species that can pose risks of aircraft strikes, such as raptors and mammalian predators.

Based on the number of airports that have requested assistance from WS previously, WS could lethally take up to 200 Eastern cottontail rabbits annually in the State to alleviate damage or threats of damage. If the population of cottontail rabbits remains at least stable in Rhode Island, WS' take of up 200 Eastern cottontails annually would represent 0.1% of the minimum statewide population of 165,370 rabbits. Damages and threats of damages associated with cottontails most often occur in urban/suburban areas and at airports within Rhode Island where hunting is restricted or not allowed. Studies show that even if hunters take as many as 40% of the rabbits available in autumn, the rabbit population the following year would not be adversely affected because of the tremendous reproductive potential of rabbits (Fergus 2006). Therefore, WS' proposed take would not adversely affect the ability to harvest rabbits during the annual regulated hunting season in the State.

New England Cottontail Rabbit Population Information and Effects Analysis

The New England cottontail is the native cottontail of Rhode Island and originally ranged across the State with the exception of Block Island but has been largely displaced by the Eastern cottontail. New England and Eastern cottontails look almost identical except for a slight variation in their coat colors. The New England cottontails normally have a small black spot on their foreheads (RIDEM 2012). The New England cottontail has a total body length ranging from 36 to 48 cm (14 to 19 inches) and weighs 0.7 to 1.4 kg (1.5 to 3 lbs) on average.

Active at dawn and at dusk or night, the New England cottontail feeds on grasses and plant leaves in spring and summer and eats bark and twigs in winter. Home ranges vary from one-half to 8 acres, with adult males having larger home ranges than females. Research has shown that New England cottontails on patches of habitat larger than 12 acres are healthier compared to those on patches less than seven acres. Presumably, rabbits on small patches of habitat deplete their food supply sooner and have to eat lower quality food, or may need to search for food in areas where there is more risk of being killed by a predator.

No population estimates are available for New England cottontails in Rhode Island. New England cottontail populations in Rhode Island are believed to be very low and declining. The New England cottontail is listed as a Rhode Island state species of concern and is a candidate species for federal listing under the ESA.

However, the New England cottontail is still considered a small game and furbearing species by the RIDEM. At the time this EA was developed, cottontails, including New England cottontails, could be harvested during regulated hunting and trapping seasons in the fall and winter. During the season, people could harvest three cottontails daily, with no limit on the number of cottontails that could be possessed during the length of the season. Surveys conducted by the RIDEM in 2005 located New England cottontails in only a few locations and a survey conducted during 2011 failed to locate any New England cottontails. WS would consult with the RIDEM prior to initiating any projects targeting rabbits in the State and the RIDEM would provide WS with known locations of New England cottontail populations (B. Tefft, RIDEM pers. comm. 2012).

WS does not anticipate take of New England cottontails in Rhode Island, and because it is a candidate species for federal listing, no take of New England cottontails would occur on USFWS refuges. New England cottontails could potentially be taken as a non-target during damage management activities to control Eastern cottontails in Rhode Island. However, as requested by RIDEM, WS would consult with RIDEM before conducting any rabbit control activities in Rhode Island to determine if New England cottontails may be found within the project area. If New England cottontails may be in the project area, only live trapping or non-lethal methods may be utilized. Additionally, at the request of the RIDEM, WS may screen proposed cottontail damage management project sites by collecting fecal pellets for DNA analysis by RIDEM prior to initiating any control activities. At the time this EA was prepared, the RIDEM lab required approximately one week to process DNA in fecal pellets to identify cottontail species. Live captured cottontails would be identified to species, with the assistance of the RIDEM, if necessary. The RIDEM would determine the disposition of any New England cottontails live captured, either release on site or translocation.

WS would assist in survey activities to identify New England cottontail populations by providing carcasses of cottontails found dead to RIDEM for species identification. WS may also assist the RIDEM and the USFWS in efforts to monitor and enhance New England cottontail populations and their habitat.

If New England cottontail becomes federally listed as threatened or endangered, no lethal rabbit management activities would be conducted by WS in areas known or suspected to be inhabited by New England cottontails. WS would consult with RIDEM personnel and the New England Field Office (NEFO) of the USFWS website and/or personnel to determine if New England cottontails may be present in project areas, for rabbits or other species. WS would conduct formal or informal Section 7 Consultations under the ESA as necessary to eliminate or mitigate threats to New England cottontails.

Snowshoe Hare Population Information and Effects Analysis

The snowshoe hare is similar to cottontail rabbits but is generally larger, growing to be 33 to 46 cm (13 to 18 inches) in length and weighing 0.9 to 2.3 kg (2 to 5 lbs) on average. The male and female look similar except the female is slightly larger. Both the front and hind feet of the snowshoe hare are covered with thick fur (Vermont Fish and Wildlife Department 2012). The snowshoe hare also changes color from brown in the summer to white in the winter.

In Northern regions, snowshoe hares occupy conifer and mixed forests in all stages of succession, but early successional forests foster peak abundance. Deciduous forests are usually occupied only in early stages of succession. In New England, snowshoe hares preferred second-growth deciduous, coniferous, and mixed woods with dense brushy understories; they appear to prefer shrubby old-field areas, early- to mid-successional burns, shrub-swamps, bogs, and upper montane krumholz vegetation (DeGraaf et al. 1992).

In New England, snowshoe hares favor second-growth aspen-birch near conifers, but other forest types occupied by snowshoe hares includes Northern hardwoods, Eastern hemlock, and Eastern white pine. Snowshoe hares also use shrub swamps dominated by buttonbush, alders, and silky dogwood (DeGraaf and Rudis 1986, DeGraaf et al. 1992). Snowshoe hare are rare in Rhode Island and the State is at the outside fringe of the range of this animal. Some instances of recent hare activity have been traced to illegal introductions of this species (B. Tefft, RIDEM pers. comm. 2012).

In their Northern range, snowshoe hare populations tend to be highly cyclic with cycles ranging from seven to 17 years, typically 10 years. For example, in central Alberta, low snowshoe hare density occurred in 1965 with 42 to 74 snowshoe hares per 100 acres (40 ha). The population peak occurred in November 1970 with 2,830 to 5,660 snowshoe hares per 100 acres (40 ha) (Keith and Windberg 1978). In the Southern portion of its range, limited field data suggest that snowshoe hare populations do not undergo their characteristic 10-year cycles, but experience more stable dynamics at notably lower population densities (Keith 1990, Murray 2000). Murray et al. (2002) found densities of less than 0.01 per ha to 0.98 per ha in Idaho. The New York Cooperative Extension (1981) estimated winter snowshoe hare densities of 2.5 per ha in good habitat during peak years.

Based on the land area of Rhode Island, there are over 267,805 ha of land in the State. The RIDEM (2012) reports snowshoe hares are much less common than cottontail rabbits. As a result, if 5% of the land area of the State has sufficient habitat to support hares, home ranges of hares do not overlap, and hare densities average between 0.01 hares per ha, a statewide hare population could be estimated at 134 hares. The RIDEM estimates the statewide population at 250 or fewer hares (B. Tefft, RIDEM per. comm. 2012). The population of hares within the State is likely higher than 134 hares given that hares occur at higher densities and home ranges can overlap; however, it is probably 250 or lower as estimated by RIDEM. Therefore, the population estimated at 134 hares would be considered a minimum population estimate.

Based on the number of airports that have requested assistance from WS previously and the potential for requests of assistance from other entities, WS could lethally take up to 10 snowshoe hares annually in the State to alleviate damage or threats of damage. If the population of snowshoe hares remains at least stable in Rhode Island, WS' take of up 10 snowshoe hares annually would represent 4.0% of a statewide population estimated at 250 and 7.5% of the statewide population estimated at 134 snowshoe hares.

Because the statewide population is estimated to be low and due to similarities between cottontail rabbits and snowshoe hares, WS would consult with the RIDEM before conducting any hare control activities in Rhode Island, to determine if New England cottontails may be found within the project area and minimize impacts to native hare populations. If New England cottontails may be in the project area or at the request of the RIDEM, only live trapping or non-lethal methods may be utilized. Additionally, at the request of the RIDEM WS may screen proposed hare damage management project sites by collecting fecal pellets for DNA analysis prior to initiating any control activities. This analysis may be used to determine if New England cottontails are in the project area or to determine if snowshoe hares present are native or introduced. At the time this EA was prepared, the RIDEM lab required approximately one week to process DNA in fecal pellets to identify cottontail species. Live captured hares would be positively identified to species. The RIDEM would determine the disposition of any snowshoe hares live captured, either release on site or relocation.

Beaver Population Information and Effects Analysis

The North American beaver is a semi-aquatic mammal occurring in rivers, streams, lakes, reservoirs, and wetlands across North America. Beaver are large, bulky rodents whose most prominent features include a large scaly, paddle-shaped tail and orange-colored incisors (Hill 1982). Most adults weigh from 15.8 to 38.3 kg (35 to 50 lbs) with some occasionally reaching more than 45 kg (100 lbs) and are the largest North American rodents (Miller and Yarrow 1994). They range in most of Canada and the United States, with the exception of portions of Florida and the desert southwest. Beaver are active throughout most of the year and are primarily nocturnal, but can be seen during daylight hours. Beaver living along a river or large stream generally make bank burrows with multiple underwater entrances. Those in smaller streams, lakes, and ponds usually build dams and a lodge (National Audubon Society 2000). Beaver are unique in their ability to create and modify their habitat by building dams (Boyle and Owens 2007).

Beaver were trapped extensively during the 19th and part of the 20th century and as a result, disappeared from much of their range (Novak 1987), but had already been extirpated from Rhode Island during the colonial period (C. Brown, RIDEM pers. comm. 2012). Now reestablished over most of the North American continent and protected from overexploitation, the beaver population has exceeded the societal carrying capacity in some areas. Beavers reappeared in Rhode Island in the mid-1970s as part of range expansion originating in eastern Connecticut (C. Brown, RIDEM pers. comm. 2012). Dams built and maintained by beaver may flood stands of commercial timber, highways, and croplands. However, the dams also help reduce erosion and the ponds formed by the dams may create a favorable habitat for many forms of life (Hill 1982).

In Rhode Island, beaver can be found in watersheds across Providence, Kent, and Washington Counties. They are not currently found in Bristol or Newport Counties, on the islands of Narragansett Bay or Block Island. Beaver family groups are often referred to as colonies and are typically comprised of two adult parents with two to six offspring from the current or previous breeding season. The average size of a beaver family group has been documented as ranging from 3.2 to 9.2 beaver (Novak 1987). Beaver abundance has been reported in terms of families per km of rivers and streams or per km^2 of habitat. Beaver family abundance has been estimated linearly from 0.4 families per km (0.25 per mile) of river and stream habitat in Alberta, Canada to 1.2 families per km (0.74 per mile) in New York and Utah (Hill 1982, Novak 1987). Beaver population estimates by area range from 0.15 to 4.6 families per km^2 (0.39 to 11.91 families per square mile) (Hill 1982, Novak 1987).

If only half of the 2,410.8 km (1,498 miles) of rivers and streams in Rhode Island were acceptable beaver habitat and if the range of beaver was 0.4 to 1.2 beaver families per 1 km (0.62 miles) of rivers and streams, there would be 482 to 1,446 beaver families in rivers and streams. Using the lowest average family size of three beaver per family, the statewide beaver population for rivers and streams in Rhode Island could be estimated at 1,446 to 4,339 beavers.

If only half of the 501.81 km^2 (193.75 $miles^2$) of wetlands and 84.65 km^2 (32.69 $miles^2$) of lakes and ponds in Rhode Island were acceptable beaver habitat and if the range of beaver was 0.15 to 4.6 families per km^2 (0.06 to 1.78 per $mile^2$) of wetlands, lakes, and ponds, there would be 128 to 3,910 beaver families. Using the lowest average family size of three beaver per family, the statewide beaver population for rivers and streams in Rhode Island could be estimated at 382 to 11,712 beaver. The resulting total statewide beaver population could be estimated at between 1,828 and 16,068 individuals.

Beaver are managed as furbearers by the RIDEM with an annual trapping season. Take can occur by licensed trappers during the regulated season using body grip (conibear) traps and box/cage type traps. Trapping beaver requires a permit in addition to a Rhode Island trapping license. Pelts of beaver harvested by lawful methods or salvaged during the legal season that are to be sold or transferred out of state must be sealed in Rhode Island. Sealing involves having a tag affixed to the pelt at an official furbearer check station (RIDEM 2011*b*). Sealing, in combination with mandatory trapper reporting are used by the RIDEM to track beaver harvest during the trapping season. In addition, beaver can be lethally taken as a nuisance by landowners or leasee in the State when causing damage or posing a threat of damage or when permitted by the RIDEM.

WS has not previously been requested to assist with managing damage or threats of damage associated with beaver in the State. Based on anticipated requests for assistance with beaver damage management in Rhode Island, WS could lethally take up to 50 beaver annually and remove or install flow control devices in 25 beaver dams as part of an integrated damage management program.

WS anticipates an increase in the need to address damage and threats associated with beaver due to increased activity at airports and landfills, as well as current and anticipated activities on federal, state, municipal, and private property, along road and railways, and to protect T&E species from beaver flooding, tree felling, and habitat manipulation.

WS may employ dam removal or installation of flow control devices as methods to address damage by beaver flooding and human health threats related to waterborne contaminants such as Giardia and increased numbers of mosquitoes and other biting insects which act as vectors for diseases such as Eastern equine encephalitis and West Nile Virus.

As shown in Table 4.10 from 2006 through 2011, 501 beaver have been harvested or taken as a nuisance in the State (RIDEM 2011*c*, C. Brown, RIDEM, unpublished data). Nuisance take for 2011 is currently unavailable. The number of beaver taken annually in Rhode Island during the annual harvest season from 2006 to 2011 has ranged from 39 beaver taken during 2010 to 124 beaver during 2008, which is an average annual take of 77.3 beaver. From 2006 to 2010, the total number of beaver taken pursuant to nuisance permits in the state has ranged from a low of one beaver in 2007 to a high of 15 in 2010, which is an average annual nuisance take of 7.4 beaver. If harvest during the trapping season for beaver were combined with the number of beaver taken under nuisance permits from 2006 through 2011, the combined take would range from 54 beaver to a high of 125 beaver, an average of 83.5 beaver taken annually.

Table 4.10- Known cumulative take of beaver in Rhode Island, 2006-2011

Year	Harvest Take[1,2]	Nuisance Take[1,3]	WS' Take[4]	Total
2006	90	4	0	**94**
2007	124	1	0	**125**
2008	63	7	0	**70**
2009	73	10	0	**83**
2010	39	15	0	**54**
2011	75	N/A[†]	0	**75**
TOTAL	**464**	**37**	**0**	**501**

[1]Take reported by calendar year
[2]Harvest take includes those beaver reported during the trapping season
[3]Nuisance take of beaver does not include beaver lethally taken by landowners
[4]Reported by federal fiscal year
[†]Data is currently unavailable

WS' annual removal of up to 50 beaver would represent 2.7% of the lowest population estimate of 1,828 beaver statewide. The population of beaver in Rhode Island is likely greater than the low population estimate 1,828. An allowable harvest level for beaver has been estimated at 30% of the population (Novak 1987). Based on the lowest estimated population of 1,828 beaver, 30% harvest would be 548 beavers. The total annual known take of beaver in Rhode Island has not exceeded 30% of this estimated statewide population since regular harvest resumed during the trapping season in 1991. The highest annual harvests since 1991 were 148 beavers in 2002 and 147 beavers in 2004.

If the proposed take of up to 50 beaver is combined with the highest level of harvest since 1991 and highest nuisance take since 2006 of beaver in Rhode Island, the overall take would be more than 18%, below the level where a population stabilization or decline would occur. The RIDEM, as the agency with beaver management responsibility could impose restrictions on depredation and harvest as needed to assure cumulative take does not adversely affect the continued viability of populations if warranted based on population data. This should assure that cumulative impacts on beaver populations would not adversely affect the quality of the human environment.

WS may breach or remove beaver dams or install flow control devices during beaver damage management activities. WS would only utilize manual methods (*e.g.*, by hand, hand tools) to breach or remove dams. WS may utilize or request cooperators use heavy equipment, such as backhoes or trackhoes, in certain situations to remove dams or assist in installing flow control devices. Manual removal of dams requires access to the most disturbed sites in beaver habitat. Almost all activity related to manual removal of such dams occurs with 10 feet of the center of the dam. This area is always dredged, dug, and littered by the beaver's dam building activity and it is unlikely that freshwater mussels and high numbers of other aquatic animals or plants would be found in close proximity to this area. Material removed from those dams would be placed onto the bank of the water body or stream, or escapes to flow downstream. Mud and small materials such as bark and other plant debris also escapes downstream and tends to settle out within 40 to 60 feet. Small to medium limbs may drift further distances. Few large limbs are used in such dams and those that are usually remain at the dam site.

Dam breaching, removal, or installation of flow control devices are usually conducted in conjunction with local population reductions using trapping and/or shooting. As a result, changes in habitat generally have no long-term effects on local beaver populations. Some animals that escape removal may lose or have limited access to stored food caches during winter months due to lower water levels and the presence of ice. This may limit winter survival of some individuals due to starvation or increased predation risk while feeding on land. However, reductions in local populations would result in lower interspecific competition for available food resources. Dam removal or flow manipulation would have no effect on neighboring populations and would not alter habitat in a way that does not allow for future use by beaver or recolonization.

Porcupine Population Information and Effects Analysis

Porcupines are heavy-bodied, short-legged, slow rodents with a waddling gait. In Rhode Island, they are typically arboreal, spending most of their time in trees. Adults are typically 25 to 30 inches (64 to 76 cm) long and weigh 10 to 30 pounds (4.5 to 13.5 kg). They rely on their sharp, barbed quills (up to 30,000 per individual) for defense. They are found across Rhode Island with the exception of Block Island.

Porcupines are considered a non-game species by the RIDEM. WS has not received requests for assistance associated with porcupines previously. No nuisance take of porcupines has been reported to the RIDEM between 2006 and 2010. Data for 2011 is currently unavailable. However, porcupines can be lethally taken as a nuisance by landowners or leasee in the State when causing damage or posing a threat of damage or when permitted by the RIDEM.

Porcupine population densities have been observed at 12.6 porcupines per km^2 (32.5 mi^2) in Oregon (Smith 1977). Brander (1973) reported 12.4, 16.6, and 9.2 porcupines per km^2 in Michigan, and Curtis (1944) reported 9.3 porcupines per km^2 in Maine.

Population estimates for porcupine in Rhode Island are currently not available. The RIDEM reports that porcupines can be found only in the northwest corner of the State and may be one of the State’s rarest mammal species (C. Brown, RIDEM pers. comm. 2012). The land area of Rhode Island is 2,678 km^2 (1,034 mi^2). If porcupines only inhabit 10% of the land area of the State and densities occur at 9.2 porcupines per km^2, the statewide population could be estimated at nearly 2,464 porcupines. Porcupines are not found throughout the State and the estimate is intended to evaluate the magnitude of take proposed under the proposed action.

Based the lack of lethal control by WS or other entities, the general rarity of the species and lack of legal harvest and a reasonable anticipation of an increase in the number of requests for assistance, WS could lethally take up to 10 porcupines as part of an integrated damage management program. WS anticipates an increase in the need to address damage and threats associated with porcupines at airports, on federal, state, municipal, and private property, including commercial orchards and timber stands and to protect T&E plant species from predation.

If WS lethally takes 10 porcupines and if the lack of nuisance take of porcupines from 2006 through 2010 is indicative of future lethal take in Rhode Island, the total non-WS take and the proposed total WS take of porcupines evaluated in this assessment would not reach the level necessary to cause a decline in the porcupine population. WS’ take of 10 porcupines would represent 0.4% of the estimated statewide porcupine population.

Woodchuck Population Information and Effects Analysis

The woodchuck, also known as the "*groundhog*" or "*whistle pig*", is a large rodent, often seen in pastures, meadows, fields, and along highways in Rhode Island. They dig large burrows, generally 8 to 12 inches at the opening, sometimes five 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, it will feed heavily on corn and can cause extensive damage in a garden to other crops (National Audubon Society 2000). Woodchucks may also present hazards to livestock and farm equipment as a result of burrowing, jeopardize the integrity of earthen dams, gnaw buried electrical cables, and damage hoses, wiring and other accessories on automobiles by gnawing (Bollengier 1994).

The breeding season for woodchucks is usually from March through April (Bollengier 1994). Female woodchucks usually produce from four to six young (Chapman and Feldhamer 1982). 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 a 1:1 sex ratio and an average litter size of four young, they could produce over 645 woodchucks through their lifetime. Woodchuck ranges in the United States extend throughout the East, northern Idaho, northeastern North Dakota, southeastern Nebraska, eastern Kansas, northeastern Oklahoma, and south to Virginia and Alabama.

Woodchuck populations in Rhode Island are not monitored by RIDEM or WS. This species is classified as a game species in the state and there is a continuous open season with no take limit (RIDEM 2011*b*). Nuisance take reports indicate that 137 woodchucks were taken under nuisance permits in the State from 2006 through 2010 (see Table 4.11; C. Brown, RIDEM, unpublished data). Nuisance take of woodchucks for 2011 is currently not available. Four woodchucks have been killed by WS from FY 2006 through FY 2011 with three woodchucks being dispersed by WS to alleviate damage or threats of damage in Rhode Island. Based on previous requests for assistance and in anticipation of additional efforts, up to 100 woodchucks could be lethally removed to alleviate damage by WS. In addition, up to 100 burrow entrances could be treated using gas cartridges annually by WS.

Gas cartridges would be employed to fumigate woodchuck burrows in areas where damages are 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. The cartridges are placed inside active burrows at the entrance, the cartridge is ignited, and the entrance to the burrow is sealed with dirt, which allows the burrow to fill with carbon monoxide. Carbon monoxide is a method of euthanasia considered conditionally acceptable by the AVMA for free-ranging mammal species (AVMA 2007).

Table 4.11 - Known cumulative take of woodchucks in Rhode Island, 2006-2011

Year	Nuisance Take[1]	WS' Take[2]	Total
2006	18	1	**19**
2007	14	0	**14**
2008	21	1	**22**
2009	45	0	**45**
2010	39	0	**39**
2011	N/A	2	**2**
TOTAL	**137**	**4**	**141**

[1]Data reported by calendar year
[2]Reported by federal fiscal year

The number of entrances to burrow systems used by woodchucks varies. Twichell (1939) found the number of entrances to burrow systems used by woodchucks ranged from two to six entrances in Missouri with the average number being 2.8 entrances. Other studies note the number of entrances per burrow system ranged from one to five entrances (Grizzell, Jr. 1955) to high of 11 entrances per system (Merriam 1971). Merriam

(1971) found the mean number of entrances per burrow system was 2.98 entrances. The use of burrow systems is usually restricted to a male and a reproductive female (Swihart 1992, Armitage 2003). The number of woodchucks lethally removed when using gas cartridges to fumigate burrows would be based on the mean number of entrances per burrow system of approximately three entrances (Twichell 1939, Merriam 1971) and each burrow system occupied by a male and a female (Swihart 1992, Armitage 2003). The take of woodchucks would also occur using other methods, such as shooting, live traps, and body-gripping traps. However, the number of woodchucks lethally taken using gas cartridges and by other methods is not expected to exceed 100 woodchucks.

Activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced because of damage management activities conducted under the proposed action alternative aimed at reducing damage at a local site. Although population estimates and density information is currently unavailable to determine a population estimate, the limited take proposed by WS would not reach a magnitude where adverse effects would occur. The unlimited take and continuous open season for woodchucks provides an indication that densities are sufficient that overharvest is unlikely to occur.

Gray Squirrel Population Information and Effects Analysis

Gray squirrels 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. Eastern gray squirrels measure 41 to 51 cm (16 to 20 inches). They weigh from 567 g to 794 g (1.25 to 1.75 lbs) (National Audubon Society 2000).

Gray squirrels are found throughout most of the eastern United States, including Rhode Island, with the exception of Block Island. They inhabit mixed hardwood forests, especially those containing nut trees such as oak and hickory. While gray squirrels 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, and walnuts 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*).

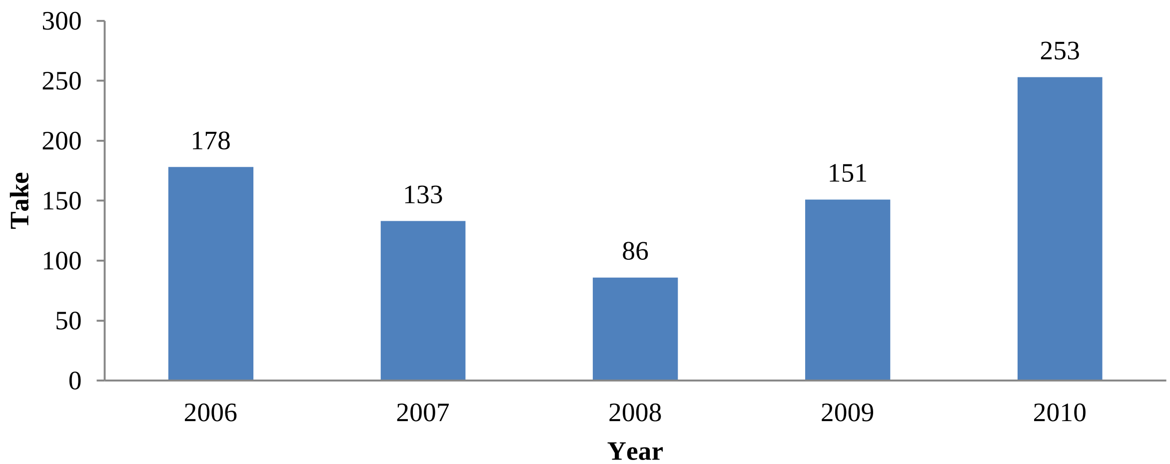
Gray squirrels produce young during early spring but may actually produce young at any time until early September (National Audubon Society 2000). Older adults may produce two litters per year (Burt and Grossenheider 1976, Jackson 1994*b*). The gestation period is 42 to 45 days, and about three young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

Gray squirrel populations periodically increase and decrease, 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 also provide prey for hawks, owls, snakes, and several mammalian predators. Predation seems to have little effect on squirrel populations. Typically, about half the squirrels in a population die each year and wild squirrels over four years old are rare, while captive individuals may live 10 years or more (Jackson 1994*b*).

Gray squirrels can be found across Rhode Island with the exception of Block Island. Gray squirrel densities fluctuate based on available food sources but long-term densities tend to be stable (Gurnell 1987). Densities of Eastern gray squirrels were reported slightly less than three per ha (1.2 per acre) in continuous woodlands in North Carolina (Barkalow et al. 1970, Manski et al. 1981). Doebel and McGinnes (1974) found gray squirrel densities in small woodlots of less than 10 ha in area can be as high as 16 squirrels per ha. In urban parks, Manski et al. (1981) found gray squirrel densities can be more than 21 squirrels per ha (8.4 per acre). A three acre park in Washington, D.C. had a density of 50 squirrels per ha (20 per acre) (Hadidian 1987). The State of Rhode Island has 267,805 ha of land area (1,034 square miles). If only 50% of the land in Rhode Island were suitable habitat for gray squirrels, under a worst case scenario, with a population density of three gray squirrels per ha, the gray squirrel population could be estimated to be approximately 401,700 squirrels in Rhode Island.

Gray squirrels are considered a small game animal by the RIDEM and at the time this EA was developed, gray squirrels could be harvested during the regulated hunting season in the fall, with a daily bag limit of five squirrels, with no limit on the number of squirrels that could be possessed during the length of the season (RIDEM 2011*b*). The number of squirrels harvested annually in the State during the regulated season is not currently available. Additionally, gray squirrels may be taken outside of the regulated hunting seasons by landowners when causing damage or under nuisance permits. There were 801 gray squirrels lethally removed to alleviate damage under nuisance permits from 2006 and 2010 (see Figure 4.2; C. Brown, RIDEM, unpublished data). The number of squirrels lethally removed under nuisance permits during 2011 is currently unavailable.

Figure 4.2 – Nuisance take of Eastern gray squirrels in Rhode Island, 2006-2010



From FY 2006 through FY 2011, WS did not receive requests for assistance associated with gray squirrels. WS may be requested to address damage being caused by squirrels. Based upon anticipated requests for WS' assistance, it is possible that WS could kill as many as 100 gray squirrels each year in the State under the proposed action alternative. Squirrels would usually be removed from populations that are not hunted. Removing this number of squirrels would be of low magnitude when compared to the statewide population of gray squirrels. Although the number of squirrels harvested annually is not known, the number of gray squirrel removed annually to alleviate damage is known and the cumulative take is not likely to reach a level where adverse effects would occur to the statewide population, including take by WS. Some local populations may be temporarily reduced because of damage management activities aimed at reducing damage at a local project site; however, statewide populations would not expected to be adversely effected by the cumulative take. The unlimited take allowed by the RIDEM during the length of squirrel hunting season provides an indication that gray squirrel population densities are not subject to overharvest.

Red Squirrel Population Information and Effects Analysis

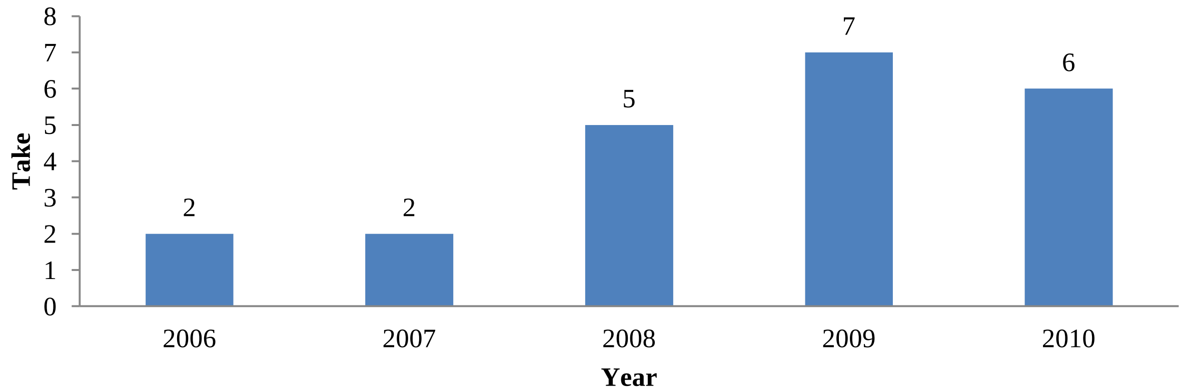
The red squirrel, also known as the chickaree, ranges across mainland Rhode Island. It is reddish brown to copper in color, with a light gray or white underbelly. They weigh between 200 to 250 grams (7 to 9 ounces) and are 25 to 36 cm (10 to 14 inches) in length. They prefer to live in coniferous forests, but also occur in mixed hardwood stands.

Red squirrels could be taken by WS during projects to manage damage to property, agricultural resources, to manage threats to human health and during wildlife hazard management, assessment, and monitoring at airports and airbases. Red squirrels may enter and cause damage to residential and non-residential buildings, garden and landscape plants, and maple syrup collection tubing.

Kemp and Keith (1970) reported densities of red squirrels ranging from 0.055 to 0.096 per ha (0.135 to 0.237 per acre) in deciduous woodlands in Alberta, Canada. The State of Rhode Island has 267,805 ha of land area (1,034 square miles). If only 25% of the land in Rhode Island were suitable habitat for red squirrels, under a worst case scenario, with a population density of 0.055 red squirrels per ha, the red squirrel population could be estimated to be approximately 3,680 squirrels in Rhode Island.

The number of red squirrels removed annually to alleviate damage has averaged 4.4 annually from 2006 to 2010 (see Figure 4.3; C. Brown, RIDEM, unpublished data). Nuisance take data is currently not available for 2011. The cumulative take is not likely to reach a level where adverse effects would occur to the statewide population, including take by WS. Some local populations may be temporarily reduced because of damage management activities aimed at reducing damage at a local project site; however, statewide populations would not expected to be adversely effected by the cumulative take.

Figure 4.3 – Nuisance take of red squirrels in Rhode Island, 2006-2010



Based upon anticipated requests for WS' assistance, it is possible that WS could kill as many as 50 red squirrels each year in the State under the proposed action alternative. Removing 50 red squirrels would represent 1.4% of the estimated statewide population annually and would be of low magnitude when compared to the estimated statewide population of red squirrels.

Southern Flying Squirrel Population Information and Effects Analysis

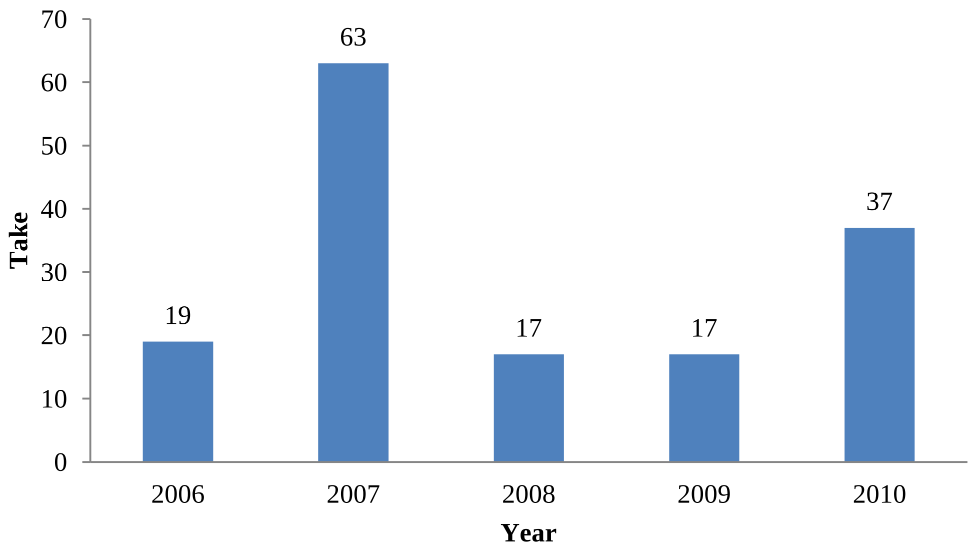
Southern flying squirrels are easily distinguished by the "*gliding membrane*", a flap of loose skin that extends from wrist to ankle. The loose skin along the side of the body is supported by cartilaginous spurs on the wrists and ankles. The soft fur on the back and tail is grey with varying amounts of grey tinge; the belly is white. The tail is dorso-ventrally flattened. The eyes are very large, probably related to the nocturnal habits and the visual requirements of gliding. Total length is 21.1 to 25.7 cm (8.3 to 10.1 inches) and weight ranges from 51 to 71 grams (1.8 to 2.5 ounces).

According to Saunders (1988), population densities of Southern flying squirrels can vary from two to 12 flying squirrels per ha (0.8 to 4.8 per acre). If only 25% of the land in Rhode Island were suitable habitat for flying squirrels, under a worst case scenario, with a population density of two flying squirrels per ha, the Southern flying squirrel population could be estimated to be approximately 133,900 in Rhode Island.

Based upon anticipated requests for WS' assistance, it is possible that WS could kill as many as 100 flying squirrels each year in the State under the proposed action alternative. Removing 100 flying squirrels would represent 0.1% of the estimated statewide population annually and would be of low magnitude when compared to the estimated statewide population of flying squirrels.

The number of flying squirrels removed annually to alleviate damage has averaged 30.6 annually from 2006 to 2010 (see Figure 4.4; C. Brown, RIDEM, unpublished data). Nuisance take data is currently not available for 2011. The cumulative take is not likely to reach a level where adverse effects would occur to the statewide population, including take by WS. Some local populations may be temporarily reduced because of damage management activities aimed at reducing damage at a local project site; however, statewide populations would not expected to be adversely effected by the cumulative take.

Figure 4.4 – Nuisance take of Southern flying squirrels in Rhode Island, 2006-2010



Flying squirrels could be taken by WS during projects to manage damage to property, agricultural resources, to manage threats to human health and during wildlife hazard management, assessment, and monitoring at airports and airbases. These species may enter and cause damage to residential and non-residential buildings, garden and landscape plants, and maple syrup collection tubing. Exposure to Southern flying squirrels has been linked to cases of epidemic typhus in humans. Typhus spread by flying squirrels is known as "*sylvatic typhus*" and the CDC has documented 39 such cases in the United States from 1976 to 2001 (Pennsylvania Department of Health 2009). The flying squirrel acts as host to the *Rickettsia prowazekii* bacteria and transmission to humans is believed to occur via lice or fleas.

Eastern Chipmunk Population Information and Effects Analysis

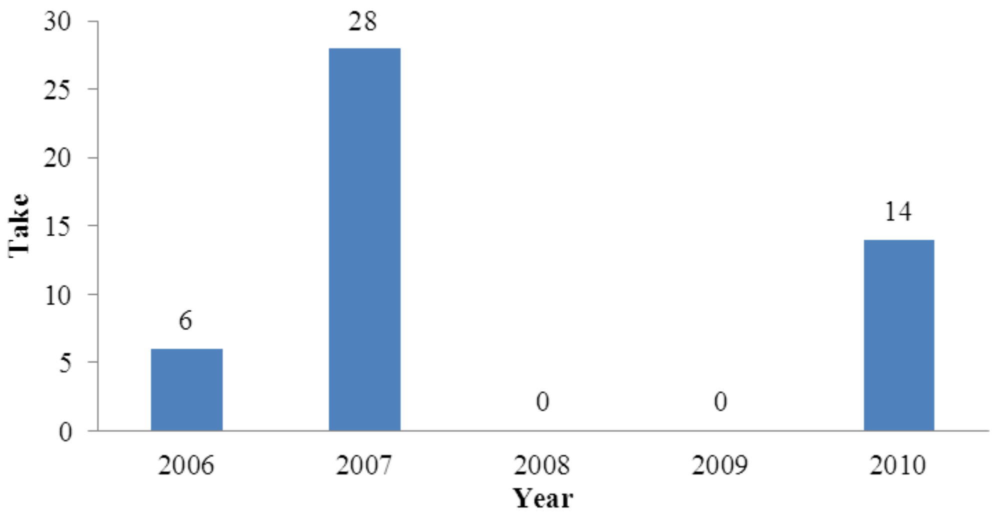
The Eastern chipmunk is a small ground squirrel. It is reddish in color with a single black stripe running down the center of its back and a white stripe running between two black stripes down each side of the body from the neck to the base of the tail with a white belly and eye stripes. They range from 20.3 to 25.4 cm (8 to 10 inches) in length and from 57 to 142 grams (2 to 5 ounces) in weight.

Population densities of Eastern chipmunks are typically 5 to 10 animals per ha (2 to 4 per acre). If sufficient food and cover are available, Eastern chipmunk population densities may be as high as 24 animals per ha (10 per acre). Home ranges often overlap among individuals (Williams and Corrigan 1994). If only 25% of the land in Rhode Island were suitable habitat for chipmunks, under a worst-case scenario, with a population density of five chipmunks per ha, the Eastern chipmunk population could be estimated to be approximately 3,680 in Rhode Island.

Based upon anticipated requests for WS' assistance, it is possible that WS could kill as many as 100 chipmunks each year in the State under the proposed action alternative. Removing 100 chipmunks would represent 0.03% of the estimated statewide population annually and would be of low magnitude when compared to the estimated statewide population of chipmunks.

The number of chipmunks removed annually to alleviate damage has averaged 9.6 annually from 2006 to 2010 (see Figure 4.5; C. Brown, RIDEM, unpublished data). Nuisance take data is currently not available for 2011. The cumulative take is not likely to reach a level where adverse effects would occur to the statewide population, including take by WS. Some local populations may be temporarily reduced because of damage management activities aimed at reducing damage at a local project site; however, statewide populations would not expected to be adversely effected by the cumulative take of chipmunks.

Figure 4.5 – Nuisance take of Eastern chipmunks in Rhode Island, 2006-2010



Muskrat Population Information and Effects Analysis

Muskrats are fairly large rodents with dense, glossy fur, dark brown above, lighter on the sides, paler below, to nearly white on the throat. They have long scaly tails which are nearly naked and laterally flattened, tapering to a point but not paddle-shaped as the beaver. The muskrat spends its life in aquatic habitats and is well adapted for swimming. Its large hind feet are partially webbed, stiff hairs align the toes and its laterally flattened tail is almost as long as its body. The muskrat has a stocky appearance, with small eyes and very short, rounded ears. Its front feet, which are much smaller than its hind feet, are adapted primarily for digging and feeding (Miller 1994).

They build houses, or lodges of aquatic plants, especially cattails, up to 2.4 m (8 feet) in diameter and 1.5 m (5 feet) high. Those structures are usually built atop piles of roots, mud, or similar support in marshy areas, streams, lakes, or along water banks. Muskrats also burrow in stream or pond banks with entrances often above the water line. Other signs of the presence of muskrats include feeding platforms built of cut vegetation in water or on ice, marked by discarded or uneaten grasses or reed cuttings, and floating blades of cattails, sedges, and similar vegetation near banks. This species is most active during crepuscular periods and at night, but may be seen at any time of the day in all seasons, especially spring. Muskrats are excellent swimmers and spend much of their time in the water. They inhabit fresh, salt, and brackish waters of marshes, ponds, lakes, rivers, and canals in most of Canada and the United States, except for Arctic regions, much of California, the southwestern United States, Texas, and Florida (National Audubon Society 2000). They can be found in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1987).

Muskrats are highly prolific and produce three to four litters per year that average five to eight young per litter (Wade and Ramsey 1986), which makes them relatively immune to overharvest (Boutin and Birkenholz 1987). Gestation period varies between 25 and 30 days. Young muskrats can reproduce the spring after their birth. Harvest rates from three to eight per acre have been reported to be sustainable in muskrat populations (Boutin and Birkenholz 1987). Muskrat home ranges vary from 529 $feet^2$ to 11,970 $feet^2$ (0.1 to

0.25 acres), with the size of muskrat home ranges depending on habitat quality and population density (Boutin and Birkenholz 1987).

The muskrat is found across Rhode Island including Block Island and are managed as furbearers by the RIDEM with an annual trapping season, which allows an unlimited number of muskrats to be harvested during the open season. Take can occur by licensed trappers during the regulated season using approved conibear and cage-type traps. Foothold and colony traps are prohibited, unless authorized by the RIDEM (RIDEM 2011*b*).

From the 2006 through 2011, the number of muskrats reported harvested annually in Rhode Island under mandatory trapper reports has ranged from 42 during 2009 to 161 during 2006 (RIDEM 2011*c*). WS conducted no lethal take of muskrat in Rhode Island during this period and there was no nuisance take reported during this period.

Based on the number of muskrats harvested from 2006 through 2011, the relatively low level of legal harvest, and a reasonable anticipation of an increase in the number of requests for assistance, WS could lethally take up to 100 muskrats per year as part of an integrated damage management program. WS anticipates the need to address damage and threats associated with muskrats on federal, state, municipal, and private property, landfills, along road and railways and to protect T&E species from predation and habitat manipulation.

No population estimates are available in Rhode Island for muskrat. Muskrat population densities have been reported at 48 muskrat per km in the Ware River watershed in neighboring Massachusetts and as low as 23 per km in Pennsylvania (Brooks and Dodge 1986) and Chulick (1979) reported 40 muskrats per km in streams adjacent to agricultural fields. Hunt (1986) estimated 98,136.3 ha (242,500 acres) of muskrat habitat out of 449,079.7 ha (1,109,700 acres) of wetlands in Maine or 21.85% of wetlands representing muskrat habitat. Hunt (1986) also noted that this was likely a low estimate and estimated the population density at 3.71 muskrats per ha (1.5 per acre).

If 50% of the 2,410.8 km (1,498 miles) of rivers and streams in Rhode Island are acceptable muskrat habitat and the low-density estimate of 23 muskrats per km (0.62 miles) of rivers and streams would result in a statewide estimate of 27,724 muskrats in rivers and streams. If 25% of the 50,181 ha (124,000 acres) of wetlands and 8,465 km^2 (22,918 acres) of lakes and ponds in Rhode Island are acceptable muskrat habitat and the density estimate of 3.71 muskrats per ha of wetlands, lakes and ponds would result in a statewide estimate of 21,992 muskrats in wetlands, lakes and ponds. The total statewide muskrat population for Rhode Island could be estimated at 49,716.

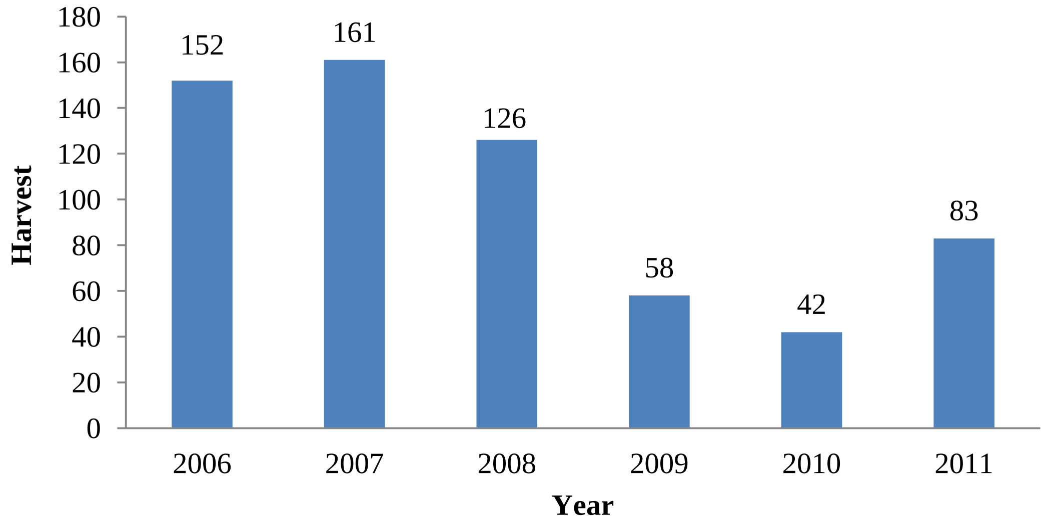
Like many other mammal species, muskrats maintain sufficient population densities in the State to all for an annual trapping season. During the trapping season, an unlimited number of muskrats can be harvested. As shown in Figure 4.6, from 2006 through 2011, 622 muskrat have been harvested in the State. There was no nuisance take during this period and nuisance take data for 2011 is currently unavailable. The number of muskrat taken annually in Rhode Island during the annual harvest season from 2006 to 2011 has ranged from 42 muskrats taken during 2009 to 161 muskrats during 2007 with an average annual take of 103.7 muskrats.

Based upon anticipated requests for WS' assistance, it is possible that WS could kill as many as 100 muskrats each year in the State under the proposed action alternative. Removing 100 muskrats would represent 0.2% of the estimated statewide population annually and would be of low magnitude when compared to the estimated statewide population of muskrats.

When combined, the average annual harvest (104) and WS' estimated annual take of 100 muskrats would represent a cumulative take of 204 muskrats annually. If the statewide population of muskrats were estimated at 49,716 individuals, the average cumulative take of 204 muskrats would represent 0.4% of the estimated population. If the highest level of annual take during the harvest season (161) were combined with the estimated annual take by WS of 100 muskrats, the highest cumulative take would be 261 muskrats. The cumulative take of 261 muskrats would represent 0.5% of a statewide population estimated at 49,716 muskrats.

Like other mammal species addressed in this EA, the unlimited take allowed by the RIDEM during the trapping season and the permitting of take to alleviate damage by the RIDEM provides an indication the RIDEM believes that muskrat populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely.

Figure 4.6 – Harvest of Muskrats in Rhode Island, 2006-2011



Black Rat Population Information and Effects Analysis

The black rat or roof rat is a species of Old World rat native to India and Southeast Asia. Today, black rats can be found throughout the world. The black rat was introduced into what is now the United States in the late 1500s to early 1600s (National Audubon Society 2000). The black rat is similar in appearance to the Norway rat, but has a longer tail and a shorter nose (Whitaker, Jr. and Hamilton, Jr. 1998).

Black rats are variable in color ranging from light brown to black. Black rats measure 32.5 to 45.5 cm (12.75 to 18 inches) in length. They weigh from 115 to 350 g (4 to 12 oz) (National Audubon Society 2000). They inhabit a variety of habitats, and thrive in human dominated landscapes. Black rats breed throughout the year, and may produce two to eight young per litter (National Audubon Society 2000). Black rats are capable of breeding at two to three months of age. A female black rat will typically have four to six litters per year, and wean approximately 20 young (Whitaker, Jr. and Hamilton, Jr. 1998). Home ranges of black rats vary greatly depending on the type of habitat in which they are found. The black rat is omnivorous, but prefers to feed on grain and seeds if they are available. Considerable damage to stored grains in the form of consumption and contamination can be done by black rats (National Audubon Society 2000). Because of their ability to climb, they often do damage to nuts and fruits while still on the tree (Whitaker, Jr. and Hamilton, Jr. 1998). Common predators of black rats are snakes, owls, dogs, and cats (National Audubon Society 2000).

The black rat is most abundant in the southern United States (National Audubon Society 2000). While in the eastern United States, the black rat is most abundant along coastal areas but can be found inland to eastern Arkansas, western Kentucky, northern Alabama, northern Georgia, North Carolina, and Virginia (National Audubon Society 2000). While black rat population estimates are difficult to determine, the species is can be locally abundant and generally considered a pest due to its proclivity to harbor diseases and compete with native species.

The black rat is one of the three commensal rodent species that occur in the United States. The others are the Norway rat and the house mouse. These three species typically have a close relationship with humans and are typically more common in populated areas. The black rat is commonly found inhabiting buildings. When found with Norway rats in the same building, black rats will generally be found higher in the building, due to their ability to climb better than Norway rats. Black rats generally nest and live in the walls of buildings (Whitaker, Jr. and Hamilton, Jr. 1998).

The status of the black rat in Rhode Island is unknown, and the RIDEM is unaware of any specimen records of the species in the State (C. Brown, RIDEM pers. comm. 2012). However, translocations of black rats from other states or countries where they do occur via shipping, aircraft, rail, or trucking could easily occur. Given the species reproductive capabilities and use of human structures for shelter, isolated populations could easily become established.

The WS program in Rhode Island has not received requests for assistance associated with black rats. Normally, requests for assistance received by WS regarding damage caused by black rats would be referred to and handled by local health departments, private entities, and/or the RIDEM. However, WS could be requested to address black rats in Rhode Island to protect T&E species from predation or competition. To protect T&E species if rats become established in areas where T&E species occur, WS could kill as many as 50 black rats each year in the State; however, determination of the exact number of rats killed during activities could be difficult when rodenticides were employed. This is because most rats that were killed by those methods would die underground or in structures. Black rats could be lethally removed in the State at any time with no limit on the number that could be removed. The number of black rats removed annually in the State would be unknown, since reporting of take would not be required for rats.

The methods that could be employed by WS under this alternative to address black rats would be live-capture methods, body-gripping traps (*i.e.*, snap traps), and rodenticides. Black rats live-captured would be euthanized using those methods and procedures addressed in WS Directive 2.505. As was mentioned previously, the actual lethal take of target individuals when using rodenticides can be difficult to estimate because most rats killed by those methods die underground or in structures. However, as stated previously, WS does not expect the total take of black rats in the State to exceed 50 rats annually. When employing rodenticides, total take of rats would be based on surveys conducted of the area to determine the local population size. The removal of black rats by WS would occur to benefit T&E species that were being negatively affected by black rats through competition for resources or from predation.

Although the status of black rats in the State is unknown, rats are generally prolific breeders and are generally locally abundant throughout their range. Additionally, populations of rats fluctuate greatly over time. Due to the species' relatively high reproductive potential and because management activities would be restricted to specific local sites, WS' activities under the proposed action would have minimal impacts on overall populations of black rats. Any removal of black rats, including complete removal of rats from a localized area, could provide some benefit to the native environment by reducing competition with native wildlife. However, any take by WS under this alternative would not reach a level that would likely adversely affect the population of black rats. WS' activities would be conducted pursuant to Executive Order 13112.

Norway Rat Population Information and Effects Analysis

Like black rats, Norway rats[12] likely originated from parts of Asia. Today, Norway rats can be found throughout the world and they were likely introduced unintentionally into North America by setters who arrived on ships from Europe. Norway rats can be found throughout the United States and southern Canada and on the Pacific coast north to Alaska.

Norway rats inhabit a variety of habitats, and thrive in human dominated landscapes. They may be found in this range wherever humans live (Timm 1994, National Audubon Society 2000). Norway rats live in close association with people (Burt and Grossenheider 1976, Timm 1994, National Audubon Society 2000), and in urban areas they live in and around residences, in cellars, warehouses, stores, slaughterhouses, docks and sewers. On farms, rats may inhabit granaries, barns, livestock buildings, silos, and kennels (Timm 1994). In

[12]Norway rats are also called the brown rat, house rat, barn rat, sewer rat, gray rat, or wharf rat.

summer, rats may inhabit cultivated fields (National Audubon Society 2000). Norway rats are more closely associated with human habitation than black rats.

Norway rats are a stocky burrowing rodent with coarse fur that is usually brownish or reddish gray above and whitish gray on the belly. Blackish individuals occur in some locations. Norway rats can measure up to 25 cm long not including the tail, which is typically the same length as the body. The average weight of Norway rats is 550 g in males and about 350 g in females (National Audubon Society 2000). Norway rats breed throughout the year, producing up to five litters per year (National Audubon Society 2000). Home ranges of Norway rats vary greatly depending on the type of habitat in which they are found.

Norway rats breed year-round (National Audubon Society 2000) but peaks occur in spring and fall. Reproductive activity typically declines during the heat of summer and often stops completely in winter, depending on habitat. The average female rat has four to six litters per year with two to 22 young per litter (Timm 1994, National Audubon Society 2000). Twelve litters per year are possible (Burt and Grossenheider 1976, National Audubon Society 2000). Gestation is 21 to 26 days. Female rats may breed again within one to two days after a litter is born (Timm 1994).

Norway rats make a network of interconnecting tunnels for nesting and are colonial. They may burrow to make nests under buildings and other structures, beneath concrete slabs, along stream banks, around ponds, in garbage dumps, and at other locations where suitable food, water, and shelter are present (Timm 1994). They are primarily nocturnal and usually become active about dusk, when they begin to forage for food and water. Some individuals may be active during daylight hours when rat populations are high. They have poor eyesight, relying more on hearing and the senses of smell, taste, and touch. They are considered color blind (Timm 1994).

Norway rats will eat nearly any type of food. When given a choice, they will select a nutritionally balanced diet, choosing fresh, wholesome items over stale or contaminated food. They prefer cereal grains, meats and fish, nuts, and some types of fruit. Food items in household garbage offer a balanced diet and satisfy their water requirements (Timm 1994). Rats often contaminate food they do not eat with droppings. They will also kill chickens and eat their eggs. They eat wild plants, insects, and seeds (National Audubon Society 2000). Common predators of Norway rats are snakes, owls, dogs, and cats (National Audubon Society 2000).

Like black rats, Norway rats are not a native species in North America. Like other rat species, Norway rats are provided no protection from lethal take, which is allowed at any time using available methods with no limit on the number that can be lethally removed. The number of Norway rats lethally taken in the State to manage damage or threats of damage is currently unknown. While Norway rat population estimates are difficult to determine, the species is abundant and generally considered a pest due to its proclivity to harbor diseases and compete with native species.

WS has provided technical assistance to three individuals associated with Norway rats from FY 2006 to FY 2011. WS has not previously received requests for direct operational assistance to manage damage caused by Norway rats. Similar to black rats, most requests for assistance received by WS regarding damage caused by Norway rats would be referred to and handled by local health departments, private entities, and/or the RIDEM. Although no previous requests for direct operational assistance have been received by WS to address Norway rats, WS anticipates being requested to assist with managing predation risks and competition associated with Norway rats to protect T&E species. If requested, WS could lethally remove up to 50 Norway rats annually in the State to protect T&E species; however, determination of the exact number of rats killed during damage management activities could be difficult if rodenticides were employed. This would be because most rats that were killed by those methods would die underground or in structures. The statewide population of Norway rats is unknown; however, Norway rats are not considered a native species in the State. Norway rats can be lethally removed in the State at any time with no limit on the number that can be removed. The number of Norway rats removed annually in the State is currently unknown.

The methods that would be primarily employed by WS under this alternative to address damage or threats of damage occurring from Norway rats would be live-capture methods, body-gripping traps (*i.e*., snap traps), and rodenticides. Norway rats live-captured would be euthanized using those methods and procedures addressed in WS Directive 2.505. As was mentioned previously, the actual lethal take of target individuals when using rodenticides can be difficult to estimate because most rats killed by those methods would die underground or in structures. However, WS does not expect the total take of Norway rats in the State to exceed 50 rats annually. When employing rodenticides, total take of rats would be based on surveys conducted of the area baited with rodenticides to determine the local population size. The removal of Norway rats is often requested to benefit native wildlife species that are being negatively affected by Norway rats through competition for resources or from predation.

As was stated previously, the statewide population of rats is unknown; however, rats can be found statewide and are considered a non-native species. Any removal of rats could be viewed as providing some benefit to the native environment. Activities conducted by WS to manage damage or threats of damage associated with Norway rats would occur pursuant to Executive Order 13112. Although the statewide population of Norway rats is unknown, the proposed take of up to 50 rats annually would not reach a level where adverse effects would occur to the statewide population given the statewide distribution. Although Norway rats could be completely removed from localized areas during efforts to reduce predation and competition between rats and native wildlife, the statewide population is not likely to be adversely affected.

White-footed Mouse Population Information and Effects Analysis

Fifteen species of native mice of the genus *Peromyscus* may be found in the United States. Two occur in New England and only one of these, the white-footed mouse, occurs in Rhode Island. Reports of the deer mouse (Hall and Kelson 1959, Hall 1981) in Rhode Island have been discounted as misidentified white-footed mice by Waters (1962). Collectively, all species of *Peromyscus* are often referred to as "*white-footed mice*" or "*deer mice*." All of the *Peromyscus* species have white feet, usually white undersides, and brownish upper surfaces. Their tails are relatively long, sometimes as long as the head and body.

The white-footed mouse is found throughout the United States east of the Rocky Mountains except in parts of the Southeast. It uses a variety of habitats including wooded and brushy areas, cultivated and open habitats, and human structures such as homes and outbuildings (National Audubon Society 2000). White-footed mice are prolific breeders and may raise several litters of one to eight young (average three to five) after a gestation period of 21 to 23 days. The young are weaned at two to three weeks of age and become sexually mature at about seven to eight weeks. Those born in spring and summer may breed the same year (Timm and Howard 1994).

White-footed mice principally cause problems by entering homes, cabins, and other structures that are not rodent-proof. They build nests, store food, and cause considerable damage to upholstered furniture, mattresses, clothing, paper, or other materials that they find suitable for nest building. They can enter parked automobiles and nest in engines, glove boxes, or other cavities damaging wires, hoses, and insulation (T. Cozine, WS pers. comm. 2012). They can also cause extensive damage in reseeding programs, causing failure of such operations by feeding on planted seeds (Timm and Howard 1994).

In addition to damage to planting efforts and human property, deer mice have been associated with two serious diseases in recent years: Lyme disease, a bacterial infection, and Hanta virus, a respiratory illness. Lyme disease is carried by deer ticks, tiny arthropods that reside on white-footed mice at the immature stage. Hanta virus appeared in New Mexico in the early 1990s and caused a number of deaths; it is carried by the deer mouse and has been found in many regions in other *Peromyscus* species, as well as in *Microtus* species (Timm and Howard 1994, National Audubon Society 2000).

Other identified damage occurs at airports within the range of deer and white-footed mice, where those species act as attractants for various mammal and avian predators, especially coyotes, fox, various hawks, and owls. Those predators often forage on airports where large populations of mice occur, and thereby present special hazards to operating aircraft, air passengers and crews (D. Wilda, WS pers. comm. 2012).

White-footed mice are classified as an unprotected non-game species in Rhode Island. No limits are set on the take of white-footed mice. In future programs, WS may be requested to address damage being caused by white-footed mice in Rhode Island to protect resources being damaged or threatened. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill as many as 50 white-footed mice each year in the State. Some local populations of those species might be reduced because of damage management activities in a specific locale.

Based upon the above information, WS' limited lethal take of white-footed mice would have no adverse impacts on overall populations of the species in Rhode Island. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of those rodents.

Vole and Lemming Population Information and Effects Analysis

Voles, also called meadow mice or field mice, are compact rodents with stocky bodies, short legs, and short tails. Their eyes are small and their ears are partially hidden. Their under fur is generally dense and covered with thicker, longer guard hairs. They usually are brown or gray, though many color variations exist (O'Brien 1994, National Audubon Society 2000). Lemmings are similar in overall appearance. There are three species of voles and one species of lemming known to occur in Rhode Island.

There are 23 species of voles and lemmings in the United States (O'Brien 1994); four of these are found in Rhode Island. The number of vole species in the genus *Microtus* in the United States is debatable depending on the source. The National Audubon Society (2000) lists 15 species in the genus while Jones et al. (1992) list 17 species in the genus. However, in Rhode Island there are only two *Microtus* species, the meadow vole and the woodland vole. The Southern red-backed vole of the genus *Myodes* and the Southern bog lemming of the genus *Synaptomys* are the other vole and lemming species found in the State.

The meadow vole is the most widely distributed *Microtus* species. Meadow voles measure 140 to 195 mm (5.5 to 7.7 inches) and weigh 33 to 65 g (1.2 to 2.3 ounces). Their fur is gray to yellow-brown, obscured by black-tipped hairs. Northern subspecies may also have some red in their fur. The under parts are gray, at times washed with silver or buff (O'Brien 1994). Meadow voles have a remarkable reproductive output and are the world's most prolific mammals. Females can breed when they are a month old and produce litters of three to 10 pups every three weeks for the rest of their lives (Smithsonian National Museum of Natural History 2012).

Woodland voles measure 105 to 145 mm (4.1 to 5.7 inches) and weigh 14 to 37 grams (0.5 to 1.3 ounces), and have reddish-brown short soft fur above with grayish, washed with buff coloration below (National Audubon Society 2000, Smithsonian National Museum of Natural History 2012). The woodland vole utilizes tunnel systems that are usually one to several inches below ground. The woodland vole is found in the eastern United States ranging from New England to central Iowa, north to central Wisconsin, and in the southern states except for most coastal areas. Habitat for the woodland vole is deciduous woodlands with thick leaf mold or thick herbaceous ground cover and sometimes park-like grassy areas (National Audubon Society 2000).

Southern red-backed voles measure 116 to 172 mm (4.6 to 6.8 inches) and weigh 6 to 42 g (0.2 to 1.5 ounces). Red-backed voles have a broad rusty or reddish band from the forehead to the rump, which may vary from dark chestnut to yellowish brown, even black. The nose and sides of the head and body are grayish washed with pale buff or yellowish. Tail is bicolored, dark brown to black above and white to gray below (Merritt 1981). They breed from March through November, producing two or three litters of four to five young each year. By three months of age, the young voles are sexually mature and ready to reproduce.

This species is semi-fossorial, using burrow systems built by other rodents and natural aboveground runways through logs, rocks, and roots of trees (Smithsonian National Museum of Natural History 2012).

Southern bog lemmings measure 94 to 154 mm (3.7 to 6.1 inches) and weigh between 21.4 to 50 g (0.8 to 1.8 ounces). The bog lemming is a small vole with small eyes, ears, and tail. The head appears large in comparison to the body and facial hairs can be raised to form a "*facial disk*" around the nose. Color ranges from bright chestnut to dark grizzled brown above and silver to light gray below. They range across Eastern North America (Linzey 1983). They live in a wide variety of habitats, including grasslands, mixed deciduous/coniferous woodlands, spruce-fir forests, and freshwater wetlands. They eat grasses, sedges, mosses, fungi, fruit, bark, and roots (Smithsonian National Museum of Natural History 2012). Southern bog lemmings are considered a species of special concern in Rhode Island.

Voles feed on a variety of green vegetation, including grasses, forbs, and tubers, and in late summer they store seeds, tubers, bulbs, and rhizomes (O'Brien 1994, National Audubon Society 2000). They eat bark at times, primarily in fall and winter, and will eat crops, especially when their populations are high. Occasional food items include snails, insects, and animal remains. Voles may cause extensive damage to orchards, ornamentals, and tree plantings due to their girdling of seedlings and mature trees while feeding on bark. This usually occurs in fall and winter. Field crops such as alfalfa, clover, grain, potatoes, and sugar beets may be damaged or destroyed by voles. Their activities on such crops may interfere with crop irrigation by displacing water and causing levees and checks to wash out. They can also ruin lawns, golf courses, and ground covers.

Voles may breed throughout the year, but most commonly in spring and summer (O'Brien 1994), and may do so all year long in the south (National Audubon Society 2000). They have one to five litters per year, and meadow voles have produced up to 17 litters per year in a laboratory (O'Brien 1994). Litter sizes range from one to 11, but usually average three to six. The gestation period is about 21 days, and young are weaned by the time they are 21 days old. Females mature in 35 to 40 days and life spans of voles are short; probably ranging from two to 16 months. In one population, there was 88% mortality during the first month of life (O'Brien 1994).

Large population fluctuations are characteristic of voles and generally peak every two to five years, but cycles are not predictable. Population densities are variable. Among meadow voles, an Ontario, Canada population ranged from 80 to 400 per ha (32 to 162 per acre) over one year, while an Illinois population ranged from 5 to 15 per ha (two to six per acre), also over one year. Much higher densities may be reached during population irruptions.

A wide variety of predators feed on voles. Voles are relatively easy for most predators to catch and are active, and therefore available, day and night, year round. Despite their vulnerability and availability, voles are not usually "*controlled*" by predators, because they have a high reproductive potential. Postpartum breeding is common and females may breed as early as one week of age. Synchronous breeding also occurs. These factors enable voles to increase at a faster rate than predators are able to reduce them (Pearson 1985).

WS has provided no technical assistance or direct operational assistance associated with voles and lemmings in Rhode Island from FY 2006 to FY 2011. Determination of numbers of voles and lemmings killed by damage management actions would be difficult when lethal chemical methods such as zinc phosphide treatments are employed. This is because most animals killed by those methods die underground. WS may conduct activities to reduce vole numbers at airports to reduce attractiveness of properties to predators and to reduce damage to orchards, landscape plants, seedlings, trees, shrubs, and other ground cover.

In future programs, WS could receive requests for assistance in reducing damage caused by voles to any resource anywhere in Rhode Island. Based upon additional efforts that could occur by WS, it is possible that WS could kill 50 meadow voles, 50 woodland voles, 50 Southern red-backed voles, and 50 Southern bog lemmings, each year in such programs, statewide. Based upon the above information, WS' limited lethal take of voles would have no adverse impacts on overall populations of vole species in Rhode Island.

Impacts to such rodents would be minimal because any rodent control would be localized, and is compensated by the high reproductive rate of those rodents.

Jumping Mouse Population Information and Effects Analysis

The meadow jumping mouse and the woodland jumping mouse are the two species of jumping mice that occur in Rhode Island. Meadow jumping mice measure 180 to 234 mm (7.1 to 9.2 inches) and weigh 12 to 30 g (0.4 to 1.1 ounces). The coarse coat has a broad dorsal band that is brown or yellowish brown darkened with brownish black hairs. The sides are paler and underparts white sometimes suffused with yellow but usually separated from the sides by a clear yellowish color. The tail is distinctly bicolor with dark brown above and yellowish white below. They have very long tails and longer hind legs than front legs, with very large hind feet. They are most common in grassy or weedy fields, where they use runways made by other rodents. If they are frightened, they may creep away through the grass, or make a series of short jumps. Meadow jumping mice have litters of three to six young after an 18-day gestation period. Most of the mice born late in the summer are not able to put on enough weight to survive hibernation. They range across North America from Alaska and across Canada and from the Midwest to the Eastern United States as far south as Alabama and Mississippi (Whitaker 1972).

Woodland jumping mice measure 210 to 255 mm (8.3 to 10.0 inches) and weigh 14 to 31 g (0.5 to 1.1 ounces). Their coarse coat has a brown to black dorsal stripe on orange, with a yellow or red tint and scattered dark guard hairs above and white below. The tail is distinctly bicolored, grayish brown above and white below usually with a white tip. Woodland jumping mice have litters of two to seven young after a 25 to 29 day gestation period. Woodland jumping mice as the name suggests are a species of woodland habitats and are rarely found in open habitat. They range throughout the Northeastern United States and Southeastern Canada (Whitaker and Wrigley 1972).

WS has provided no technical assistance or received requests for direct operational assistance associated with jumping mice in Rhode Island from FY 2006 to FY 2011. Removal of jumping mice by WS would be done primarily at airports by methods that may include trapping and the use of registered chemicals/ rodenticides (see Appendix B). Similar to voles, determination of numbers of jumping mice killed by damage management actions would be difficult when lethal chemical methods such as zinc phosphide treatments are employed. This is because most animals killed by those methods die underground. WS may conduct activities to survey for the presence of small mammals and/or reduce jumping mouse numbers at airports to reduce attractiveness of properties to predators or while investigating or managing zoonotic diseases. Projects may also be conducted to reduce damage to orchards, landscape plants, seedlings, trees, shrubs, and other ground cover.

In future programs, WS could receive requests for assistance in reducing damage caused by jumping mice to any resource anywhere in Rhode Island. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill 50 jumping mice, in any species combination, each year in such programs, statewide. Based upon the above information, WS' limited lethal take of jumping mice would have no adverse impacts on overall populations of jumping mice species in Rhode Island. Impacts to such rodents would be minimal because any rodent control would be localized, and is compensated by the high reproductive rate of those rodents.

Shrew Population Information and Effects Analysis

The shrews are small, mouse-sized mammals with elongated snouts, dense fur of uniform color, small eyes, and five clawed toes on each foot. Their skulls, compared to those of rodents, are long, narrow, and lack the zygomatic arch on the lateral side characteristic of rodents. The teeth are small, sharp, and commonly dark-tipped. Pigmentation on the tips of the teeth is caused by deposition of iron in the outer enamel. This deposition may increase the teeth's resistance to wear, an obvious advantage for permanent teeth that do not continue to grow in response to wear. Shrews are similar in appearance to mice except that mice have four toes on their front feet, larger eyes, bicolored fur, and lack an elongated snout. Shrews are also similar to moles, but are usually smaller and lack the enlarged front feet. Worldwide, over 250 species of shrews are recognized, with over 30 species recognized in the United States and Canada (Schmidt 1994). There are four species of shrews that occur in Rhode Island, the Northern short-tailed shrew of the genus *Blarina*, and the masked, smoky, and American water shrew, all of the genus *Sorex* (Hall 1981, Whitaker and Hamilton 1998). Two of these species, the smoky shrew and the American water shrew, are listed as species of concern in Rhode Island.

Northern short-tailed shrews measure 118 to 139 mm (4.6 to 5.5 inches) and weigh 18 to 30 g (0.6 to 1.1 ounces). They are are the largest shrew species occurring in Rhode Island. Their eyes are tiny and small external ears are concealed under their fur. Their noses are pointed but generally shorter and heavier than in other shrew species. Dorsal fur is soft and short and varies from slate gray in winter and paler in summer with lighter underparts. The tail is hairy and indistinctly bicolored (George et al. 1986). The northern short-tailed shrew has dark red-brown to dark chestnut coloration at the apex of the teeth and poisonous saliva that enables them to kill mice and larger prey. They often will paralyze invertebrates, such as snails, and store them alive for later eating (Whitaker and Hamilton 1998, Smithsonian National Museum of Natural History 2012). As its name implies, the short tail, 20% of total length, readily distinguishes it from shrews in the genus *Sorex*, whose tail lengths exceed 40% of total length (George et al. 1986). Short-tailed shrews have litters averaging 4.5 to 7 young and a 21 to 22 day gestation period. The northern short-tailed shrew is primarily a species of northeastern and north-central United States and adjacent southern Canada (George et al. 1986). The northern short-tailed shrew is a ubiquitous species that occupies a diversity of habitat types, including wetlands and uplands (Whitaker and Hamilton 1998). It is reported to occur in both forested and open habitats by Miller and Getz (1977). Wrigley et al. (1979) found that vegetation cover did not appear to influence short-tailed shrew presence in Manitoba. In forested communities, short-tailed shrews are less common in conifer stands (Miller and Getz 1977, DeGraaf et al. 1991). Northern short-tailed shrew population densities range from 1.6 to 121 per ha (Williams 1936, Jackson 1961) and populations occasionally crash, requiring several years to recover (Ozoga and Verne 1968).

The masked or cinereus shrew measures between 75 to 125 mm (2.3 to 4.9 inches) and weighs between 2.2 to 5.4 g (0.08 to 0.19 ounces). Masked shrews are not distinctly marked, the back is brown, the underside is grayish white, and the tail has a blackish tip. Litter size ranges from four to 10, averaging seven and young are weaned at approximately 20 days. The masked shrew is the most widely distributed shrew (Merritt 1995). Its range covers most of northern North America extending south as far down to Maryland, along the Rocky Mountains in the west, and to the Appalachians in the east. It can be found in many types of habitat like arid grasslands, moist areas, woodland, and tundra. The masked shrew mostly lives in humid areas and with high levels of vegetation to hide in. Moisture determines the abundance of this shrew. Population densities ranging from five to 18 masked shrews per ha were reported by Merritt (1995).

The smoky shrew measures between 110 to 127 mm (4.3 to 5.0 inches) and weighs between six to 11 g (0.21 to 0.39 ounces). Smoky shrews derive their name from the slate-gray or blackish gray winter coat that develops by the end of October. A spring molt, complete by late June, produces a coat of dull brown. The tail is always bicolored and grayish brown above and yellowish underneath. Females produce two to three litters per year. Litter size ranges from two to eight, averaging six. The smoky shrew ranges from southeastern Canada to across the Eastern United States as far south as northern Georgia (Saunders 1988). It can be found in many types of habitat primarily cool, shaded floors of deciduous and coniferous forests, as well as bogs, swamps and grassy areas (Owens 1984). Hamilton (1940) reported population densities of smoky shrews ranging from 62 to 124 per ha in good habitat in New York and from 12 to 35 per ha in lesser quality habitat.

The American water shrew measures between 147 to 157 mm (5.8 to 6.2 inches) and weighs between 10 to 17 g (0.35 to 0.60 ounces). Water shrews are a grey-black to blackish-brown shrew with a pointed, down-drooping nose. Water shrews have a fringe of stiff hairs along the margins of the toes, especially those of the broad hind feet, and the partially webbed hind toes are unique features adapted for aquatic environments. The reproductive biology of water shrews is poorly documented, especially for eastern populations. Litter size is five to seven and females may bear two or three litters per year. The duration of gestation and lactation is unknown. Water shrews occur from southern Alaska south and east across Canada, parts of the western, northern, and northeastern United States. The range coincides with the boreal and mixed forests. Water, as the name suggests, is the prerequisite for this shrew. Bogs, the edges of lakes and ponds, marshes, shrub swamps, rivers, and streams, even if only intermittent, provide suitable habitat. Fast-flowing cold streams may harbor the largest populations (Saunders 1988). Water shrews have been documented feeding on fish eggs in hatchery ponds (Banfield 1974) and salmon parr (Buckner 1970, Lampman 1947). No population density estimates are readily available for Northern water shrews; however, in Canada, Banfield (1974) reported that this shrew is usually uncommon but sizeable populations sometimes occur in favorable locations.

WS has provided no technical assistance or been requested to provide direct operational assistance associated with shrews in Rhode Island from FY 2006 to FY 2011. Removal of shrews by WS would be done primarily at airports by trapping. WS may conduct activities to survey for the presence of small mammals and/or reduce shrew numbers at airports to reduce attractiveness of properties to predators or while investigating or managing zoonotic diseases.

Although damage or threats involving shrews are minimal (Schmidt 1994), in future programs, WS could receive requests for assistance in reducing damage caused by shrews to any resource anywhere in Rhode Island. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill 50 shrews, in any species combination, each year in such programs, statewide. Based upon the above information, WS' limited lethal take of shrews would have no adverse impacts on overall populations of shrew species in Rhode Island. Impacts to such insectivores would be minimal because any insectivore control would be localized, and is compensated by the high reproductive rate of those insectivores.

Though population estimates are not available, these species are generally prolific breeders and are generally abundant throughout their range although densities are generally high in appropriate habitat ranging from five to 124 per ha depending on species. Additionally, populations of these species fluctuate greatly over time.

Mole Population Information and Effects Analysis

Moles may be distinguished from meadow voles, or shrews with which they are often confused by noting certain characteristics. They have a hairless, pointed snout extending nearly 13 mm (0.5 inches) in front of the mouth opening. The small eyes and the openings of the ear canals are concealed in the fur and there are no external ears. The forefeet are very large and broad, with palms wider than they are long and the toes are webbed to the base of the claws, which are broad and depressed. The hind feet are small and narrow, with slender, sharp claws. In North America, there are seven species of moles. The star-nosed mole, hairy-tailed mole, and Eastern mole occur east of the Rockies and all of those species occur in Rhode Island.

The star-nosed mole measures between 132 to 230 mm (5.2 to 9.1 inches) and weighs between 40 to 85 g (1.4 to 3.0 ounces; Smithsonian National Museum of Natural History 2012). The star-nosed mole has a rose-colored ring of fleshy, retractable tentacles surrounding its nose. This nasal disc is bilaterally symmetrical with 11 projections on each side. Equally distinct is the scaly, fleshy tail that is covered with concentric rings and short, coarse hairs. The tail, nearly as long as the combined length of the head and body, is constricted at the base, tapered at the tip, and during the winter swollen in size, when it serves as a fat storage organ. The eyes of this species are larger than the eyes of the hairy-tailed mole, and its blackish-brown to black fur is longer, the metallic sheen absent. The limbs are short, and the front feet are paddle-like with long, stout claws. The surfaces of the pinkish-colored feet possess dark scales (Saunders 1988). Litter size ranges from three to seven, averaging five. The star-nosed mole ranges from southeastern Manitoba to Labrador and Nova Scotia, south and east to southeastern Georgia. The star-nosed mole prefers damp to saturated soils, and often lives in the organic muck adjacent to water, in grassy meadows, marshes, swamps, and deciduous, coniferous, and mixed forests. Population densities may range from 25 to 30 or more star-nosed moles per ha (10 to 12 per acre) (Saunders 1988).

The hairy-tailed mole measures between 151 to 173 mm (5.9 to 6.8 inches) and weighs between 41.0 to 62.8 g (1.45 to 2.22 ounces; Smithsonian National Museum of Natural History 2012). Hairy-tailed mole fur is black or blackish-brown and has a purplish-brown sheen. The tail is short, less than 25% of total length, fleshy, slightly constricted at the base and as the name implies, covered with long coarse hairs (Hallett 1978). Litter size averages four to five (Eadie 1948, Conner 1960), but may be as high as eight (Richmond and Roslund 1949). The hairy-tailed mole ranges from southeastern Canada, throughout most of the northeastern United States, south and west into North Carolina and Ohio. The RIDEM considers the hairy-tailed mole to be uncommon to rare in the state and the distribution appears to be limited to the northwestern region of State. It was first documented in the State in 2009, but only by photograph (C. Brown, RIDEM pers. comm. 2012). Soils, rather than plant communities, determine its distribution. Its occurrence coincides with the presence of dry to moist, but never wet, sandy loams with good surface cover and sufficient moisture (Saunders 1988, Hallett 1978). Eadie (1939) found average population densities of three per ha with a maximum of 27 per ha in New Hampshire and in years of unusually high densities, 25 to 30 moles per ha (10 to 12 per acre) have been reported in New York (Hamilton, Jr. 1939).

The Eastern mole exhibits distinct sexual dimorphism, males are generally larger than females. Male Eastern moles measure 103 to 208 mm (4.06 to 8.19 inches); females measure 129 to 168 mm (5.08 to 6.61 inches). Male Eastern moles weigh 40 to 140 g (1.41 to 4.94 ounces); females weigh from 32 to 90 g (1.13 to 3.17 ounces; Smithsonian National Museum of Natural History 2012). The Eastern mole is grayish brown, darker above and paler or browner beneath and when viewed from different angles, the hair often has a silvery sheen. There is an orange strip on the belly caused by skin gland secretions, which is usually brighter in males (Schwartz and Schwartz 2001). The fur is short, fine, and directionless, it can lay flat facing forward or backward, depending on whether the animal is moving forward or backward through a tunnel (Smithsonian National Museum of Natural History 2012). Gestation is from four to six weeks and litter size ranges from two to five, young leave the nest at four weeks of age (Yate and Schmidly 1978, Schwartz and Schwartz 2001). The Eastern mole has the largest range of any North American mole, occurring from Northeastern Mexico north to the upper Midwest and Southern Ontario, Canada and east from Florida to Southern New England where favorable soils are found (Yates and Schmidly 1978, Smithsonian National Museum of Natural History 2012). However, the Eastern mole is rare in Rhode Island with a very limited distribution. The Eastern mole was first documented in the State during 2007 (C. Brown, RIDEM pers. comm. 2012). Eastern mole habitat includes loose soils containing humus in meadows, pastures, lawns, open woodlands, gardens, and stream banks. Soils must also be well drained but moist (Schwartz and Schwartz 2001). Population densities ranging from 4.9 to 7.4 Eastern moles per ha (2 to 3 moles per acre) were reported by Schwartz and Schwartz (2001) as being high, while Hartman and Krentz (1993) reported 1.3 to 3.0 Eastern moles per ha (0.5 to 1.2 per acre) in South Carolina.

WS has provided no technical assistance or received requests for direct operational assistance associated with moles in Rhode Island from FY 2006 to FY 2011. Removal of moles by WS would be done primarily at airports by trapping. WS may survey for the presence of small mammals and/or reduce mole numbers at airports to reduce attractiveness of properties to predators or while investigating or managing zoonotic diseases.

With the exception of mostly aesthetic damage to turf grass, damage and threats involving moles are minimal. However, in future programs, WS could receive requests for assistance in reducing damage caused by moles in Rhode Island. Based upon an anticipated increase for requests for WS' assistance, it is possible that WS could kill 50 moles, in any species combination, each year in such programs, statewide. Based upon the above information, WS' limited lethal take of moles would have no adverse impacts on overall populations of mole species in Rhode Island. Impacts to such insectivores would be minimal because any removal would be localized, and is compensated by limited predation due to the fossorial nature of moles.

Though population estimates are not available, these species are generally locally abundant throughout their range, although densities are generally higher in appropriate habitat. Densities of moles are generally much lower than densities for shrews and other small mammals ranging from 1.3 to 30 per ha depending on species and habitat quality.

Wildlife Disease Surveillance and Monitoring

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen if it is introduced. Effective implementation of a surveillance system would facilitate planning and execution at regional and state levels, and coordination of surveillance data for risk assessment. It would also facilitate partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups.[13]

To provide the most useful information and a uniform structure for surveillance, strategies for collecting samples could be employed. Those strategies include:

<u>Investigation of Illness/Death in Mammals</u>: A systematic investigation of illness and death in mammals may be conducted to determine the cause of the illness or death. This strategy offers the best and earliest probability of detection if a disease is introduced into the United States. Illness and death involving wildlife are often detected by or reported to natural resource agencies and entities. This strategy capitalizes on existing situations of mammals without additional mammals being handled or killed.

<u>Surveillance in Live Wild Mammals</u>: This strategy involves sampling live-captured, apparently healthy mammals to detect the presence of a disease. Mammal species that represent the highest risk of being exposed to, or infected with, the disease because of their movement patterns, or mammals that may be in contact with species from areas with reported outbreaks would be targeted. Where possible, this sampling effort would be coordinated with local projects that already plan on capturing and handling the desired mammal species. Coordinating sampling with ongoing projects currently being conducted by state and federal agencies, universities, and others maximizes use of resources and minimizes the need for additional mammal capture and handling.

<u>Surveillance in Harvested Mammals</u>: Check stations for harvestable mammal species provide an opportunity to sample dead mammals to determine the presence of a disease, and could supplement data collected during surveillance of live mammals. Sampling of mammals harvested or taken as part of damage management activities would focus on species that are most likely to be exposed to a disease.

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, hair sample, fecal sample) and the subsequent release of live-captured mammals would not result in adverse effects since those mammals are released unharmed on site. In addition, sampling of sick, dying, or mammals harvested by hunters would not result in the additive lethal take of mammals that would not have already occurred in the absence of a sampling program for diseases. Therefore, the sampling of mammals for diseases would not adversely affect the populations of any of the mammal species addressed in this EA and would not result in any take 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 requestor or from a site visit. Requestors may implement WS' recommendations, implement other actions, seek assistance from other entities, or take no action. However, those people requesting assistance would likely be those persons that would implement damage abatement methods in the absence of WS' recommendations.

[13]Data collected by organizations/agencies conducting research and monitoring will provide a broad species and geographic surveillance effort.

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

With the oversight of the RIDEM, 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 RIDEM, 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 take, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (White et al. 1989, USFWS 2001, FDA 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 take of mammals by WS would occur under this alternative. Mammals could continue to be lethally taken to resolve damage and/or threats occurring either through permits issued by the RIDEM, during the regulated hunting or trapping seasons, or without a permit as allowed in certain situations by state laws and regulations. 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 take levels similar to the proposed action.

Since mammals could still be taken 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 take that could occur since the cooperator requesting WS' assistance could conduct mammal damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with mammals could occur by other entities despite WS' lack of involvement under this alternative.

Issue 2 - Effects on Non-target Wildlife Species Populations, Including T&E Species

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

Alternative 1 - Continue the Current Adaptive Integrated Mammal Damage Management Program (No Action/Proposed Action)

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

Personnel from WS would be experienced with managing wildlife damage and would be trained in the employment of methods, which would allow WS' employees to use the WS Decision Model to select the most appropriate methods for taking targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that were as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. SOPs to prevent and reduce any potential adverse impacts 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 take 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 impacted if the area excluded was large enough. The use of auditory and visual dispersal methods to reduce damage or threats caused by mammals would also likely disperse non-targets in the immediate area the methods were employed. Therefore, non-targets may be permanently dispersed from an area while employing non-lethal dispersal techniques. However, like target species, the potential impacts on non-target species would likely be temporary with target and non-target species often returning after the cessation of dispersal methods.

Non-lethal methods that use auditory and visual stimuli to reduce or prevent damage would be intended to elicit fright responses in wildlife. When employing those methods to disperse or harass target species, any non-targets near methods when employed would also likely be dispersed from the area. Similarly, any exclusionary device constructed to prevent access by target species could also exclude access to 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 lethal take of non-targets, the use of non-lethal methods can restrict or prevent access of non-targets to beneficial resources. However, non-lethal methods would not be employed over large geographical areas and those methods would not be applied at such intensity levels that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species were unharmed. Overall, the use of non-lethal methods would not adversely affect populations of wildlife since those methods would often be temporary.

Only those repellents registered with the EPA pursuant to the FIFRA and registered for use in the State by the RIDEM would be recommended and used by WS under this alternative. Therefore, the use and recommendation of repellents would not have negative effects 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.

Other non-lethal methods available for use under this alternative would include live traps, nets, and repellents. Live traps and nets restrain wildlife once captured; therefore, those methods would be considered live-capture methods. Live traps 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 2006, WS has not used repellents to reduce mammal damage in the State. However, WS may recommend commercially available repellents when providing technical assistance or could operationally employ repellents in the future. Only those repellents registered with the EPA pursuant to the FIFRA and registered with the RIDEM would be recommended or used by WS under this alternative. The active ingredients in many commercially available repellents are naturally occurring substances (*e.g.*, capsaicin, fish oil, 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.

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

Potential impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal take 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 RIDEM or persons under their supervision under Alternative 2, 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. Non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods are generally regarded as having minimal impacts on overall populations of wildlife since individuals of those species are unharmed. Overall, potential impacts to non-targets from the use of non-lethal methods would not adversely affect populations since those methods are often temporary and do not result in lethal take. 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 take during hunting and/or trapping seasons, shooting, body-gripping traps, fumigants, rodenticides, euthanasia chemicals, and euthanasia after live-capture. Available methods and the application of those methods to resolve mammal damage is further discussed in Appendix B.

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

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

Fumigants would be used in active burrows or dens only, which would minimize risk to non-targets. Dolbeer et al. (1991) found a total of one cottontail rabbit and three mice (*Permyscus* spp.) in three of the 97 woodchuck burrows treated with gas cartridges during the late summer. During 2,064 trap nights at 86 woodchuck burrow entrances targeting small mammals, Swihart and Picone (1995) captured 99 individuals of four small mammal species, which included short-tailed shrews, meadow voles, meadow jumping mouse, 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 take from the use of fumigants would be limited.

Zinc phosphide is a toxicant used to kill rodents, lagomorphs, and nutria. Zinc phosphide is two to 15 times more toxic to rodents than to carnivores (Hill and Carpenter 1982). Secondary risks appear to be minimal to predators and scavengers that scavenge carcasses of animals killed with zinc phosphide (Tietjen 1976, Hegdal and Gatz 1977, Hegdal et al. 1980, Hill and Carpenter 1982, Johnson and Fagerstone 1994). Risks would be minimal based on: 1) 90% of the zinc phosphide ingested by rodents is detoxified in the digestive tract (Hegdal et al. 1980), 2) 99% of the zinc phosphide residues occur in the digestive tracts, with none occurring in the muscle, 3) the amount of zinc phosphide required to kill target rodents is not enough to kill most other predatory animals that consume tissue (Johnson and Fagerstone 1994).

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

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

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

Use of zinc phosphide on various types of fruit, vegetable, or cereal baits (*e.g.*, apples, carrots, sweet potatoes, oats, barley) has proven to be effective at suppressing target wildlife populations. All chemicals that could be used by WS would be registered under the FIFRA and administered by EPA and the RIDEM. Specific bait applications would be designed to minimize non-target hazards (Evans 1970). WS' personnel that use chemical methods would be certified as pesticide applicators by the RIDEM and would be required to adhere to all certification requirements set forth in FIFRA and the Rhode Island 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.

Anticoagulant rodent baits with warfarin, brodifacoum, or diphacinone as active ingredients could be used in bait stations to target small rodents. WS could utilize locking bait stations to restrict access of non-target species to rodenticides, such as anticoagulants. The use and proper placement of bait stations would minimize the likelihood that the bait would be consumed by non-target species. There may be secondary hazards from anticoagulant baits. Those risks are reduced somewhat by the fact that the predator scavenger species would usually need exposure to multiple carcasses over a period of days. Areas where anticoagulants could be used would be monitored and carcasses picked up and disposed of in accordance with label directions.

WS would monitor the take 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 RIDEM any non-target take to ensure take by WS was considered as part of management objectives established for those species by the RIDEM. The potential impacts to non-targets would be similar to the other alternatives and would be considered minimal to non-existent.

As discussed previously, the use of non-lethal methods to address damage or threats would generally be regarded as having no impact 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.

The lethal take of non-targets could result in declines in the number of individuals in a population; however, those occurrences should be infrequent and should not affect the overall populations of any species under the proposed action. Between FY 2006 and FY 2011, the unintentional take of wildlife by WS in Rhode Island during damage management activities targeting mammals did not occur. Although non-targets could be lethally taken by WS, take of individuals from any species is not likely to increase substantively above the number of non-targets taken annually by WS during previous damage management activities. In addition, those species likely to be lethally taken or live-captured during damage management activities are likely considered target species in this EA and the level of take analyzed for each species under Issue 1 would include non-target take that could occur by WS. Therefore, the take of non-target species is evaluated cumulatively under Issue 1 for those species addressed in this EA, including take that could occur when a species is considered a target or non-target. WS would continue to monitor activities, including non-target take to ensure the annual take of non-targets does not result in adverse effects to a species' population. All of the mammal species likely to be lethally taken as non-target can be harvested in the State during annual harvest seasons.

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 take of unintended species. Those occurrences would be rare and should not affect the overall populations of any species under the proposed action.

The proposed mammal damage management could benefit many other wildlife species that are affected by predation or competition for resources. For example, fox often feed on the eggs, nestlings, and fledglings of ground nesting bird species, browsing damage from deer overabundance may affect species diversity, or raccoons may feed on T&E species of mussels in a stream. This alternative has the greatest possibility of successfully reducing mammal damage and conflicts to wildlife species since all available methods could possibly be implemented or recommended by WS.

T&E Species Effects

Special efforts would be made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. SOPs to avoid effects on T&E species are described in Chapter 3 of this EA.

***Federally Listed Species* -** The current list of species designated as threatened and endangered in Rhode Island as determined by the USFWS and the National Marine Fisheries Services was obtained and reviewed during the development of this EA. Appendix C contains the list of species currently listed in the State along with common and scientific names. Based on a review of those T&E species listed in the State during the development of the EA, WS determined that activities conducted pursuant to the proposed action would not likely adversely affect those species listed in the State by the USFWS and the National Marine Fisheries Services nor their critical habitats. As part of the development of the EA, WS consulted with the USFWS under Section 7 of the ESA.

The determination has been made that on a project-by-project basis; WS would review the USFWS NEFO website, or contact the USFWS NEFO directly, to determine if federally listed T&E species could be present when a project is conducted. If, according to the website or through direct communication, there are no known instances of a listed species being present in the project area, or if the species would not be present during the period the project is to be conducted, a "*no effect*" determination would be made and the project conducted. If listed species could be present in a project area, WS would consult with the USFWS to determine if listed species were present or if listed species could reasonably be expected to be in the project area. If the determination that listed species do not occur in the project area or during the period the project would be conducted, once again, a "*no effect*" determination would be made and the project conducted.

If federally listed species were present or if species could reasonably be expected to be in the project area during the period the project would be conducted, the appropriate informal or formal Section 7 Consultation would be conducted with the USFWS. If necessary, mitigation measures would be implemented at the recommendation of the USFWS to reduce or eliminate threats to T&E species. If a request is received by WS to conduct mammal damage management activities to reduce predation on or habitat manipulation of federally listed T&E species, WS would initiate consultation for those activities, unless WS' employees are listed as subpermittees on a USFWS Regional Endangered Species Permit.

State Listed Species – The current list of State listed species designated as endangered or threatened as determined by the RIDEM was obtained and reviewed during the development of the EA (see Appendix C). Based on the review of species listed in the State, WS has determined that the proposed activities would not adversely affect those species currently listed by the State. Any activity involving State listed mammals being analyzed in this EA, specifically, the state threatened bobcat and species of concern, such as the New England cottontail, Southern bog lemming, smoky shrew and water shrew, would require prior authorization by the RIDEM through permitting or specific authorization. There is no formal regulatory protection, except for bobcats and New England cottontails for which there are closed or regulated seasons under hunting and trapping regulations and for purposes of research or other purposes could be collected or taken under the appropriate permit issued by the RIDEM. For instance, if someone wanted to conduct a small mammal survey, or other research project (C. Brown, RIDEM pers. comm. 2012). The RIDEM has concurred with WS' determination for listed species in the State.

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.

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 take when compared to the non-target take that could occur by WS under the proposed action alternative.

If requestors were provided technical assistance but do not implement any of the recommended actions and take no further action, the potential to take 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 take 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 persons 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 requestor 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 persons implementing control methods and could lead to greater take of non-target wildlife than the proposed action. When those persons experiencing damage caused by wildlife reach a level where assistance does not adequately reduce damage or where no assistance is available, people have resorted to using chemical toxicants that are illegal for use on the intended target species. The illegal use of methods often results in loss of both target and non-target wildlife (White et al. 1989, USFWS 2001, FDA 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 take of wildlife species.

The ability to reduce negative impacts 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 take.

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 taken under permits issued by the RIDEM, take would continue to occur during the regulated harvest seasons, and non-native mammal species could continue to be taken without the need for a permit. 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 the other federal, state, and private entities. Although some risks would 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 impacts 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 Methods 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 Mammal Damage Management Program (No Action/Proposed Action)

The cooperator requesting assistance would be made aware through a MOU, cooperative service agreement, 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, 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, those methods discussed in Appendix B could be integrated 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, the recommendation of harvest during hunting and/or trapping seasons, fumigants, rodenticides, and shooting. Those lethal methods available under the proposed action alternative or similar products would also be available under the other alternatives. None of the lethal methods available would be restricted to use by WS only. Euthanasia chemicals would not be available to the public but those mammals live-captured could be killed using other methods.

WS' employees who conduct activities to manage damage caused by mammals would be knowledgeable in the use of those methods available, the wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by mammals. When employing lethal methods, WS' employees would consider risks to human safety when employing those methods based on location and method. For example, risks to human safety from the use of methods would likely be lower in rural areas that are less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property could be controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at 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 activity was minimal (*e.g.*, in areas closed to the public).

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

Other live-capture devices, such as cannon nets, pose minor safety hazards to the public since activation of the device would occur by trained personnel after target species were observed in the capture area of the net. Lasers would 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 are required to attend an approved firearm safety-training course and to remain certified for firearm use, must attend a safety-training course in accordance with WS Directive 2.615. As a condition of employment, WS' employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC § 922(g)(9)). A safety assessment based on site evaluations, coordination with cooperating and local agencies (if applicable), and consultation with cooperators would be conducted before firearms were deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues were considered before firearms would be deemed appropriate for use. The use of all methods, including firearms, would be agreed upon with the cooperator to ensure the safe use of those methods. The security of firearms would also occur pursuant to WS Directive 2.615.

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

The use of immobilizing drugs would only be administered to mammals that have been live-captured using other methods or administered through injection using a projectile (*e.g.*, dart gun). Immobilizing drugs used to sedate wildlife would be used to temporarily handle and transport animals to lessen the distress of the animal from the experience. Drug delivery would likely occur on site with close monitoring of the animal to ensure proper care of the animal. Immobilizing drugs would be reversible with a full recovery of sedated animals occurring. Drugs used in capturing and handling wildlife that would be available include telazol, ketamine, and a mixture of ketamine/xylazine. 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. Meeting the requirements of the AMDUCA should prevent any adverse effects on human health with regard to this issue (see Section 1.6). SOPs that would be part of the activities conducted would include:

- All immobilizing drugs used in capturing and handling wildlife would be under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and WS.
- As determined on a state-level basis by those veterinary authorities (as allowed by AMDUCA), programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to a harvest season to avoid release of animals that may be consumed by hunters. If the use of immobilizing drugs occurred during a harvest season or during a period when the withdrawal period would overlap with a harvest season, ear tagging or other marking of animals drugged and released would occur 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 taken 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.

By following those procedures in accordance with AMDUCA, wildlife management programs would avoid any adverse effects on human health with regard to this issue.

Euthanizing chemicals would be administered under similar circumstances to immobilizing drugs. Euthanizing chemicals 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 Directives; therefore, would not be available for harvest and consumption.

All WS' personnel who handle and administer chemical methods would be properly trained in the use of those methods. Training and adherence to agency directives (see WS Directive 2.430) would ensure the safety of employees applying chemical methods. Mammals euthanized by WS or taken using chemical methods would be disposed of in accordance with WS Directive 2.515. All euthanasia would occur in the absence of the public, whenever possible, which would minimize risks. SOPs are further described in Chapter 3 of this EA.

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

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

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

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

Risks to human safety from the use of Gonacon™ would be minimal and would occur primarily to those persons injecting the deer through accidental self-injection or those persons handling syringes. To reduce the risks of accidental exposure through self-injection, the label of Gonacon™ requires the use of long sleeved shirts, long pants, gloves, socks, and shoes. In addition, injection would only occur after deer had been properly restrained to minimize accidental injection during application to the deer. The label also requires that children be absent from the area during application of the vaccine as well as a warning to women that accidental self-injection could cause infertility. WS' employees who were pregnant would not be involved with handling or injecting of the vaccine.

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 had exceeded the biological or social carrying capacity. Those areas would likely be places where hunting was prohibited or restricted (*e.g.*, in 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 take 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 seasons that are established by the RIDEM 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 RIDEM for the regulated hunting and trapping season would further minimize risks associated with hunting and trapping. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized populations of mammals would not increase those risks.

No adverse effects to human safety have occurred from WS' use of methods to alleviate mammal damage in the State from FY 2006 through FY 2011. 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.

As stated earlier, the cooperator requesting assistance would be made aware through a MOU, cooperative service agreement, or a similar document that those devices agreed upon could potentially be used on property they owned or managed. By signing a MOU, cooperative service agreement, or other similar document, the cooperator would be aware of the use of those methods on property they own or manage, which would allow them to identify any risks to human safety associated with the use of those methods.

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

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

Under a technical assistance only alternative, the use of immobilizing drugs, euthanasia chemicals, and Gonacon™ would not be available to the public. However, personnel with the RIDEM or their designated agents could use Gonacon™ under this alternative, if registered. Drugs used in capturing and handling wildlife could be administered under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and other entities, such as the RIDEM. If nets were recommended, the persons employing the net would be present at the site during application to ensure the safety of the public and operators. Although some fire and explosive 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 would 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 are 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 and to others if drift occurred during application of the product. 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 those products 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 RIDEM 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, that would be established by the RIDEM 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 RIDEM 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 take 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.

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 damage from 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, and euthanasia chemicals would not be available under this alternative to the public. However, fumigants, rodenticides, and repellents would continue to be available to those persons with the appropriate pesticide applicators license. Since most methods available to resolve or prevent mammal damage or threats would be available to anyone, the threats to human safety from the use of those methods would be similar between the alternatives. However, methods employed by those persons not experienced in the use of methods or are 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 on the Socio-cultural Elements of the Human Environment

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 Mammal Damage Management Program (No Action/Proposed Action)

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

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

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

All activities would be conducted where a request for assistance was received and only after the cooperator and WS had signed a cooperative service agreement or similar document. Some aesthetic value would be gained by the removal of mammals 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 taking those mammals would not likely be additive to the number of mammals that could be taken in the absence of WS' involvement.

WS' take of mammals from FY 2006 through FY 2011 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 taken 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 taken by the property owner or manager if WS were not involved in the action. Given the limited take 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 taken under this alternative by those entities experiencing mammal damage or threats, which would result in localized reductions in the presence of mammals at the location where damage was occurring. The presence of mammals where damage was occurring would 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 economic 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 requestor that would 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 acitons, 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 taken under this alternative in the State. Lethal take could continue to occur when permitted by the RIDEM through the issuance of permits, take could occur during the regulated harvest season, and in the case of non-regulated species, take could occur any time without the need for a permit.

Since mammals would continue to be taken 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 taken since WS' has no authority to regulate take or the harassment of mammals in the State. The RIDEM with management authority over mammals could continue to adjust all take levels based on population objectives for those mammal species in the State. Therefore, the number of mammals lethally taken annually through hunting and under permits would be regulated and adjusted by the RIDEM.

Those people experiencing damage or threats could continue to use those methods they feel appropriate to resolve mammal damage or threats, including lethal take, 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 Mammal Damage Management Program (No Action/Proposed Action)

Under the proposed action, WS would integrate methods using WS' Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, non-lethal methods would be used by WS that were generally regarded as humane. Non-lethal methods that would be available include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), translocation, exclusion devices, frightening devices, reproductive inhibitors, cage traps, foothold traps[14], nets, immobilizing drugs, and repellents.

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

Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. With the multitude of attitudes on the meaning of humaneness and the varying perspectives on

[14]Foothold traps would only be used by WS when permitted by the RIDEM pursuant to State law

the most effective way to address damage and threats in a humane manner, agencies are challenged with conducting activities and employing methods that are perceived to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of WS would be to use methods as humanely as possible to resolve requests for assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

Some methods have been stereotyped as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. For instance, a cage trap would generally be considered by most members of the public as "*humane*". Yet, without proper care, live-captured wildlife in a cage trap can be treated inhumanely if not attended to appropriately.

Therefore, the goal would be to address requests for assistance 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 are regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

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

If mammals were to be live-captured by WS, WS' personnel would be present on-site during capture events or capture devices would be checked frequently (at a minimum of once every 24 hours) to ensure mammals captured were addressed in a timely manner and to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary. Euthanasia of live-captured target mammals by WS under Alternative 1 would occur pursuant to WS Directive 2.505.

Under the proposed action, lethal methods could also be employed to alleviate or prevent mammal damage and threats, when requested. Lethal methods would include shooting, body-gripping traps, fumigants, rodenticides, euthanasia chemicals, and the recommendation of take during hunting and/or trapping seasons. In addition, target species live-captured using non-lethal methods could be euthanized by WS. WS' use of lethal control methods under the proposed action would follow those required by WS' directives (see WS Directive 2.505, WS Directive 2.430).

The euthanasia methods being considered for use under the proposed action for live-captured mammals are carbon dioxide, carbon monoxide, gunshot, and barbiturates or potassium chloride in conjunction with general anesthesia. Those methods are considered acceptable methods by the AVMA for euthanasia and the use of those methods would meet the definition of euthanasia (AVMA 2007). 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, whenever possible. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2007). WS' personnel that employ firearms to address mammal damage or threats to human safety would be trained in 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 are 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. Personnel from WS would be experienced and professional in their use of management methods. Consequently, management methods would be implemented in the most humane manner possible. Many of the methods discussed in Appendix B to alleviate mammal damage and/or threats in the State could be used under any of the alternatives by those persons experiencing damage regardless of WS' direct involvement. The only methods that would not be available to those persons experiencing damage associated with mammals would be reproductive inhibitors, immobilizing drugs, and euthanasia drugs. Therefore, the issue of humanness 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 could be perceived to be similar to humaneness issues discussed under the proposed action. This perceived similarity could 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 requestor 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 Rhode Island. Those people experiencing damage or threats associated with mammals could continue to use those methods legally available. Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods.

The humaneness of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the public to use to resolve damage and threats caused by mammals. Under Alternative 3, euthanasia or killing of live-captured animals would also be determined by those persons employing methods to live-captured wildlife.

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

The populations of several of the mammal species addressed in this assessment are sufficient to allow for annual harvest seasons that typically occur during the fall. Hunting and trapping seasons are established by the RIDEM. Those species addressed in this EA that have established hunting and/or trapping seasons include coyote, gray fox, red fox, striped skunk, raccoon, fisher, mink, long-tailed weasel, short-tailed weasel, Eastern cottontail, New England cottontail, snowshoe hare, gray squirrel, muskrat, beaver, Virginia opossum, and white-tailed deer. For many mammal species considered harvestable during hunting and/or trapping seasons, the estimated number of mammals harvested during the season is reported by the RIDEM or in published reports.

Alternative 1 - Continue the Current Adaptive Integrated Mammal Damage Management Program (No Action/Proposed Action)

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

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

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

Under the technical assistance only alternative, WS would have no direct impact on mammal populations in the State. If WS recommended the use of non-lethal methods and those non-lethal methods were employed by those persons experiencing damage, mammals would likely be dispersed from the damage area to areas outside the damage area, which could serve to move those mammals from those less accessible areas to places accessible to hunters. Although lethal methods could be recommend by WS under a technical assistance only alternative, the use of those methods could only occur after the property owner or manager received a permit from the RIDEM or when considered a non-regulated species, could be removed at any time using legally available methods. Lethal take could also occur during the annual hunting and trapping season in areas where those activities were permitted. WS' recommendation of lethal methods could lead to an increase in the use of those methods. However, the number of mammals taken under permits and during the regulated hunting/trapping seasons would be determined by the RIDEM. 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 RIDEM determines the number of mammals that may be taken during the hunting/trapping season and under permits.

Alternative 3 – No Mammal Damage Management Conducted by WS

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

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Concern has also been expressed regarding the potential effects of the proposed action and the alternatives on wetland ecosystems associated with activities that could be conducted to address beaver damage or threats. Concerns have been raised that removing and/or modifying beaver dams in an area would result in the loss of wetland habitat and the plant and animal species associated with those wetlands. In addition, concerns are often raised regarding the use of lethal methods to remove beaver to alleviate damage or threats.

If beaver were lethally removed from an area and any associated beaver dam was removed or breached, the manipulation of water levels by removing/breaching the dam could prevent the establishment of wetlands in areas where water has been impounded by beaver dams for an extended period.

Over time, the impounding of water associated with beaver dams can establish new wetlands. Because beaver dams may involve waters of the United States, the removal of a beaver dam is regulated under Section 404 of the CWA. The United States Army Corps Of Engineers and the EPA regulatory definition of a wetland (40 CFR 232.2) is: "*Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas*."

Although beaver can cause damage to resources, there can be many benefits associated with beaver and beaver activities. Beaver can provide ecological benefits associated with the creation of wetland habitats (Munther 1982, Wright et al. 2002, Rossell et al. 2005, Bergman et al. 2007, Pollock et al. 2007, Fouty 2008*a*, Fouty 2008*b*, Hood and Bayley 2008). Beaver can also provide aesthetic and recreational opportunities for wildlife observation (Wade and Ramsey 1986, Ringleman 1991), improve water quality (Muller-Schwarze and Sun 2003), and provide cultural and economic gains from fur harvest (Hill 1976, McNeely 1995, Lisle 1996, Lisle 2003).

Beaver impoundments can increase surface and groundwater storage, which can help reduce problems with flooding by slowing the downstream movement of water during high-flow events and help to mitigate the effects of drought (Fouty 2008*a*, Hey and Phillips 1995, Naiman et al. 1988, Wade and Ramsey 1986). Hood and Bayley (2008) determined that the presence of beaver could help reduce the loss of open water wetlands during warm, dry years. The presence of active beaver lodges accounted for over 80% of the amount of open water variability in the mixed-wood boreal region of east-central Alberta (Hood and Bayley 2008). Hood and Bayley (2008) also found temperature and rainfall influenced the amount of open-water wetlands, but to a much lesser extent than the presence of beaver. During wet and dry years, the presence of beaver was associated with a 9-fold increase in open water area over the same areas when beaver were absent. Hood and Bayley (2008) noted that beaver could mitigate some of the adverse effects of global warming through their ability to create and maintain areas of open water. Beaver ponds and associated wetlands can provide a potential water source for livestock, serve as basins for the entrapment of streambed silt and eroding soil (Hill 1982), and help to filter nutrients from the water; thereby, maintaining the quality of nearby water systems (Arner and Hepp 1989).

Beaver may increase habitat diversity by opening forest habitats via dam building and tree cutting, which can result in a greater mix of plant species, and different-aged plant communities (Hill 1982, Arner and Hepp 1989). The creation of standing water, edge habitat, and plant diversity, all in close proximity, can result in excellent habitat for many wildlife species (Jenkins and Busher 1979, Arner and DuBose 1982, Hill 1982, Arner and Hepp 1989, Medin and Clary 1990, Medin and Clary 1991). The wetland habitat that can be created by beaver ponds can be beneficial to some fish (primarily warm water species), reptiles, amphibians, waterfowl, shorebirds, and furbearers such as muskrats, otter, and mink (Arner and DuBose 1982, Naimen et al. 1986, Miller and Yarrow 1994). For example, in Mississippi, beaver ponds over three years in age were found to have developed plant communities valuable as nesting and brood rearing habitat for wood ducks (Arner and DuBose 1982). Reese and Hair (1976) found that beaver pond habitats were highly attractive to a large number of birds throughout the year and that the value of beaver pond habitat to waterfowl was minor when compared to other species of birds (Novak 1987). Beaver ponds can be beneficial to some T&E species. The USFWS estimates that up to 43% of T&E species rely directly or indirectly on wetlands for their survival (EPA 1995).

Under the proposed action alternative, WS could recommend and/or implement methods to manipulate water levels associated with water impounded by beaver dams to alleviate flooding damage. If the technical assistance alternative was selected, WS could recommend methods to people requesting assistance that could result in the manipulation of water levels associated with water impounded by beaver dams. WS would not be involved with any aspect of activities associated with beaver dams under the no involvement by WS alternative. Methods that would generally be available under all the alternatives would include exclusion devices and water flow devices (see Appendix B for additional information). In addition, the use of backhoes or other mechanical methods could be employed by property owners or managers to remove or breach beaver dams under any of the alternatives; however, WS would not operationally employ backhoes or other large machinery to remove or breach dams.

Exclusion devices and water control systems have been used for many years to manipulate the level of water impounded by beaver dams with varying degrees of success (United States General Accounting Office 2001). Landowner management objectives play a role in how the efficacy of a level system is perceived (Nolte et al. 2001). Nolte et al. (2001) found that survey respondents classified pond levelers installed to manage wetlands for waterfowl habitat more successful than levelers installed to provide relief from flooding. Langlois and Decker (1997) reported that "*...very few beaver problems...can actually be solved with a water level control device*" with a 4.5% success rate in Massachusetts and a 3% success rate in New York. Nolte et al. (2001) reported only 50% of installed pond levelers in Mississippi met landowner objectives and found that pond levelers placed in sites with high beaver activity more frequently failed if installed without implementing population control measures. Higher success rates have been reported for newer exclusion and water control systems ranging from 87% to 93% (Callahan 2005, Boyles 2006, Simon 2006, Boyles and Owens 2007). Lisle (2003) reported the use of water control devices or a combination of a Beaver Deceiver™ and flow management device virtually eliminated the need for maintenance and beaver removal at 20 sites where clogged culverts and flooded roads had previously been a routine issue.

When using exclusion and water control systems, those methods must be specifically designed to meet the needs of each site (Langlois and Decker 1997). Consequently, devices installed by inexperienced individuals may have a higher failure rate than those installed by a professional (Lisle 1996, Callahan 2003, Boyles 2006, Simon 2006, Spock 2006). Higher success rates reported for newer exclusion and water control devices may be indicative of increased understanding of the kinds of situations where those devices work best. For example, Callahan (2005) noted that exclusion and water control systems installed at culvert sites were more successful than similar systems installed at freestanding dams. Callahan (2003) and Callahan (2005) also provided a list of sites that were not well suited to the use of exclusion or water control devices. Boyles (2006) and Boyles and Owens (2007) reported some of the highest success rates for newer exclusion and water control systems; however, those devices were only tested at culvert sites.

Beaver build dams to raise water levels to meet their needs for security and access to forage. While pond levelers allow for the retention of some water, if the water level does not meet the needs of the beaver, they may move a short distance upstream or downstream and build a new dam, or abandon the area (Callahan 2003, Langlois and Decker 2004, Clemson University 2006). This may merely result in moving the problem to a new landowner or, depending upon site characteristics, the resulting pond may result in new or increased damage problems for the original landowner. McNeely (1995) reported the most common reasons cited for lack of success of water flow devices were clogging caused by debris or silt and beaver construction of additional dams upstream or downstream of the management device. In a study by Callahan (2005), construction of a new dam upstream or downstream of a pond leveler device was the most common cause of failure for free-standing dams (*e.g.*, dams not associated with a culvert or other similar constriction in water flow, 11 of 156 sites). Callahan (2005) also found that insufficient pipe capacity (6 sites), dammed fencing (2 sites), and lack of maintenance (2 sites) were also causes for pond leveler failures. Nolte et al. (2001) also reported the need to address problems with dams upstream or downstream of a device. At culvert sites, Callahan (2005) found a lack of maintenance was the primary cause of failure with culvert exclusion devices (4 of 227 sites). Callahan (2005) also found vandalism resulted in the failure of a culvert device at one of the sites. At two culvert sites, Callahan (2005) found dammed fencing reduced or completely impeded the operation of exclusion devices.

Most pond levelers and exclusion devices require maintenance. The amount of maintenance required can vary considerably among sites, depending on site conditions and the type of device (Nolte et al. 2001, Callahan 2005, Boyles 2006, Spock 2006). Stream flow, leaf fall, floods, and beaver activity can continuously bring debris to the intake of a water control device. Ice damage and damage from debris washed downstream during high water events may also trigger the need for maintenance (*e.g*., cleaning out the intake pipe). Although most exclusion and water control devices generally require some level of maintenance, there are reports of devices that have remained effective for a period of years with no maintenance (Nolte et al. 2001). Nolte et al. (2001) reported that post-installation maintenance had been performed by property owners or managers on 70% of the 20 successfully operating Clemson pond levels installed by WS in Mississippi. The most common action was to adjust the riser on the pipe to manipulate water levels. Other maintenance included removal of vegetation and secondary dams built after the installation of the devices. In a survey of individuals who had received assistance with exclusion and water control devices, Simon (2006) found 18 of 36 survey respondents reported maintaining their devices, while installation program staff monitored an additional 10 devices. Of those survey respondents, Simon (2006) found that 61% reported that routine maintenance took 15 minutes or less while 93% reported that maintenance took a half hour or less. Boyles (2006) reported that time spent in device maintenance ranged from one to 4.75 hours per year.

Installation and upkeep of water control devices vary from site to site. For example, transporting materials over long distances in difficult terrain to install devices in remote locations where road access is not available could increase costs compared to the ability to transport materials for installation at a culvert site along a roadway. Callahan (2005) reported that the average cost for an exclusion fence at a culvert was $750 with an average annual maintenance cost of approximately $200. Flexible leveler pipe systems cost an average of $1,000 to install and $100 per year in maintenance, while the average cost to install a combination fence and leveler was $1,400 with approximately $150 per year in maintenance (Callahan 2005). Over a ten-year period, Callahan (2005) estimated the cost of installation and annual maintenance would range from $200 to $290 per year depending on the device installed. Spock (2006) reported that exclusion and/or water control device installation cost ranged from < $600 to over $3,000 dollars, with slightly more than half the systems (58.2%) ranging between $600 and $1,000 to install. In many cases, Spock (2006) found the cost included the first year of maintenance. The more expensive installations tended to be extensive fence and leveler systems or systems with numerous leveler pipes (Spock 2006). Boyles (2006) reported that device installation cost an average of $1,349 per device and $3,180 per site with subsequent annual maintenance cost averaging $19.75 per site per year (Boyles 2006). However, unlike the study by Callahan (2005) the devices evaluated by Boyles (2006) had only been in place for a relatively short time (average time in place 15 months, range 6 to 22 months versus average time in place 36.6 months, range 3 to 75 months). The cost of maintenance may vary over time as site conditions change.

Alternative 1 - Continue the Current Adaptive Integrated Mammal Damage Management Program (No Action/Proposed Action)

Manipulation of water levels associated with water impoundments caused by beaver dams could be addressed by WS under the proposed action using either dam breaching, dam removal, or the installation of water flow devices, including exclusion devices. Those methods allow dams to be breached or removed to maintain the normal flow of water. Heavy equipment, such as backhoes or bulldozers, would not be used by WS to breach, remove, or install water flow devices, although heavy machinery could be utilized by a cooperator or their agents. WS may utilize small all terrain or amphibious vehicles and/or watercraft for transporting personnel, equipment, and supplies to worksites.

The breaching or removal of dams could be conducted by hand. Breaching would normally be conducted through incremental stages of debris removal from the dam that allows water levels to be gradually lowered. Breaching of dams would normally occur to limit the potential for flooding downstream by gradually allowing water levels to lower as more of the dam was breached over time. Breaching also minimizes the release of debris and sediment downstream by allowing water to move slowly over or through the dam. Depending on the size of the impoundment, water levels could be slowly lowered over several hours or days when breaching dams. When breaching dams, only that portion of the dam blocking the stream or ditch channel would be altered or breached, with the intent of returning water levels and flow rates to historical levels or to a level that eliminates damage threats or habitat alteration that would be acceptable to the property owner or resource manager. Similar to breaching dams, the removal of the dam removes the debris impounding water and restores the normal flow of water.

Beaver dams would generally be breached or removed by hand with a rake or power tools (*e.g.*, a winch). In addition to dam breaching and removal, water flow devices and exclusion methods would also be available for WS to employ during direct operational assistance or to recommend during technical assistance. Several different designs of water flow devices and exclusion methods would be available; however, the intent of all those methods would be to lower water levels by allowing water to flow through the beaver dam using pipes and wire mesh. After installation, beaver dams would be left intact with water levels maintained at desired levels by adjusting the water flow device. Water flow devices and exclusion methods allow beaver to remain at the site and maintain the beaver dam.

Although dams could be breached/removed manually, those methods can be usually ineffective because beaver could quickly repair or replace the dam if the beaver were not removed prior to breaching or removing the dam (McNeely 1995). Damage may be effectively reduced in some situations by installing exclusion and water control devices. Exclusion and water control devices can be designed so that the level of the beaver-created water impoundment can be managed to eliminate or minimize damage from flooding while retaining the ecological and recreational benefits derived from beaver impounding water over time. For example, WS may recommend modifications to site and culvert design (Jensen et al. 1999) as a non-lethal way of reducing problems with beaver dams at culverts.

Manipulating water levels impounded by beaver dams under the proposed action alternative would generally be conducted to maintain existing stream channels and drainage patterns, and to reduce water levels to alleviate flooding. WS could be requested to assist with manipulation of a beaver dam to alleviate flooding to agricultural crops, timber resources, public property, such as roads and bridges, private property, areas flooded because of beaver dams constructed on adjacent property, and water management structures, such as culverts. The intent of breaching or removing beaver dams would not be to drain established wetlands. With few exceptions, requests for assistance received by WS would involve breaching or removing dams to return an area to the condition that existed before the dam had been built, or before the impounded water had been affecting the area long enough for wetland characteristics to become established.

Most activities conducted by WS in Rhode Island would not have the potential to affect wetlands, since those activities would not be conducted near or in wetlands. In addition, those methods available for use to alleviate damage associated with mammals do not result in habitat changes or ground disturbances. However, WS' activities related to wetlands, such as beaver dam removal, would be conducted according to federal and state laws and guidelines enacted to minimize impacts to such habitats, and to provide guidance for such conduct. In addition, landowners would be required to obtain the appropriate permits for removal of beaver dams of certain specifications and types specified by law, in order that regulatory agency oversight might be able to determine effects for such actions. Further, WS does not remove dams in established wetlands except to restore mitigation wetlands, but does so in instances, and at sites, where normal drainage may be restored to reduce damage and effects on natural habitat or other human resources.

Under this alternative, water levels would be manipulated to return streams, channels, dikes, culverts, and canals to their original function. Most requests to alleviate flooding from impounded water would be associated roads, crops, merchantable timber, pastures, and other types of property or resources that were not previously flooded. Most dams removed would have been created because of recent beaver activity. WS' personnel receive most requests for assistance associated with beaver dams soon after affected resource owners discover damage. During the six-year period, FY 2006 through FY 2011, no dams were removed by WS.

Upon receiving a request to manipulate the water levels in impoundments caused by beaver dams, WS would visually inspect the dam and the associated water impoundment to determine if characteristics exist at the site that would meet the definition of a wetland under section 404 of the Clean Water Act (40 CFR 232.2). If wetland conditions were present at the site, the entities requesting assistance from WS would be notified that a permit might be required to manipulate the water levels impounded by the dam and to seek guidance from the RIDEM, the EPA, and/or the United States Corps of Engineers pursuant to State laws and the Clean Water Act. If the area does not already have hydric soils, it usually takes several years for them to develop and a wetland to become established; this often takes greater than 5 years as indicated by the Swampbuster provision of the Food Security Act. Most beaver dam removal by WS would occur under exemptions stated in 33 CFR parts 323 and 330 of Section 404 of the Clean Water Act or parts 3821 and 3822 of the Food Security Act. However, manipulating water levels associated with some beaver dams could trigger certain portions of Section 404 that require landowners to obtain permits from the United States Army Corps of Engineers prior to removing a blockage. WS' personnel would determine the proper course of action upon inspecting a beaver dam impoundment. Appendix D describes the procedures used by WS to assure compliance with the pertinent laws and regulations.

The manipulation of water impoundment levels by WS through dam breaching, dam removal, or installation of water flow devices would typically be associated with dams constructed from recent beaver activity and would not have occurred long enough to take on the qualities of a true wetland (*i.e.* hydric soils, hydrophytic vegetation, and hydrological function). WS' activities associated with beaver dam breaching, beaver dam removal, or the installation of flow control device would only be conducted to restore the normal flow of water through drainages, streams, creeks, canals, and other watercourses where flooding damage was occurring or would occur. Beaver dam breaching or removal would not affect substrate or the natural course of streams.

In the majority of instances, beaver dam removal would be accomplished by manual methods (*i.e*., hand tools). WS' personnel would not utilize heavy equipment, such as trackhoes or backhoes, for beaver dam removal. Only the portion of the dam blocking the stream or ditch channel would be breached or removed. In some instances, WS would install water flow devices to manage water levels at the site of a breached beaver dam. Dams would be breached or removed in accordance with exemptions from Section 404 permit requirements established by regulation or as allowed under nationwide permits granted under Section 404 of the Clean Water Act (see Appendix D). The majority of impoundments that WS removes would be in existence for only a few months. Those impoundments would not be considered wetlands as defined by 40 CFR 232.2; therefore, those impoundments would not possess the same wildlife habitat values as established wetlands.

In those situations where a non-federal cooperator had already made the decision to breach or remove a beaver damage to manipulate water levels with or without WS' assistance, WS' participation in carrying out the action would not affect the environmental status quo.

Additional concern has been raised relating to the lethal removal of beaver by WS or the recommendation of lethal methods to alleviate damage or threats of damage under the proposed action alternative. Beaver lethally removed could be replaced by other beaver requiring additional assistance later. Houston (1995) indicated that beaver tend to reoccupy vacant habitats. The likelihood that a site would be recolonized by beaver varies depending on many factors. For example, removal of beaver and a beaver dam from a relatively uniform section of irrigation canal may resolve the problem for an extended period because the relatively uniform nature of the canal does not predispose a site to repeat problems. Recolonization would also depend on the proximity and density of the beaver population in the surrounding area. Isolated areas or areas with a lower density of beaver would normally take longer for beaver to recolonize than areas with higher beaver densities. Activities conducted under the proposed action would be directed at specific beaver and/or beaver colonies and would not be conducted to suppress the overall beaver population in the State.

In accordance with WS Directive 2.101, preference would be given to non-lethal methods where practical and effective. Although use of exclusion and water control devices could greatly reduce the need for lethal beaver removal, beaver removal may still be needed in some situations even though a flow device or water control system had been installed (Wood et al. 1994, Nolte et al. 2001, Simon 2006, Spock 2006). Callahan (2005) states the trapping of beaver to alleviate damage should occur "*...where a flow device is either not feasible or fails, the water level needs to be drastically lowered, or the landowner wants no beavers or ponds* *on their property*". Spock (2006) reported that beaver had to be trapped out of one site when an exclusion system was augmented by the installation of a water control device. Lisle (1996) noted that it might be necessary to remove beaver that have learned to dam around exclusion and water control devices. In some instances, trapping during the annual trapping season for beaver continued to occur at or near the area where water control devices were installed but was not prompted by the failure of the devices (Lisle 1996, Simon 2006, Spock 2006).

Exclusion and water control devices may not be the most effective method in specific types of terrain and are not suitable for every site (Wood et al. 1994, Nolte et al. 2001, Langlois and Decker 2004, Callahan 2005). Exclusion devices and water control devices may not be suitable for man-made, uniform channels. For example, exclusion devices and water control devices many not be suitable for agricultural drainage ditches and irrigation canals; reservoirs; areas where human health, property or safety would be threatened with even minor elevation in water level; and areas where the landowner has expressed zero tolerance for beaver activity on their property (Callahan 2003, Callahan 2005, Simon 2006). Water control devices may be ineffective in beaver ponds in broad, low-lying areas because even a slight increase in water depth can result in a substantial increase in the area flooded (Organ et al. 1996). Exclusion and water control systems would not resolve problems related to beaver construction of bank dens. Depending upon site characteristics, beaver may build bank dens instead of lodges by burrowing into banks, levees, and other earthen impoundments. When bank dens are built in earthen levees or in banks supporting roadways or railroad tracks, they can greatly weaken the earthen structure. Burrowing into embankments can weaken the integrity of impoundments. Burrows allow water to infiltrate embankments, which can allow water to seep through the embankments causing erosion and weakening water impoundments. In those situations, removal of the beaver (either by translocation or by lethal methods) could be the only practical solution to resolve the potential for damage.

Water control devices may also be inappropriate in areas that are managed for aquatic species that need free-flowing water conditions and gravel substrate to survive. The still water and silt that accumulates behind beaver dams can be detrimental to some species. In addition, beaver dams could impede the movement of fish upstream. Avery (2004) found the removal of beaver dams resulted in substantial increases in the stream area where trout could be found. For example, a 9.8-mile treatment zone on the North Branch of the Pemebonwon River in Wisconsin and an additional 17.9 miles of seven tributaries to the treatment section of the river were maintained free of beaver dams since 1986. In 1982, prior to dam removal, wild brook trout were found in only four of the seven tributaries within the treatment zone and at only four of the 12 survey stations. In the spring of 2000, wild brook trout were present in all seven tributaries and at all 12 survey stations (Avery 2004). In some cases, water control devices could be modified to improve fish passage (Close 2003). Although the presence of beaver dams could be detrimental to some species of fish, some fish species may benefit from the presence of a beaver dam (Rossell et al. 2005, Bergman et al. 2007, Pollock et al. 2007).

Although beaver can serve a valuable role in wetland ecology, the presence of beaver dams in intensively managed wetlands could be a concern to property owners or managers. In those areas, man-made water control structures are used to manage the water level in the wetland area in order to maximize habitat value for waterfowl and specific types of wetland-dependent wildlife (USDI 2008). While general elevations or reductions in water levels might conceivably be achieved by installing pipe systems through beaver dams, the devices tend to be more difficult to adjust than the water control structures. More importantly, the primary difficulty comes when drawdowns are used to achieve wetland management objectives. Drawdowns generally involve reducing the water level until large sections of mudflat are exposed. Many plant species valuable to waterfowl and other wetland bird species need exposed mudflats to sprout. Shorebirds use the mudflats to forage for invertebrates (USDI 2008). Once the plants have matured, the water level can be gradually increased until approximately half of the marsh has open water and half has standing plants (USDI 2008). Drawdowns may also be used in fall as a means of eliminating invasive fish (USDI 2008). The extent of the water level reduction conflicts with the beaver's desire for water deep enough to provide protection, and water area of sufficient extent to provide relatively easy access to foraging sites. The extent of the water level reduction during a drawdown would likely increase the risk of new dam creation in other locations that may cause new problems (Callahan 2003).

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

The issue regarding the effects on wetlands under this alternative would likely be similar to wetlands issues discussed under the proposed action. This similarity would be based on WS' recommendation of methods to manage damage caused by beaver and the recommendation of methods to manage the water impounded by beaver dams. Based on information provided by the person requesting assistance or based on site visits, WS could recommend that a landowner or manager manipulate beaver dams to reduce flooding damage or threats of damage. WS would not be directly involved with conducting activities associated with the manipulation of beaver dams under this alternative. However, the recommendation of the use of methods would likely result in the requestor employing those methods or employing an agent to employ them. Therefore, by recommending methods and thus a requester employing those methods, the potential for those methods to reduce the presence of impounded water would be similar to the proposed action.

WS could instruct and demonstrate the proper use and placement of flow control and exclusionary devices, as well as recommend the breaching or removal of beaver dams, when appropriate. WS would also assist requestors by providing information on permit requirements and which municipal and state agencies need to be contacted by the requester to obtain appropriate permits to manipulate the levels of water impounded by beaver dams.

The efficacy of methods employed by a cooperator would be based on the skill and knowledge of the requester or their agent despite WS' recommendations or demonstration. Therefore, a lack of understanding of the behavior of beaver along with inadequate knowledge and skill in using methodologies to resolve flooding could lead to incidents with a greater probability of unforeseen impacts to wetlands. In those situations, the potential for dam manipulation to adversely affect the status of wetlands would likely to be regarded as greater than those discussed in the proposed action.

WS would recommend the landowner or manager seek and obtain the proper permits to manipulate water levels impounded by beaver dams under this alternative; however, WS would not be responsible for ensuring that appropriate permits were obtained, proper methods were implemented for manipulating water levels, or for reviewing sites for the presence of T&E species. Those responsibilities would be incurred by the property owner/manager and/or their designated agent who may or may not properly follow WS' recommendations.

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of managing water levels associated with beaver dam impoundments. Under the no involvement by WS alternative, WS would not be involved with any aspect of managing damage associated with beaver in the State, including technical assistance. Due to the lack of involvement in managing damage caused by beaver, no impacts to wetlands would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage due to flooding from manipulating water levels associated with beaver dams in the absence of WS' assistance. Those methods described previously would be available to other entities to breach or remove dams, including water flow devices. The direct burden of implementing permitted methods would be placed on those persons experiencing damage.

Since the same methods would be available to resolve or prevent beaver damage or threats related to beaver dams, effects on the status of wetlands in the State from the use of those methods would be similar between the alternatives. However, manipulating water levels by those persons not experienced in identifying wetland characteristics or unaware of the requirement to seek appropriate permits to alter areas considered as a wetland, could increase threats to wetlands and the associated flora and fauna.

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 mammal damage management in the State under Alternative 1 and Alternative 2. 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 analyzed below 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 RIDEM, activities of each agency and the take 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. Methods employed in an integrated approach to reduce damage and threats are categorized into non-lethal and lethal methods. As part of an integrated 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 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. Non-lethal methods would be given priority when addressing requests for assistance (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed 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. Non-lethal methods could be used to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse mammals from an area resulting in a reduction in the presence of those mammals at the site where those methods were employed. However, mammals responsible for causing damage or threats could be moved to other areas with minimal impacts occurring to those species' populations. Non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species would be unharmed. The use of non-lethal methods would not have cumulative effects on mammal populations in the State.

Lethal methods could be employed to resolve damage associated with those mammals identified by WS as responsible for causing damage or threats to human safety only after receiving a request and only after a permit had been issued for the take of the species by the RIDEM, when required. The use of lethal methods could therefore 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 would be employed 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 RIDEM to ensure activities were within management objectives for those species. WS would submit annual activity reports to the RIDEM. The RIDEM would monitor the total take of mammals from all sources and would factor in survival rates from predation, disease, and other mortality data. WS would also monitor take by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take was maintained below the level that would cause undesired adverse effects to the viability of native species populations. The potential cumulative impacts on the populations of target mammal species from the implementation of the proposed action alternative were analyzed for each species in Section 4.1.

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on mammal populations when targeting those species responsible for damage at the levels addressed in this EA. WS' actions would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but would not be limited to:

- Natural mortality of mammals
- Mortality through vehicle strikes, aircraft strikes, and illegal harvest
- Human-induced mortality of mammals through private damage management activities
- Human-induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of mammal populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage would be constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. WS uses the Decision Model to evaluate damage occurring, including other affected elements and the dynamics of the damaging species; to determine appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over statewide mammal populations, the RIDEM could adjust take levels, including the take of WS, to ensure population objectives for mammals were achieved. Consultation and reporting of take by WS would ensure the RIDEM considers any activities conducted by WS.

WS' take of mammals in Rhode Island from FY 2006 through FY 2011 was of a low magnitude when compared to the total known take of those species and the populations of those species. The RIDEM considers all known take when determining population objectives for mammals and could adjust the number of mammals that could be taken during the regulated hunting/trapping season and the number of mammals taken for damage management purposes to achieve the population objectives. Any take by WS would occur at the discretion of the RIDEM. Any mammal population declines or increases would be the collective objective for mammal populations established by the RIDEM through the regulation of take. Therefore, the cumulative take of mammals annually or over time by WS would occur at the desire of the RIDEM as part of management objectives for mammals in the State. No cumulative adverse effects on target and non-target wildlife would be expected from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on wildlife

Damage management activities associated with mammals would be conducted by WS 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 mammals in Rhode Island have not reached a magnitude that would cause adverse effects to mammal populations in the State.

SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on mammals, and have been tailored to respond to changes in wildlife populations that could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alterations in programs 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 on Non-target Wildlife Species Populations, Including T&E Species

Potential effects on non-target species from conducting mammal damage management arise from the use of non-lethal and lethal methods to alleviate or prevent those damages. The use of non-lethal methods during activities to reduce or prevent damage caused by mammals has the potential to exclude, disperse, or capture non-target wildlife. However, the effects of non-lethal methods are often temporary and often do not involve the take (killing) of non-target wildlife species. When using exclusion devices and/or repellents, both target and non-target wildlife can be prevented from accessing the resource being damaged. Since exclusion and repellents do not involve lethal take, 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 often be expensive and require constant maintenance to ensure effectiveness. Similarly, repellents can require constant re-application 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 take (killing) of non-target species and similar to exclusionary methods would not be used to the extent or at a constant level that would prevent non-targets from accessing critical resources that would threaten survival of a population.

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

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

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according with WS' Directives and relevant federal, state, and local regulations. Chemical methods available for use under the proposed action would include repellents, reproductive inhibitors, rodenticides, immobilizing drugs, euthanasia chemicals, fumigants, and gas cartridges, 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 baits often requires an acclimation period using untreated bait 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 Rhode Island 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 Rhode Island when used according to label requirements.

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

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

The methods described in Appendix B all have a high level of selectivity and could be employed using SOPs to ensure minimal impacts to non-target species. No non-targets were taken by WS during mammal damage management activities has been limited and has not reached a magnitude where adverse effects would occur from FY 2006 through FY 2011. Based on the methods available to resolve mammal damage and/or threats, WS does not anticipate the number of non-targets taken to reach a magnitude where declines in those species' populations would occur. Therefore, take under the proposed action of non-targets would not cumulatively affect non-target species.

On a project by project basis, WS would review the USFWS NEFO and RIDEM websites and/or contact the USFWS NEFO and RIDEM directly to determine if federally or state listed T&E species could be present when a project is conducted. If, according to the websites or through direct communications, there are no known instances of a listed species being present in the project area, or if the species would not be present during the period the project is to be conducted, a "*no effect*" determination would be made and the project conducted. If listed species could be present, WS would consult with the USFWS and/or the MDFW to determine if listed species are or could reasonably be expected to be in the project area. If the determination that listed species do not occur in the project area or during the period the project would be conducted, once again, a "*no effect*" determination would be made and the project conducted.

If federally listed species were present or if species could reasonably be expected to be in the project area during the period the project was conducted, the appropriate informal or formal Section 7 Consultation would be conducted with the USFWS. If necessary, mitigation measures would be implemented at the recommendation of the USFWS to reduce or eliminate threats to T&E species. If a request is received by WS to conduct large rodent damage management activities to reduce predation on or habitat manipulation of federally listed T&E species, WS would initiate consultation for those activities.

If state listed species were determined to be present or possibly present at a project site, WS would consult with RIDEM and implement requested mitigation measures to reduce or eliminate direct threats to state listed species. Additionally, based on a review of the proposed activities, WS has determined some activities to manage beaver flooding may have an effect on state listed species. Before conducting installation of flow control devices or dam removal, WS would consult and in necessary be permitted by the RIDEM. To screen for additional potential impacts to rare wetland wildlife habitat, WS would review NHESP town maps of Estimated Habitats of Rare Wildlife. These maps show habitat that is based on documented occurrences of rare wetlands wildlife within the last 25 years. Estimated Habitat maps are also available from local Conservation Commissions, in the Natural Heritage Atlas, and from Mass GIS.

Issue 3 - Effects of Damage Management Methods 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, cooperative service agreement, or other comparable document between WS and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or take wildlife. Firearms used to alleviate or prevent damage, though hazards do exist, would be employed to ensure the safety of employees and the public.

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

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

WS has received no reports or documented any adverse effects to human safety from WS' damage management activities conducted from FY 2006 through FY 2011. No cumulative adverse 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 on the Socio-cultural Elements of the Human Environment

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

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

Mammal population objectives would be established and enforced by the RIDEM through the regulation of take during the statewide harvest seasons. Therefore, WS would have no direct impact on the status of mammal populations since all take by WS occurs at the discretion of the RIDEM. Since those persons seeking assistance could remove mammals from areas where damage was occurring when permitted by the RIDEM, 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 humans. Mortality is high among wildlife populations and specific individuals among a species may experience death early in life. Mortality in wildlife is a natural occurrence and humans who form affectionate bonds with animals would 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 and Koepke 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 (Parkes 1979, Lefrancois 1999).

Some mammals with which humans 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 adverse effects on this element of the human environment.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked and monitored at least every 24 hours to ensure any wildlife confined or restrained were addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured mammals would be applied according to WS' directives. Shooting would occur in some situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of mammals taken by this method.

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

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

As discussed in this EA, the magnitude of WS' mammal take for damage management purposes from FY 2006 through FY 2011 was low when compared to the total take of mammals and when compared to the estimated statewide population of those species. Since all take of mammals is regulated by the RIDEM, take by WS that would occur annually and cumulatively would occur pursuant to mammal population objectives established in the State. WS' take of mammals (combined take) annually to alleviate damage would be a minor component to the known take that occurs annually during the harvest seasons.

The populations of several mammal species are sufficient to allow for annual harvest seasons that typically occur during the fall. Hunting and trapping seasons are established by the RIDEM. Those species addressed in this EA that have established harvest seasons include: Eastern and New England cottontail, snowshoe hare, gray fox, red fox, gray squirrel, raccoon, coyote, mink, muskrat, striped skunk, Virginia opossum, short-tailed and long-tailed weasel, beaver, fisher, and white-tailed deer.

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

Issue 7 – Effects of Beaver Removal and Dam Manipulation on the Status of Wetlands in the State

Beaver build dams primarily in smaller riverine streams (intermittent and perennial brooks, streams, and small rivers) and in drainage areas with dams consisting of mud, sticks, and other vegetative materials. Their dams obstruct the normal flow of water and typically change the pre-existing hydrology from flowing or circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment. The depth of bottom sediment depends on the length of time an area is covered by water and the amount of suspended sediment in the water.

The pre-existing habitat and the altered habitat have different ecological values to the fish and wildlife native to an area. Some species would abound by the addition of a beaver dam, while others would diminish. For example, some fish species require fast moving waters over gravel or cobble beds, which beaver dams can eliminate, thus reducing the habitat's value for these species. In general, it has been found that wildlife habitat values decline around bottomland beaver impoundments because trees are killed from flooding and mast production declines. On the other hand, beaver dams can potentially be beneficial to some species of fish and wildlife such as river otter, neotropical birds, and waterfowl.

If a beaver dam is not breached and water is allowed to stand, hydric soils and hydrophytic vegetation eventually form. This process can take anywhere from several months to years depending on pre-existing conditions. Hydric soils are those soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. In general, hydric soils form much easier where wetlands have preexisted. Hydrophytic vegetation includes those plants that grow in water or on a substrate that is at least periodically deficient in oxygen because of excessive water content. If these conditions are met, then a wetland has developed that would have different wildlife habitat values than an area that has been more recently impounded by beaver dam activity.

The intent of most dam breaching is not to drain established wetlands. With few exceptions, requests from public and private individuals and entities that WS receives involve dam breaching to return an area back to its pre-existing condition within a few years after the dam was created. If the area does not have hydric soils, it usually takes many years for them to develop and a wetland to become established. This often takes greater than five years as recognized by the Swampbuster provisions. Most beaver dam removal by WS is either exempt from regulation under Section 404 of the CWA as stated in 33 CFR Part 323 or may be authorized under the United States Army Corps of Engineers Nationwide Permit System in 33 CFR Part 330.

However, the breaching of some beaver dams can trigger certain portions of Section 404 that require landowners to obtain permits from the United States Army Corps of Engineers. WS' personnel determine the proper course of action upon inspecting a beaver dam impoundment.

It should also be noted that beaver created wetlands are dynamic and do not remain in one state for indefinite periods. Large beaver ponds may eventually fill with sediment and create a beaver meadow. Beaver may be removed from an area due to natural predation or they may abandon an area due to lack of food. Once a dam is abandoned, it is subject to natural decay and damage due to weather. The dam would eventually fail and the wetland would return to a flowing stream or brook. WS' beaver management activities may accelerate or modify these natural processes by removing beaver and restoring or increasing water flow; however, they are generally processes that would occur naturally over time.

Therefore, the activities of WS to manage flooding damage by manipulating beaver dams would not be expected to have any cumulative adverse effects on wetlands in Rhode Island when conducted in accordance with the CWA and the Swampbuster provision of the Food Security Act.

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS AND REVIEWERS

Timothy S. Cozine, CWB®, USDA-WS, Staff Wildlife Biologist, Amherst, MA
Monte Chandler, USDA-WS, State Director, Amherst, MA
Ryan Wimberly, USDA-WS, Environmental Management Coordinator, Madison, TN

5.2 LIST OF PERSONS CONSULTED

Charles Brown, RIDEM, Division of Fisheries and Wildlife, Kingston, RI
Brian Tefft, RIDEM, Division of Fisheries and Wildlife, Kingston, RI
Martin Wencek, RIDEM, Freshwater Wetlands Program, Office of Water Resources, Providence, RI
Anthony Tur, USFWS, New England Field Office, Concord, NH
Michael Elliott, USACE, Regulatory Division, Concord, MA

APPENDIX A
LITERATURE CITED

ABC. 2011. Domestic cat predation on birds and other wildlife. http://www.abcbirds.org/abcprograms/policy/cats/materials/CatPredation2011.pdf. Accessed July 23, 2012.

Anderson, E.M. 1987. A critical review and annotated bibliography of literature on the bobcat. Special Report Number 62, Colorado Division of Wildlife, Denver, Colorado.

Anderson, D.W., J.O. Kieth, G.R. Trapp, F. Gress, and L.A. Moreno. 1989. Introduced small ground predators in California brown pelican colonies. Colonial Waterbirds 12:98-103.

Apa, A., D. Uresk, and R. Linder. 1991. Impacts of black-tailed prairie dog rodenticides on nontarget passerines. Great Basin Nat. 51:301-309.

Archer, J. 1999. The Nature of grief: The evolution and psychology of reactions to loss. Taylor & Francis/Routledge, Florence, Kentucky. 317 pp.

Armitage, K.B. 2003. Marmots (*Marmota monax* and allies). Pp 188-210 *in* G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds. Wild Mammals of North America: Biology, Management, and Conservation. The Johns Hopkins University Press, Baltimore, Maryland.

Arner, D. H. 1964. Research and a practical approach needed in management of beaver and beaver habitat in the Southeastern United States. Transactions of the North American Wildlife Conference 29:150-158.

Arner, D. H., and J. S. DuBose. 1982. The impact of the beaver on the environment and economics in the southeastern United States. International Congress of Game Biologists 14:241-247.

Arner, D. H., and G. R. Hepp. 1989. Beaver pond wetlands: A southern perspective. Pp 117-128 *in* L. M. Smith, R. L. Pederson, and R. M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock, Texas.

AVMA. 1987. Panel report on the colloquium on recognition and alleviation of animal pain and distress. Journal of the American Veterinary Medical Association, 191:1186-1189.

AVMA. 2003. Position statement on abandoned and feral cats. AVMA Membership Directory and Resource Manual. Shaumburg, Illinois, 2003:74.

AVMA. 2004. Animal welfare forum: Management of abandoned and feral cats. Journal of the American Veterinary Medical Association. Vol. 225, No. 9, November 1, 2004.

AVMA. 2007. AVMA guidelines on euthanasia. American Veterinary Medical Association. http://www.avma.org/issues/animal_welfare/euthanasia.pdf. Accessed on February 2, 2009.

AVMA. 2009. Position on abandoned and feral cats. http://www.avma.org/issues/policy/animal_welfare/feral_cats.asp. Accessed May 9, 2012.

Avery, E. L. 1992. Effects of removing beaver dams upon a northern Wisconsin brook trout stream. Wisconsin Department of Natural Resources Final D-J Project Report, F-83R, 185 pp.

Avery, E. L. 2004. A compendium of 58 trout stream habitat development evaluations in Wisconsin – 1985-2000. Wisconsin Department of Natural Resources Research Report 187. 96 pp.

Banfield, A.W.F. 1974. The Mammals of Canada. University of Toronto Press, Toronto, Ontario, Canada.

Barkalow, Jr., F.S., R.B. Hamilton, and R.F. Soots, Jr. 1970. The vital statistics of an unexploited gray squirrel population. The Journal of Wildlife Management 34:489-500.

Barrows, P.L. 2004. Professional, ethical, and legal dilemmas of trap-neuter-release. Journal of the American Veterinary Medical Association 225:1365–1369.

Beaver, B.V., W. Reed, S. Leary, B. McKieran, F. Bain, R. Schultz, B.T. Bennett, P. Pascoe, E. Shull, L. C. Cork, R. Francis-Floyd, K.D. Amass, R. Johnson, R.H. Schmidt, W. Underwood, G.W. Thorton, and B. Kohn. 2001. 2000 Report of the AVMA panel on euthanasia. Journal of the American Veterinary Medical Association 218:669-696.

Bekoff, M. 1982. Coyote. Pp 447–459 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, Maryland. 1147 pp.

Beran, G.W. 1994**.** Handbook of zoonoses. CRC Press, Boca Raton, Florida. 1,168 pp.

Bergman, D., D. Nolte, and J. Taylor. (comp.). 2007. Proceedings of the International Beaver Ecology and Management Workshop. USDA, APHIS, WS, Arizona State Office, 8836 North 23rd Ave. Suite 2, Phoenix AZ 85021.

Berryman, J.H. 1991. Animal damage management: Responsibilities of various agencies and the need for coordination and support. Proc. East. Wildl. Damage Control Conf. 5:12-14.

Berthier, K., M. Langlais, P. Auger, and D. Pontier. 2000. Dynamics of a feline virus with two transmission modes within exponentially growing host populations. Proc. Biol. Sci. 267: 2049–2056.

Bevan, D.J., K.P. Chandroo, and R.D. Moccia. 2002. Predator control in commercial aquaculture in Canada. http://www.cdc.gov/rabies/bats/education/index.htmlhttp://www.aps.uoguelph.ca/aquacentre/files/misc-factsheets/Predator%20Control%20in%20Commercial%20Aquaculture%20in%20Canada.pdf. Accessed March 29, 2012.

Bishop, R.C. 1987. Economic values defined. Pp 24-33 *in* D. J. Decker and G. R. Goff, eds. Valuing wildlife: Economic and social perspectives. Westview Press, Boulder, Colorado. 424 pp.

Blanton, J.D, D. Palmer, J. Dyer, and C.E. Rupprecht. 2011. Rabies surveillance in the United States during 2010. Journal of the American Veterinary Medical Association 239:773–783.

Blundell, G.M., J.W. Kern, R.T. Bowyer, and L.K. Duffy. 1999. Capturing river otters: a comparison of Hancock and leg-hold traps. Wildlife Society Bulletin 27:184-192.

Boggess, E.K. 1994*a*. Raccoons. Pp C101-C107 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Boggess, E.K. 1994*b*. Mink. Pp C89-C92 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Bollengier, Jr., R.M. 1994. Woodchucks. Pp B183-B187 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Boutin, S., and D.E. Birkenholz. 1987. Muskrat and round-tailed muskrat. Pp 315–325 *in* M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch, eds. Wild Furbearer Management and Conservation in North America. Ontario Ministry of Natural Resources. Toronto, Ontario, Canada.

Bouwer, H. 1989. The Bouwer and Rice slug test--an update. Ground Water 27:304-309.

Boyce, P.S. 1998. The social construction of bereavement: An application to pet loss. Dissertation Abstracts International Section A: Humanities and Social Sciences. Vol 59(4-A). US: University Microfilms International. 1348 pp.

Boyles, S. L. 2006. Report on the efficacy and comparative costs of using flow devices to resolve conflicts with North American beavers along roadways in the Coastal Plain of Virginia. M.S. Thesis, Christopher Newport University, Newport News, Virginia. 48 pp.

Boyles, S., and S. Owens. 2007. North American Beaver (*Castor canadensis*): A technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/northamericanbeaver.pdf. Accessed on August 11, 2010.

Brander, R.B. 1973. Life-history notes on the porcupine in a hardwood-hemlock forest in upper Michigan. Michigan Acad. 5:425-433.

Brooks, R.P., and W.E. Dodge. 1986. Estimation of habitat quality and summer population density for muskrats on a watershed basis. Journal of Wildlife Management, 50:269-273.

Brown, C. 2009. Species spotlight: River otter. Wild Rhode Island 2:3.

Brown, S. T., and J. W. Brown. 1999. How to control beaver flooding. and inserts, “Beaver flex pipe and cage”, and “How to protect trees from beavers,” Beavers Wetlands and Wildlife, Dolgeville, New York 13329.

Brown, S., D. Shafer, and S. Anderson. 2001. Control of beaver flooding at restoration projects. WRAP Techical Notes Collection (ERDC TN-WRAP-01-01), U.S. Army Engineer Research and Development Center, Vicksburg MS. www.wes.army.mil/el/wrap.

Buckley, M., T. Souhlas, E. Niemi, E. Warren, and S. Reich. 2011. The economic value of beaver ecosystem services: Escalante River Basin, Utah. ECONorthwest, Eugene, Oregon. 66 pp.

Buckner, C.H. 1970. Direct observation of shrew predation on insects and fish. Blue Jay 28:171-172.

Burt, W.H., and R.P. Grossendeider. 1976. A field guide to the mammals. Houghton Mifflin Col, Boston, Massachusetts. 289 pp.

California Department of Fish and Game. 1991. Final environmental document - bear hunting. Title 14 Calif. Code of Regs. Calif. Dept. of Fish and Game, State of California, April 25, 1991. 337 pp.

Callahan, M. 2003. Beaver management study. Association of Massachusetts Wetland Scientists Newsletter 44:12-15.

Callahan, M. 2005. Best management practices for beaver problems. Association of Massachusetts Wetland Scientists Newsletter 53:12-14.

Camenzind, F.J. 1978. Behavioral ecology of coyotes on the National Elk Refuge, Jackson Wyoming. Pp 267-294 *in* M. Bekoff, ed. Coyotes: biology, behavior and management. Academic Press, New York, New York.

Casey, D., and D. Hein. 1983. Effects of heavy browsing on a bird community in deciduous forest. Journal of Wildlife Management 47:829-836.

Castillo, D., and A.L. Clarke. 2003. Trap/neuter/release methods ineffective in controlling domestic cat "colonies" on public lands. Natural Areas Journal 23:247–253.

Canadian Broadcast Company. 2009. Coyotes kill Toronto singer in Cape Breton. http://www.cbc.ca/news/canada/nova-scotia/story/2009/10/28/ns-coyote-attack-died.html. Accessed November 23, 2011.

CDC. 1990. Compendium of rabies control. Morbidity and mortality weekly report. 39 Number RR-4:6, Atlanta, Georgia.

CDC. 1999. Mass treatment of humans who drank unpasteurized milk from rabid cows – Massachusetts, 1996-1998. CDC – Morbidity and Mortality Weekly Report. 48:228-229.

CDC. 2011. Rabies. http://www.cdc.gov/rabies/index.html. Accessed July 23, 2012.

Chapman, J. A., and G.A. Feldhamer. 1982. Wild Mammals of North America. Baltimore and London: John Hokins University Press.

Childs, J.E. 1986. Size dependent predation on rats by house cats in an urban setting. Journal of Mammalogy 67:196-198.

Childs, J.E. 1991. And the cats shall lie down with the rat. Natural History, June 100:16-19.

Chulick, G. 1979. The effect of habitat quality on stream-dwelling muskrat populations. M.S. Thesis, Pennsylvania State Univ., University Park. 109 pp.

Churcher, P.B., and J.H. Lawton. 1987. Predation by domestic cats in an English village. J. Zool. 212:439-455.

Churcher, P.B., and J.H. Lawton. 1989. Beware of well-fed felines. Natural History 7:40-46.

Clark, F.W. 1972. Influence of jackrabbit density on coyote population change. Journal of Wildlife Management 36:343-356.

Clemson University. 2006. Clemson beaver pond leveler Version II. DVD. Clemson University Extension, Clemson, South Carolina.

Close, T. L. 2003. Modifications to the Clemson pond leveler to facilitate brook trout passage. Minnesota Department of Natural Resources Special Publication 158. 9 pp.

Coleman, J.S., and S.A. Temple. 1989. Effects of free ranging cats on wildlife: a progress report. Proc. Eastern Wildl. Damage Contr. Conf. 4:9-12.

Coleman, J.S., S.A. Temple, and S.R. Craven. 1997. Facts on cats and wildlife: A conservation dilemma. University of Wisconsin, Cooperative Extension Publications, Madison, Wisconsin. http://m.extension.illinois.edu/wildlife/files/cats_and_wildlife.pdf. Accessed July 23, 2012.

Colt, A.B. 2008. Bays, Rivers, and Watersheds Systems-Level Plan: 2009-2013. The Rhode Island Bays, Rivers, and Watersheds Coordination Team Strategic Planning Work Group. http://www.dem.ri.gov/bayteam/documents/slpfinal.pdf. Accessed January 11, 2012.

Coman, B.J., and H.B. Brunner. 1972. Food habits of the feral house cat in Victoria. Journal of Wildlife Management 36:848-853.

Conner, P.F. 1960. The small mammals of Otsego and Schoharie Counties, New York. Bull. New York State Mus. And Sci. Serv. 382:1-84.

Connolly, G.E. 1978. Predator control and coyote populations: A review of simulation models. Pp 327-345 *in* M. Bekoff, ed. Coyotes: Biology, Behavior and Management. Academic Press, New York. 384 pp.

Connolly, G.E. 1992. Coyote damage to livestock and other resources. Pp 161-169 *in* A.H. Boer, ed. Ecology and management of the eastern coyote. Wildlife Research Unit. University of New Brunswick, Fredericton, New Brunswick, Canada.

Connolly, G.E. 1995. The effects of control on coyote populations: Another look. Symposium Proceedings—Coyotes in the Southwest: A Compendium of Our Knowledge (1995). Paper 36. http://digitalcommons.unl.edu/coyotesw/36. Accessed April 6, 2012.

Connolly, G.E., and W.M. Longhurst. 1975. The effects of control on coyote populations. Univ. Calif., Div. Agric. Sci. Bull. 1872. 37 pp.

Conover, M.R. 1982. Comparison of two behavioral techniques to reduce bird damage to blueberries: Methiocarb and hawk-kite predator model. Wildlife Society Bulletin 10:211-216.

Conover, M.R. 1997. Monetary and intangible valuation of deer in the United States. Wildlife Society Bulletin 25:298–305.

Conover, M.R., W.C. Pitt, K.K. Kessler, T.J. DuBow, and W.A. Sanborn. 1995. Review of Human injuries, illnesses, and economic losses caused by wildlife in the United States. Wildlife Society Bulletin 23:407-414.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K.Limburg, S. Naeem, R. V. O'Neill, J.Paruelo, R G. Raskin, P. Sutton, and M.van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

Courchamp F., J.L. Chapuis, and M. Pascal. 2003. Mammal invaders on islands: impact, control and control impact. Biol Rev 78:347-383.

Craig, J.R., J.D. Rimsstidt, C.A. Bonnaffon, T.K. Collins, and P.F. Scanlon. 1999. Surface water transport of lead at a shooting range. Bull. Environ. Contam. Toxicol. 63:312-319.

Craven, S.R. 1994. Cottontail rabbits. Pp D75–C80 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Craven, S.R., and S.E. Hygnstrom. 1994. Deer. Pp D25-D40 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Crawford, B.A., M.R. Pelton, and K.G. Johnson. 1993. Techniques to monitor relative abundance of coyotes in East Tennessee. Proceedings of Annual Conference, Southeastern Association of Fish and Wildlife Agencies 47:62-70.

Cronan, J. M., and A. Brooks. 1968. The mammals of Rhode Island. Wildlife Pamphlet No. 6 Rhode Island Department of Natural Resources, Division of Conservation. 133 pp.

Crum, J.M. 2003. Non-seasonal mortality white-tailed deer. West Virginia Division of Natural Resources. http://www.wvdnr.gov/Hunting/DeerNSeasMortal.shtm. Accessed April 6, 2012.

Curtis, J.D. 1944. Appraisal of porcupine damage. Journal of Wildlife Management 8:88-91.

Dahl, T.E. 1990. Wetland losses in the United States, 1780s to 1980s. United States Department of Interior, United States Fish and Wildlife Service, Washington, D.C. 21 pp.

Danner, D.A., and N.S. Smith. 1980. Coyote home range, movement, and relative abundance near a cattle feedyard. Journal of Wildlife Management 44:484-487.

Dauphine, N., and R. J. Cooper. 2009. Impacts of free-ranging domestic cats (*Felix catus*) on birds in the United States: A review of recent research with conservation and management recommendations. Proceedings of the fourth international partners in flight conference: tundra to tropics., McAllen, Texas. http://www.abcbirds.org/abcprograms/policy/cats/pdf/impacts_of_free_ranging_domestic_cats.pdf. Accessed July 23, 2012.

Davidson, W.R. 2006. Field manual of wildlife diseases in the southeastern United States. 3rd ed. The Univ. of Georgia, Athens, Georgia. 448 pp.

DeCalesta, D. 1997. Deer and ecosystem management. Pp 267-279 *in* W.J. McShea, H.B. Underwood, and J.H. Rappole, eds. The science of overabundance: Deer ecology and population management. Smithsonian Institution Press, Washington. 402 pp.

Decker, D.J., and L.C. Chase. 1997. Human dimensions of living with wildlife – a management challenge for the 21st century. Wildlife Society Bulletin 25:788-795.

Decker, D.J., and G.R. Goff. 1987. Valuing wildlife: Economic and social perspectives. Westview Press. Boulder, Colorado, 424 pp.

Decker, D.J., and K.G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildlife Society Bulletin 16:53-57.

Decker, D.J., K.M. Loconti-Lee, and N.A. Connelly. 1990. Deer-related vehicular accidents in Tompkins County, New York: Incidence, costs, and implications for deer management. Trans. Northeast Sect. Wildlife Society 47:21-26.

DeGraaf, R.M., and D.D. Rudis. 1986. New England wildlife: Habitat, natural history, and distribution. Gen. Tech. Rep. NE-108. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 491 pp.

DeGraaf, R.M., D.P. Snyder, and B.J. Hill. 1991. Small mammal habitat associations in pole timber and sawtimber stands of four forest cover types. Forest Ecology and Management 46:227-242.

DeGraaf, R.M., M. Yamasaki, W.B. Leak, and J.W. Lanier. 1992. New England wildlife: management of forested habitats. Gen. Tech. Rep. NE-144. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 271 pp.

Deisch, M.S. 1986. The effects of three rodenticides on nontarget small mammals and invertebrates. M.S. Thesis, South Dakota State University, Brookings, South Dakota.

Deisch, M.S., D.W. Uresk, and R.L. Linder. 1989. Effects of two prairie dog rodenticides on ground dwelling invertebrates in western South Dakota. Proc. Great Plains Wildl. Damage Cont. Workshop 9:166-170.

Deisch, M.S., D.W. Uresk, and R.L. Linder. 1990. Effects of prairie dog rodenticides on deer mice in western South Dakota. Great Basin Nat. 50:347-353.

Devault, T.L., J.C. Beasley, L.A. Humberg, B.J. MacGowan, M.I. Retamosa, and O.E. Rhodes, Jr. 2007. Intrafield patterns of wildlife damage to corn and soybean in northern Indiana. Human-Wildlife Conflicts 1:179-187.

Doebel, J.H., and B.S. McGinnes. 1974. Home range and activity of a gray squirrel population. Journal of Wildlife Management 38:860-867.

Dolbeer, R.A. 1998. Population dynamics: the foundation of wildlife damage management for the 21^{st} century. Proc. 18^{th} Vertebr. Pest Conf., Davis, California. Pp. 2-11.

Dolbeer, R.A. 2000. Birds and aircraft: fighting for airspace in crowded skies. Proceedings of the Vertebrate Pest Conference 19:37-43.

Dolbeer, R.A. 2009. Birds and aircraft: fighting for airspace in ever more crowded skies. Human-Wildlife Conflicts 3:165-166.

Dolbeer, R.A., and S.E. Wright 2009. Safety management systems: how useful will the FAA National Wildlife Strike Database be? Human–Wildlife Interactions 3:167-178.

Dolbeer, R. A., G. E. Bernhardt, T. W. Seamans, and P. P. Woronecki. 1991. Efficacy of two gas cartridge formulations in killing woodchucks in burrows. Wildlife Society Bulletin 19:200-204.

Dolbeer, R.A., S.E. Wright, J. Weller, and M.J. Beiger. 2012. Wildlife Strikes to Civil Aircraft in the United States, 1990–2010. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Serial Report No. 17, Washington, D.C..

Drake, D., J.B. Paulin, P.D. Curtis, D.J. Decker, and G.J. San Julian. 2005. Assessment of negative economic impacts from deer in the northeastern United States. J. Ext. 43. 11 Apr. 2010. http://www.joe.org/joe/2005february/rb5.php. Access July 23, 2012.

Dubey, J.P. 1973. Feline toxoplasmosis and coccidiosis: a survey of domiciled and stray cats. Journal of American Veterinary Medical Association 162:873-877.

Dubey, J.P. , R.M. Weigel, A.M. Siegel, P. Thulliez, U.D. Kitron, M.A. Mitchell, A. Mannelli, N.E. Mateus-Pinilla, S.K. Shen, O.C.H. Kwok, and K.S. Todd. 1995. Sources and reservoirs of *Toxoplasma gondii* infection on 47 swine farms in Illinois. J. Parasitol. 81:723-729.

Eadie, W.R. 1939. A contribution to the biology of *Parascalops breweri*. Journal of Mammalogy 20:150-173.

Eadie, W.R. 1948. C*orpora amylacea* in the prostatic secretion and experiments on the formation of a copulatory plug in some insectivores. Anat. Rec. 102:259-271.

Eagle, T.C., and J.S. Whitman. 1987. Mink. Pp 614-625 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Mallock, eds., Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Eisenberg, J.F. 1989. Mammals of the Neotropics. The Northern Neotropics. The University of Chicago Press, Chicago, USA and London, United Kingdom.

Emmons, L.H., and F. Feer. 1990. Neotropical Rainforest Mammals: A Field Guide. University of Chicago Press, Chicago, USA and London, United Kingdom.

Eng, T.R., and D.B. Fishbein. 1990. Epidemiologic factors, clinical findings, and vaccination status of rabies in cats and dogs in the United States in 1988. Journal of American Veterinary Medical Association 197:201-209.

EPA. 1986*a*. Quality Criteria for Water 1986. U.S. Environmental Protection Agency, Publication EPA/440/5-86-001. Washington, D.C.

EPA. 1986*b*. Total Exposure Assessment Model (TEAM) Study: Summary and Analysis, Volume I, Final Report. EPA/600/6-87/002a. Washington, D.C.

EPA. 1998. Reregistration Eligibility Decision (RED): Zinc phosphide. United States Environmental Protection Agency, Office of Pesticide Programs Special Review and Reregistration Division, Washington, D.C. 207 pp.

EPA. 1991. Reregistration eligibility document: Inorganic nitrate/nitrite (sodium and potassium nitrates). List D, Case 4052. Environmental Protection Agency, Office of Pesticide Programs Special Review and Reregistration Division, Washington, D.C.

EPA. 1995. Facts about wetlands. United States Environmental Protection Agency. Office of water, wetlands, oceans, and watersheds (4502F), Environmental Protection Agency 843-F-95-00le.

EPA. 2001. Selected mammal and bird repellents fact sheet. http://www.epa.gov/oppbppd1/biopesticides/ingredients/factsheets/factsheet_mam-bird-repel.htm. Accessed March 2, 2012.

EPA. 2009. Pesticide fact sheet: Mammalian Gonadotropin releasing hormone (GnRH). United States Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances. Arlington, Virginia.

Erickson, D.W., C.R. McCullough, and W.R. Poranth. 1984. Evaluation of experimental river otter reintroducutions. Final Report of Missouri Department of Conservation. Federal Aid Project. No. W-13-R-38. 47 pp.

Erlinge, S. 1977*a*. Spacing strategy in stoat *Mustela erminea*. Oikos 28:32-42.

Erlinge, S. 1977*b*. Agonistic behaviour and dominance in stoats (*Mustela erminea* L). Z Tierpsychol 44:375-388.

Erlinge, S. 1981. Food preference, optimal diet and reproductive output in stoat *Mustela erminea* in Sweden. Oikos 36:303-315.

Errington, P.L. 1933. Bobwhite winter survival in an area heavily populated with grey fox. Iowa State Coll. J. Sci. 8:127–130.

Errington, P.L. 1943. An analysis of mink predation upon muskrats in north-central United States. Iowa Agricultural Experiment Station Research Bulletin 320:797-924.

Evans, J. 1970. About nutria and their control. Bureau of Sport Fisheries and Wildlife, Denver Wildlife Research Center 86:1-65.

FAA. 2011. FAA National Wildlife Strike Database (Level 1)-Version 2011.10-P dated 12-22-11. National Wildlife Strike Database ON-LINE. Downloaded March 29, 2012. http://wildlife.pr.erau.edu/public/index.html.

Federal Emergency Management Agency. 2005. Dam Owner's Guide to Animal Impacts on Earthen Dams. FEMA L-264.

Fergus, C. 2006. Cottontail rabbit. Wildlife Note – 4, LDR0103. Pennsylvania Game Commission, Bureau of Information and Education, Harrisburg, Pennsylvania.

Fernandez, S. 2008. Ticked off: Deer, Lyme Disease connected? Greenwich Post. September 4, 2008.

Figley, W.K., and LW. VanDruff. 1982. The Ecology of Urban Mallards. Wildl. Monogr. 81.40 pp.

Fitzgerald, B.M. 1977. Weasel predation on a cyclic population of the montane vole (*Microtus montanus*) in California. Journal of Animal Ecology 46:367-397.

Fitzgerald, B.M. 1990. House cat. Pp. 330-348 *in* C. M. King, ed. The handbook of New Zealand mammals. Auckland, Oxford University Press.

Fitzgerald, B.M., W.B. Johnson, C.M. King, and P.J. Moors. 1984. Research on Mustelids and cats in New Zealand. WRLG Res. Review No. 3. Wildl. Res. Liaison Group, Wellington. 22 pp.

Fitzwater, W.D. 1994. Feral house cats. Pp C-45-50 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, Eds., Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Fouty, S. 2008*a*. Climate change and beaver activity: How restoring nature's engineers can alleviate problems. Beaversprite Spring:4-5, 13.

Fouty, S. C. 2008*b*. Current and historic stream channel response to changes in cattle and elk grazing pressure and beaver activity: southwest Montana and east-central Arizona. Ph.D. Dissertation, Department of Geography, University of Oregon, Corvallis, Oregon.

Flyger, V., and J.E. Gates. 1982. Fox and gray squirrels. Pp 209-229 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild Mammals of North America: Biology, Management, and Economics. The John Hopkins Univ. Press, Baltimore, Maryland. 1147 pp.

Follmann, E.H. 1973. Comparative ecology and behavior of red and gray fox. Ph.D. Thesis, Southern Illinois Univ., Carbondale, Illinois. 152 pp.

FDA. 2003. Bird poisoning of federally protected birds. Office of Criminal Investigations. Enforcement Story 2003.

Fowler, J. F., S. Verma, and T. Delphin. 1994. An impact assessment of beaver damage in Louisiana during 1993. Report to the Louisiana State Natural Resources Committee.

Fowler, M.E., and R.E. Miller. 1999. Zoo and Wild Animal Medicine. W.B. Saunders Co. Philadelphia, Pennsylvania.

Fritzell, E.K. 1987. Gray fox and island fox. Pp 408-420 *in* M. Novak, J.A. Baker, M.E. Obbard, B. Mallock. eds. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Gardner, A.L. 1982. Virginia opossum. Pp 3-36 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, Maryland. 1147 pp.

George, W.G. 1974. Domestic cats as predators and factors in winter shortages of raptor prey. Wilson Bulletin 86:384-396.

George, S.B., J.R. Choate, and H.H. Genoways. 1986. *Blarina brevicauda*. Pp 1-9 *in* T.E. Lawlor, ed. Mammalian Species Number 261. American Society of Mammalogists, Baltimore, Maryland.

Gerell, R. 1971. Population studies on mink, *Mustela vison* Schreber, in southern Sweden. Viltrevy 8:83-114.

Gerwolls, M.K., and S.M Labott. 1994. Adjustment to the death of a companion animal. Anthrozoos 7: 172-187.

Gier, H.T. 1948. Rabies in the wild. Journal of Wildlife Management 12:142–153.

Gier, H.T. 1968. Coyotes in Kansas. Rev. ed. Kansas State Coll., Agric.Exp. Stn. Bull. 393. 118 pp.

Gillespie, J.H., and F.W. Scott. 1973. Feline viral infections. Advances in Vet. Sci. and Comp. Med. 17: 163-200.

Glover, F.A. 1943. A study of the winter activities of the New York weasel. Pennsylvania Game News 14:8–9.

Glueck, T.F., W.R. Clark, and R.D. Andrews. 1988. Raccoon movement and habitat use during the fur harvest season. Wildlife Society Bulletin 16:6-11.

Godbee, J., and T. Price. 1975. Beaver damage survey. Georgia Forestry Commission, Macon, Georgia.

Goldburg, R.J., M.S. Elliot, and R.L. Naylor. 2001. Marine Aquaculture in the United States. Prepared for the Pew Oceans Commission. http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Protecting_ocean_life/env_pew_oceans_aquaculture.pdf. Accessed March 29, 2012.

Grasse, J.E., and E.F. Putnam. 1955. Beaver management and ecology in Wyoming. Federal Aid in Wildlife Restoration Project Bulletin Number 6. Wyoming Game and Fish Commission, Cheyenne, Wyoming.

Green, J.S., F.R. Henderson, and M.D. Collinge. 1994. Coyotes. Pp C51-C76 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Green, J.S., and P.S. Gipson. 1994. Feral dogs. Pp C77-C82 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Grinnell, J., J.S. Dixon, and J.M. Linsdale. 1937. Fur-bearing mammals of California. 2 vols. Univ. California Press, Berkeley, California. 777 pp.

Grizzell, Jr., R.A. 1955. A study of the Southern Woodchuck *Marmota monax*. American Midland Naturalist 53:257-293.

Gurnell, J. 1987. The Natural History of Squirrels. Facts on File, Inc., New York.

Hadidian, J., D. Manski, V. Flyger, C. Cox, and G. Hodge, 1987. Urban gray squirrel damage and population management: A case history. Third Eastern Wildlife Damage Control Conference, Paper 19. http://digitalcommons.unl.edu/ewdcc3/19. Accessed July 23, 2012.

Hall, E.R. 1951. American weasels. University of Kansas Publication, Museum of Natural History, 4:1-466.

Hall, E.R. 1981. The Mammals of North America. 2 volumes. Ronald Press Co.

Hall, E.R., and K.R. Kelson. 1959. The Mammals of North America. Vol. 2. The Ronald Press Co., New York, N. Y. 616 pp.

Hallberg, D.L., and G.R. Trapp. 1984. Gray fox temporal and spatial activity in a riparian–agricultural zone in California's Central Valley. in R. E. Warner and K. M. Hendrix, Eds., Proc.Calif. Riparian Systems Conf., Univ. California Press, Berkeley, Pp. 920–928.

Hallett, J.G. 1978. Mammalian Species. *Parascalops breweri*. by The American Society of Mammalogists. No. 98, pp. 1-4.

Hamilton, Jr., W.J. 1934. The life history of the rufescent woodchuck *Marmota monax rufescens* Howell. Ann. Carnegie Museum 23:85-178.

Hamilton, Jr., W.J. 1939. Activity of Brewer's mole (*Parascalops breweri*). Journal of Mammalogy 20:307–310.

Hamilton, Jr., W.J. 1940. The biology of the smoky shrew (*Sorex fumeus fumeus* Miller). Zoologica 25: 473-492.

Haroldson, K.J., and E.K. Fritzell. 1984. Home ranges, activity, and habitat use by gray fox in an oak–hickory forest. Journal of Wildlife Management 48:222-227.

Harris, S. 1977. Distribution, habitat utilization and age structure of a suburban fox (*Vulpes vulpes*) population. Mammal Rev. 7:25-39.

Harris, S. 1979. Age related fertility and productivity in red fox, *Vulpe vulpes*, in suburban London. J. Zool. (London) 187:195-199.

Harris, S., and J.M.V. Rayner. 1986. Urban fox (*Vulpes vulpe*s) population estimates and habitat requirements in several British cities. J. Anim. Ecol. 55:575–591.

Hartman, G.D., and J.D. Krenz. 1993. Estimating population density of moles, *Scalopus aquaticus* using assessment lines. Acta Theriologica 38:305–314.

Hasbrouck, J.J., W.R. Clark, and R.D. Andrews. 1992. Factors associated with raccoon mortality in Iowa. Journal of Wildlife Management 56:693-699.

Hatler, D.F. 1976. The coastal mink of Vancouver Island, British Columbia. Ph. D. Thesis. Univ. of British Columbia, Canada.

Haulton, S. M., W. F. Porter, and B. A. Rudolph. 2001. Evaluating 4 methods to capture white-tailed deer. Wildlife Society Bulletin 29:255-264.

Hawkins, R. E., L. D. Martoglio, and G. G. Montgomery. 1968. Cannon-netting deer. Journal of Wildlife Management 32:191-195.

Hawkins, C.C., W.E. Grant, and M.T. Longnecker. 1999. Effect of subsidized house cats on California birds and rodents. Transactions of the Western Section of The Wildlife Society 35:29-33.

Hegdal, P.L., and T.A. Gatz. 1977. Hazards to pheasants and cottontail rabbits associated with zinc phosphide baiting for microtine rodents in orchards. Final report by the USFWS under Interagency Agreement EPA-IAG-D4-0449. 35 pp.

Hegdal, P.L., T.A. Gatz, and E.C. Fite. 1980. Secondary effects of rodenticides on mammalian predators. Pp 1781-1793 *in* J.A. Chapman and D. Pursley, eds. Proc. Worldwide Furbearer Conf. Frostburg, Maryland.

Heller, R., M. Artois, V. Xemar, D. De Briel, H. Gehin, B. Jaulhac, H. Monteil, and Y. Piemont. 1997. Prevalence of *Bartonella henselae* and *Bartonella clarridgeiae* in stray cats. J. Clinical Microbiology 35:1327-1331.

Hey, D.L., and N.S. Phillips. 1995. Flood reduction through wetland restoration: The Upper Mississippi River Basin as a case study. Restoration Ecology 3:4-17.

Hill, E.P. 1976. Control methods for nuisance beaver in the southeastern United States. Proceedings of the Vertebrate Pest Conference 7:85-98.

Hill, E.P. 1982. Beaver. Pp 256-281 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild Mammals of North America: Biology, Management, Economics. Johns Hopkins University, Baltimore, Maryland. 1147 pp.

Hill, E.F., and J.W. Carpenter. 1982. Responses of Siberian ferrets to secondary zinc phosphide poisoning. Journal of Wildlife Management 46:678-685.

Hoagland, J.W. 1993. Nuisance Beaver Damage Control Proposal. Okla. Dept. Wildl. Cons. Internal Document. 20 pp.

Honacki, J.H., K.E. Kinman, and J.W. Koeppl, editors. 1982. Mammal species of the world: a taxonomic and geographic reference. Allen Press, Inc., and Assoc. Systematics Collections, Lawrence, Kansas. 694 pp.

Hood, G.A., and S.E. Bayley. 2008. Beaver (*Castor Canadensis*) mitigate the effects of climate on the area of open water in boreal wetlands in western Canada. Biological Conservation 141:556-567.

Houston, A.E. 1995. Beaver immigration into a control area. Southern Journal of Applied Forestry 19:127-130.

Hunt, J.H. 1986. Muskrat Assessment. Maine Department of Inland Fisheries and Wildlife. Bangor, Maine. http://www.maine.gov/ifw/wildlife/species/plans/mammals/muskrat/speciesassessment.pdf. Accessed April 6, 2012.

Iverson, J.B. 1978. The impact of feral cats and dogs on a population of the West Indian rock iguana, *Cyclura carinata*. Biol. Conserv. 24:3-73.

Jackson, W.B. 1951. Food habits of Baltimore, Maryland cats in relation to rat populations. Journal of Mammalogy 32:458-461.

Jackson, H.H.T. 1961. Mammals of Wisconsin. University of Wisconsin Press, Madison, Wisconsin.

Jackson, J.J. 1994*a*. Opossums. Pp D59-D64 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Jackson, J.J. 1994*b*. Tree squirrels. Pp B171-B175 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Jenkins, S. H., and P. E. Busher. 1979. *Castor canadensis*. Mammalian Species 120:1-8.

Jensen, P.G., P.D. Curtis, and D.L. Hamelin. 1999. Managing nuisance beavers at roadsides: a guide for highway departments. Cornell Cooperative Extension Publicaiton #147BEAV.

Jessup, D.A. 2004. The welfare of feral cats and wildlife. Journal of American Veterinary Medical Association 225:1377-1382.

Johnson, G.D., and K.A. Fagerstone. 1994. Primary and secondary hazards of zinc phosphide to nontarget wildlife - a review of the literature. USDA-APHIS-DWRC Res. Rep. No. 11-55-005.

Johnson, M.R., R.G. McLean, and D. Slate. 2001. Field Operations Manual for the Use of Immobilizing and Euthanizing Drugs. USDA, APHIS, WS-Operational Support Staff, Riverdale, Maryland.

Jones, J.L. 1991. Habitat use of fisher in northcentral Idaho. Thesis, University of Idaho, Moscow, Idaho.

Jones, Jr., J.K., R.S. Hoffman, D.W. Rice, C. Jones, R.J. Baker, and M.D. Engstrom. 1992. Revised checklist of North American mammals north of Mexico, 1991. Occasional Papers, Museum of Texas Tech University 146:1-23.

Keirn, G., J. Cepek, B. Blackwell, and T. DeVault. 2010. On a quest for safer skies: managing the growing threat of wildlife hazards to aviation. The Wildlife Professional, Summer 2010: 52-55.

Keith, L.B., and L.A. Windberg. 1978. A demographic analysis of the snowshoe hare cycle. Wildlife Monographs 58:1-59.

Keith, L.B. 1990. Dynamics of snowshoe hare populations. Pp 119-195 *in* H.H. Genoways, ed. Current Mammalogy. Plenum Press, New York.

Kemp, G.A., and L.B. Keith. 1970. Dynamics and regulation of red squirrel (*Tamiasciurus hudsonicus*) populations. Ecology 51:763-779.

Kendall, C., S.R. Silva, C.C.Y. Chang, D.A. Burns, D.H. Campbell, and J.B. Shanley. 1996. Use of the d18O and d15N of nitrate to determine sources of nitrate in early spring runoff in forested catchments. IAEA, Symposium on Isotopes in Water Resources Management, Vienna, Austria, 20-24 March, 1995, 1:167-176.

Kennely, J.J., and B.E. Johns. 1976. The estrous cycle of coyotes. Journal of Wildlife Management 40:272-277.

Kern, Jr., W.H. 2002. Raccoons. WEC-34. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Kilpatrick, H.J., and W.D. Walter. 1999. A controlled archery deer hunt in a residential community: cost, effectiveness and deer recovery rates. Wildlife Society Bulletin 27:115–123.

King, C.M. 1989. The advantages and disadvantages of small size to weasels, Mustela species. Pp 302-334 *in* J.L. Gittleman, eds. Carnivore behavior, ecology, and evolution. Cornell University Press, Ithaca, New York.

Kirsch, E. M. 1996. Habitat selection and productivity of least terns on the lower Platte River, Nebraska. Wildlife Monograph 132:1-48.

Kocer, C. 2010. Weasel project completed: Results shed light on the distribution of short- and long-tailed weasels. Connecticut Wildlife. Connecticut Department of Energy and Environmental Protection. Hartford, Connecticut.

Knowlton, F.F. 1972. Preliminary interpretations of coyote population mechanics with some management implications. Journal of Wildlife Management 36:369-383.

Knowlton, F.F., and L.C. Stoddart. 1985. Coyote population mechanics: Another look. Pp 93-111 *in* F.L. Bunnell, D.S. Eastman, and J.M. Peck, eds. Symposium on the Natural Regulation of Wildlife Populations. University of Idaho, Moscow, Idaho.

Koen, E.L. 2005. Home range, population density, habitat preference, and survival of fishers (*Martes pennanti*) in eastern Ontario. Thesis, University of Ottawa, Ottawa, Ontario, Canada.

Krebs, J.W., C.E., Rupprecht, and J.E. Childs. 2000. Rabies surveillance in the United States during 1999. Journal of American Veterinary Medical Association 217:1799-1811.

Krebs, J. W., J.S. Smith, C.E. Rupprecht, and J.E. Childs. 1998. Rabies surveillance in the United States during 1997. Journal of American Veterinary Medical Association 213:1713-1672.

Krebs, J.W., J.W., T.W. Strine, J.S. Smith, D.L. Noah, C.E. Rupprecht, and J.E. Childs. 1996. Rabies surveillance in the United States during 1995. Journal of American Veterinary Medical Association 209:2031-2044.

Kreeger, T.J., U.S. Seal, and J.R. Tester, 1988. The Pathophysiological Response of Red Fox (*Vulpes vulpes*) to Padded, Foothold Traps (Draft). University of Minnesota for the Fur Institute of Canada, St. Paul, Minnesota, March 6, 1988.

Laidlaw, M.A.S., H.W. Mielke, G.M. Filippelli, D.L. Johnson, and C.R. Gonzales. 2005. Seasonality and children's blood lead levels: Developing a predictive model using climatic variables and blood lead data from Indianapolis, Indiana, Syracuse, New York, and New Orleans, Louisiana (USA) Environ Health Perspect 113793–800.800doi:10.1289/ehp.7759.

Lampman, B.H. 1947. A note on the predaceous habits of water shrews. Journal of Mammalogy 28:181.

Langham, N.P.E. 1990. The diet of feral cats (*Felis catus* L.) on Hawke's Bay farmland, New Zealand. New Zealand Journal of Zoology 17:243-255.

Langlois, S. A. and L. A. Decker. 1997. The use of water flow devices and flooding problems caused by beaver in Massachusetts. Massachusetts Division of Fisheries and Wildlife. 13 pp.

Laramie, H. A., Jr., and S. W. Knowles. 1985. Beavers and their control. University of New Hampshire Cooperative Extension Service, Durham, New Hampshire.

Larivière, S., and L.R. Walton. 1997. Mammalian Species, *Lynx rufus*. American Society of Mammalogists. 563:1-8.

Latham, R.M. 1960. Bounties are bunk. Nat. Wildl. Federation, Wash., D.C. 10 pp.

Lawhead, D.N. 1984. Bobcat (*Lynx rufus*) home range, density and habitat preference in South-Central Arizona. The Southwestern Naturalist 29:105-113.

Lefrancois, G.R. 1999. Bereavement and grieving, Pp 552-554 *in* The Lifespan. 6^{th} ed. Wadsworth. 556 pp.

Leopold, A.S. 1933. Game Management. Charles Scribner & Sons, New York, New York. 481 pp.

Levy, J.K., and P.C. Crawford. 2004. Humane strategies for controlling feral cat populations. Journal of American Veterinary Medical Association 225:1354-1360.

Lewis, J. W. 1979. Significance of beaver and beaver ponds in the Tombigbee Resource Conservation and Development Area Alabama-1978, Alabama Cooperative Extension Service, Circular CRD-7, Auburn University, Auburn, Alabama.

Lewis, J.C., and G.E. Hayes. 2004. Feasibility assessment for reintroducing fishers to Washington. Washington Department Fish and Wildlife, Olympia, Washington. 70 pp.

Liberg, O. 1984. Food habits and prey impact by feral and house based domestic cats in a rural area in southern Sweden. Journal of Mammalogy 65:424-432.

Linscombe, G., N. Kinler, and R.J. Aulerich. 1982. Mink (*Mustela vision*). Pp 629-643 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild Mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, Maryland. 1147 pp.

Linnell, M.A., M.R. Conover, and T.J. Ohashi. 1996. Analysis of Bird Strikes at a Tropical Airport. Journal of Wildlife Management 60:935-945.

Linzey, A.V. 1983. Mammalian Species. *Synaptomys cooperi*. The American Society of Mammalogists. 210:1-5.

Lisle, S. 1996. Beaver Deceivers. Wildlife Control Technology. September-October 42-44.

Lisle, S. 1999. Wildlife Programs at the Penobscot Nation. Transactions of the North American Wildlife and Natural Resource Conference 65:466-477.

Lisle, S. 2003. Use and potential of flow devices in beaver management. Lutra 46:211-216.

Lord, Jr., R.D. 1961. A population study of the gray fox. Am. Midl. Nat. 66:87–109.

Lowry, D.A. 1978. Domestic dogs as predators on deer. Wildlife Society Bulletin 6:38-39.

MacDonald, D.W., and M.T. Newdick. 1982. The distribution and ecology of fox, *Vulpes vulpes* (L.), in urban areas. Pp 123–135 *in* R. Bornkamm, J.A. Lee, and M.R.D. Seaward, eds. Urban ecology. Blackwell Sci. Publ., Oxford, United Kingdom.

MacKinnon, B., R. Sowden, and S. Dudley (Editors). 2001. Sharing the Skies: an Aviation Guide to the Management of Wildlife Hazards. Transport Canada, Aviation Publishing Division, Tower C, 330 Sparks Street, Ottawa, Ontario, K1A 0N8 Canada. 316 pages.

Majumdar, S.K., J.E. Huffman, F.J. Brenner, and A.I. Panah. 2005. Wildlife Diseases: Landscape Epidemiology, Spatial Distribution and Utilization of Remote Sensing Technology. The Pennsylvania Academy of Sciences.

Manski, D.M., L.W. VanDruff, and V. Flyger. 1981. Activities of gray squirrels and people in a downtown Washington, D.C. park: management implications. Trans. North Amer. Wild. Nat. Res. Conf. 46:439-454.

Marks, S.G., and J.E. Koepke. 1994. Pet attachment and generativity among young adults. J. Psychology 128:641.

Marshall, W.H. 1936. A study of winter activities of the mink. Journal of Mammalogy 17:382-392.

Massey, B. W. 1971. A breeding study of the California least tern, 1971. Administrative Report 71-9, Wildlife Management Branch, California Department of Fish and Game.

Massey, B. W., and J. L. Atwood. 1981. Second-wave nesting of the California least tern: age composition and reproductive success. Auk 98:596-605.

McCabe, R.A. 1949. Notes on live-trapping mink. Journal of Mammalogy 30:416-423.

McCord, C.M., and J.E. Cardoza. 1982. Pp 728-766 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild Mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

McNeely, R. 1995. Missouri's Beaver: A guide to management, nuisance prevention, and damage control. Missouri Department of Conservation, Jefferson City, Missouri.

McVey, M., K. Hall, P. Trenham, A. Soast, L. Frymier, and A. Hirst. 1993. Wildlife Exposure Factors Handbook, Volume I. U.S. Environmental Protection Agency, Washington D.C., EPA/600/R-93/187a.

Medin, D. E., and W. P. Clary. 1990. Bird populations in and adjacent to a beaver pond ecosystem in Idaho. USDA-Forest Service, Intermountain Research Station, 432.

Medin, D. E., and W. P. Clary. 1991. Small mammals of a beaver pond ecosystem and adjacent riparian habitat in Idaho. USDA-Forest Service, Intermountain Research Station, 445.

Melquist, W.E., and A.E. Dronkert. 1987. River otter. Pp 626-641 *in* M. Novak, J.A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Merriam, H.G. 1971. Woodchuck burrow distribution and related movement patterns. Journal of Mammalogy 52:732-746.

Meltzer, M.I. 1996. Assessing the costs and benefits of an oral vaccine for raccoon rabies: a possible model. Emerging Infectious Diseases 2:343-349.

Merritt, J.F. 1981. Mammalian Species. *Clethrionomys gapperi*. The American Society of Mammalogists 146:1-9.

Merritt, J.F. 1995. Seasonal thermogenesis and changes in body mass of masked shrews, *Sorex cinereus*. Journal of Mammalogy 76:1020-1035.

Meyers, B. 2000. Anticipatory mourning and the human-animal bond. Pp 537-564 *in* T.A. Rando, ed. Clinical Dimensions of Anticipatory Mourning: Theory and Practice in Working With The Dying, Their Loved Ones, and Their Caregivers. Champaign, IL, US: Research Press. xiii, 601 pp.

Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Wetlands and water. World Resources Institute, Washington, D.C..

Miller, J.E. 1994. Muskrats. Pp B61-B69 *in* J.A. Chapman and G.A. Feldhamer, eds. Wild Mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, Maryland. 1147 pp.

Miller, L.A. 1995. Immunocontraception as a tool for controlling reproduction in coyotes. Pp 172-176 *in* D. Rollins, C. Richardson, T. Blankenship, K. Canon, and S. Henke, eds. Coyotes in the Southwest: A Compendium of Our Knowledge. Proc. of a Symposium, Dec. 13-15, Texas A&M University, San Angelo, Texas.

Miller, H., and L.L. Getz. 1977. Factors influencing local distribution and species diversity of forest small mammals in New England. Canadian Journal of Zoology 55:806-814.

Miller, J.E., and G.K. Yarrow. 1994. Beaver. Pp B1-B11 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Miller, L.A., B.E. Johns, and G.J. Killian. 2000. Long-term effects of PZP immunization on reproduction of white-tailed deer. Vaccine 18:568-574.

Mitchell, J.L. 1961. Mink movements and populations on a Montana river. Journal of Wildlife Management 25:48-54.

Mosillo, M., J.E. Heske, and J.D. Thompson. 1999. Survival and movements of translocated raccoons in north central Illinois. Journal of Wildlife Management 63:278-286.

Muller, L.I., R.J. Warren, and D.L. Evans. 1997. Theory and practice of immunocontraception in wild animals. Wildlife Society Bulletin 25:504-514.

Muller-Schwarze, D., and L. Sun. 2003. The beaver: Natural history of a wetlands engineer. Cornell University Press, Ithaca, New York.

Murray, D.L. 2000. A geographic analysis of snowshoe hare population demography. Can. J. Zool. 78:1207-1217.

Murray, D.L., J.D. Roth, E. Ellsworth, A.J. Wirsing, and T.D. Steury. 2002. Estimating low-density snowshoe hare population using fecal pellet counts. Can. J. Zool. 80:771-781.

Munther, G.L. 1982. Beaver management in grazed riparian ecosystems. Wildilfe Livestock Relationships Symposium 10:234-241.

Naimen, R. J., J. M. Melillo, and J. E. Hobbie. 1986. Ecosystem alteration of boreal forest streams by beaver (*Castor canadensis*). Ecology 67:1254-1269.

NASS. 2002. U.S. Wildlife Damage. USDA, National Agricultural Statistics Service, Washington, D.C..

NASS. 2009. 2007 Census of Agriculture. Released February 4, 2009. USDA, National Agricultural Statistics Service, Washington, DC. http://www.agcensus.usda.gov/Publications/2007/index.asp. Accessed December 23, 2011.

NASS. 2010. Sheep and goats death loss 2009. Released May 27, 2010. USDA, National Agricultural Statistics Service, Washington, DC. http://usda.mannlib.cornell.edu/usda/current/sgdl/sgdl-05-27-2010.pdf. Accessed December 22, 2011.

NASS. 2011. Cattle death loss 2010. Released May 12, 2011. USDA, National Agricultural Statistics Service, Washington, DC. http://www.usda.gov/nass/PUBS/TODAYRPT/catlos11.pdf . Accessed December 22, 2011.

National Audubon Society. 2000. Field guide to North American mammals. J. O. Whitaker, Jr., ed. Indiana State Univ. Alfred A. Knopf, New York, N.Y. 937 pp.

National Oceanic and Atmospheric Administration. 2011. Marine Mammal Stranding Information. http://www.nwr.noaa.gov/marine-mammals/stranding-information.cfm. Accessed 23 April 23, 2012.

Ness, E. 2003. Oh, deer: Exploding populations of white-tailed deer are stripping our forests of life. Discover. 24:66-71.

New York Cooperative Extension. 1981. Snowshoe or Varying Hare (*Lepus americanus*). New York's Wildlife Resources, Number 1, 1981. An extension publication of the Department of Natural Resources, New York State College of Agriculture and Life Sciences. Cornell University, Ithaca, New York.

Nicholson, W.S. 1982. An ecological study of the gray fox in east central Alabama. M.S. Thesis, Auburn Univ., Auburn, Alabama. 93 pp.

Nielsen, L. 1988. Definitions, considerations, and guidelines for translocation of wild animals. Pp 12-51 *in* L. Nielsen and R. D. Brown, eds. Translocation of wild animals. Wis. Humane Soc., Inc., Milwaukee and Caesar Kleberg Wildl. Res. Inst., Kingsville, Texas. 333 pp.

Nielsen, C.K., and A. Woolf. 2001. Spatial organization of bobcats (*Lynx rufus*) in southern Illinois. American Midland Naturalist 146:43–52.

Noah, D.L., M.G. Smith, J.C. Gotthardt, J. W. Krebs, D. Green, and J.E. Childs. 1995. Mass human exposure to rabies in New Hampshire: Exposures, Treatment, and Cost. Public Health Briefs, National Center for Infectious Diseases, 1600 Clifton Rd. Mailstop G-13, Atlanta, Georrgia 30333. 3 pp.

Nolte, D. M., S. R. Swafford, and C. A. Sloan. 2001. Survey of factors affecting the success of Clemson beaver pond levelers installed in Mississippi by Wildlife Services. Pages 120-125 in M C. Brittingham, J. Kays, and R. McPeake editors, Proceedings of the Ninth Wildlife Damage Management Conference. Pennsylvania State University, University Park, Pennsylvania.

Novak, M. 1987. Beaver. Pp 283-312 *in* M. Novak, J. A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

O' Brien, J.M. 1994. Voles. Pp B177-B182 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Organ, J. F., T. Decker, J. DiStefano, K. Elowe, P. Rego, and P.G. Mirick. 1996. Trapping and furbearer management: Perspectives from the Northeast. USDI-Fish and Wildlife Service, Hadley, Massachusetts.

Osgood, F.L. 1935. Fluctuations in small mammal populations. Journal of Mammalogy 16:156.

Owens, J.G. 1984. Mammalian Species. *Sorex fumeus*. The American Society of Mammalogists 215:1-8.

Ozoga, J.J., and L.J. Verme. 1968. Small Mammals of Conifer Swamp Deeryards in Northern Michigan. Michigan Academy Sci., Arts, and Letters 53:37-49.

Pagel, M.D., R.M. May, and A.R. Collie. 1991. Ecological aspects of the geographical distribution and diversity of mammalian species. Am. Nat. 137:791-815.

Parker, G. 1995. Eastern coyote: The story of its success. Nimbus Publishing, Halifax, Canada.

Parkes, C. M. 1979. Grief: the painful reaction to the loss of a loved one. Monograph. University of California, San Diego, California.

Partington, M. 2002. Preventing beaver dams from blocking culverts. Advantage 3:1-4.

Patterson, D. 1950. Beaver-trout relationships. Wisconsin Conservation Bulletin 15:9-11.

PawsWatch. 2012. PawsWatch.org website. http://pawswatch.org/index.htm. Accessed January 23, 2012.

Pearson, O.P. 1964. Carnivore-mouse predation: an example of its intensity and bioenergetics. Journal of Mammalogy 45:177–188.

Pearson, O.P. 1971. Additional measurements of the impact of carnivores on California voles (*Microtus californicus*). Journal of Mammalogy 52:41–49.

Pearson, O.P. 1985. Predation. Pp 535-566 *in* R.A. Tamarin, ed. Biology of new world Microtus. Amer. Soc. Mammal. Shippensburg, Pennsylvania.

Pennsylvania Department of Health. 2009. Sylvatic Typhus Fact Sheet. Pennsylvania Department of Health.

Perry, D. 2007. Coexisting with beavers. DVD. Spring Farms Cares, Clinton, New York.

Phillips, R.L. 1970. Age ratios of Iowa foxes. Journal of Wildlife Management 34:52-56.

Phillips, R.L., and R.H. Schmidt. 1994. Fox. Pp C-83-88 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Pollock, M. M., T. M. Beechie, and C. E. Jordan. 2007. Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River basin, eastern Oregon. Earth Surface Processes and Landforms 32:1174-1185.

Powell, R.A. 1993. The fisher: Life history, ecology, and behavior. Second edition. University of Minnesota Press, Minneapolis, Minnesota.

Powell, R.A., and W.J. Zielinski. 1994. Fisher. Pp 28-73 *in* L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-254.

Powell, R.A., S.W. Buskirk, and W.J. Zielinski. 2003. Fisher and marten: *Martes pennanti* and *Martes americana*. Pp 635-649 *in* G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds. Wild Mammals Of North America: Biology, Management, And Conservation. The Johns Hopkins University Press, Baltimore, Maryland.

Pyrah, D. 1984. Social distribution and population estimates of coyotes in north-central Minnesota. Journal of Wildlife Management 48:679-690.

Quick, H.F. 1951. Notes on the ecology of weasels in Gunnison County, Colorado. Journal of Mammalogy 32:281-290.

Ramey, C.A., J.B. Bourassa, and J.E. Brooks. 2000. Potential risks to ring-necked pheasants in California agricultural areas using zinc phosphide. Internat. Biodeter, Biodegrad. 45:223-230.

Reese, K.P., and J.D. Hair. 1976. Avian species diversity in relation to beaver pond habitats in the Piedmont region of South Carolina. Proceeding of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 30:437-447.

Reid, D.G. 1984. Ecological interactions of river otters and beavers in a boreal ecosystem. M.S. Thesis, University of Calgary, Calgary, Alberta, 210 pp.

Reif, J.S. 1976. Seasonality, natality, and herd immunity in feline panleukopenia. Am. J. Epidemiology 103:81-87.

Richmond, N.D., and H.R. Roslund. 1949. Mammal survey of northwestern Pennsylvania. Pennsylvania Game Commission, Harrisburg, Pennsylvania. 67 pp.

RIDEM. 2011*a*. 2011-12 White-tailed Deer Status Report. Released May 2, 2012. Rhode Island Department of Environmental Management, Division of Fisheries and Wildlife. West Kingston, RI. http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/deerharv.pdf. Accessed July 23, 2012.

RIDEM. 2011*b*. 2011 - 2012 Rhode Island Hunting and Trapping Abstract. Rhode Island Department of Environmental Management, Division of Fish and Wildlife. West Kingston, Rhode Island. http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/huntabs.pdf. Accessed July 23, 2012.

RIDEM. 2011*c*. 2010-2011 Rhode Island Furbearer Harvest Report. Rhode Island Department of Environmental Management, Division of Fisheries and Wildlife. West Kingston, Rhode Island.

RIDEM. 2012. Cottontail rabbits in Rhode Island. http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/rabbits.pdf. Accessed February 2012.

Riley, S.P., D.J. Hadidian, and D.A. Manski. 1998. Population density, survival, and rabies in raccoons in an urban national park. Canadian Journal of Zoology 76:1153–1164.

Ringleman, J. K. 1991. Managing beaver to benefit waterfowl. Waterfowl Management Handbook. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Leaflet 13.4.7.

Ritcey, R.W., and R.Y. Edwards. 1956. Live trapping mink in British Columbia. Journal of Mammalogy 37:114-116.

Robinson, M. 1996. The potential for significant financial loss resulting from bird strikes in or around an airport. Proceedings and Papers. International Bird Strike Committee (IBSC) meeting no. 23, May 1996. London, U.K.: IBSC, 1996. 353-367.

Roblee, K.J. 1983. A wire mesh culvert for use in controlling water levels at nuisance beaver sites. Proc. East. Wildl. Dam. Control Conf. 3:25-33.

Roblee, K. J. 1984. Use of corrugated plastic drainage tubing for controlling water levels at nuisance beaver sites. New York Fish and Game Journal 31:63-80.

Roblee, K.J. 1987. The use of T-culvert guard to protect road culverts from plugging damage by beavers. Proc. East. Wildl. Damage Control Conf. 3:25-33.

Romin, L.A., and J.A. Bissonette. 1996. Deer-vehicle collisions: status of state monitoring activities and mitigation efforts. Wildlife Society Bulletin 24:276-283.

Rosatte, R.C. 1987. Skunks. Pp 599-613 *in* M. Novak, J. A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Roseberry, J.L., and A. Woolf. 1998. Habitat-population density relationships for white-tailed deer in Illinois. Wildlife Society Bulletin 26:252-258.

Ross, C.B., and J. Baron-Sorensen. 1998. Pet loss and human emotion: guiding clients through grief. Accelerated Development, Inc. Philadelphia, Pennsylvania. 166 pp.

Rossell, R. O. Bozsér, P. Collen, and H. Parker. 2005. Ecological impact of beavers Castor fiber and Castor Canadensis and their ability to modify ecosystems. Mammal Review 35:248-276.

Ruell, E.W., S.P.D. Riley, M.R. Douglas, J.P. Pollinger, and K.R. Crooks. 2009. Estimating bobcat population sizes and densities in a fragmented urban landscape using noninvasive capture-recapture sampling. Journal of Mammalogy 90:129–135.

Sanderson, G.C. 1987. Raccoons. Pp 486-499 *in* M. Novak, J. A. Baker, M.E. Obbard, and B. Mallock, eds., Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Sanderson, G.C., and G.F. Huber, Jr. 1982. Selected demographic characteristics of Illinois (U.S.A) raccoons (*Procyon lotor*). Pp 487-513 *in* J.A. Chapman and D. Pursely, eds. Worldwide furbearer conference proceedings. Maryland Wildl. Admin., Annapolis, Maryland.

Saunders, D.A. 1988. Adirondack Mammals. State University of New York, College of Environmental Science and Forestry. 216 pp.

Schmidt, R. 1989. Wildlife management and animal welfare. Trans. N.Amer. Wildl. And Nat. Res. Conf. 54:468-475.

Schmidt, R.H. 1994. Shrews. Pp D87-D91 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Schwartz, C.W., and E.R. Schwartz. 2001. The Wild Mammals of Missouri. Second Revised Edition. University of Missouri Press. 365 pp.

Seabrook, W. 1989. Feral cats (*Felis catus*) as predators of hatchling green turtles (*Chelonia mydas*). Journal of Zoology 219:83-88.

Seidensticker, J., M. A. O'Connell, and A. J. T. Johnsingh. 1987. Virginia Opossum. Pp 247-261 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, eds. Wild Furbearer Management and Conservation in North America. Ontario Ministry of Natural Resour., Ontario Trappers Assoc., North Bay.

Sheffield, S.R. and H.H. Thomas. 1997. *Mustela frenata*. Mammalian Species 570:1-9.

Siegfried, W.R. 1968. The reaction of certain birds to rodent baits treated with zinc phosphide. Ostrich 39:197-198.

Simard, M. A., C. Dussault, J. Huot, and S. D. Cote. 2013. Is hunting an effective tool to control overabundant deer? A test using an experimental approach. The Journal of Wildlife Management 77:254-269.

Simms, D.A. 1979*a*. North American weasels: resource utilization and distribution. Can. J. Zool. 57:504-520.

Simms, D.A. 1979*b*. Studies of an ermine population in southern Ontario. Can. J. Zool. 57:824-832.

Simon, L. 2006. Solving beaver flooding problems through the use of water flow control devices. Proceedings of the Vertebrate Pest Conference 22:174-180.

Slate, D. 1980. A study of New Jersey raccoon populations— determination of the densities, dynamics and incidence of disease in raccoon populations in New Jersey. N.J. Div. Fish, Game, and Wildl., Pittman-Robertson Proj. W-52-R-8, Final Rep. 67 pp.

Slate, D.A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. In Trans. N. A. Wildl. Nat. Res. Conf 57:51-62.

Slater, M.R. 2004. Understanding issues and solutions for unowned, free-roaming cat populations. Journal of the American Veterinary Medical Association 225:1350-1354.

Smith, G.W. 1977. Population characteristics of the porcupine in Northeastern Oregon. Journal of Mammalogy 58:674-676.

Smith, R.L. 1996. Ecology and field biology. Haper Collins College Publishers. New York, NY. 5th Ed. 733 pp.

Smithsonian National Museum of Natural History. 2012. North American Mammals. http://www.mnh.si.edu/mna/search_name.cfm. Accessed February 28, 2012.

Spock, M. 2006. Effectiveness of water flow devices as beaver conflict resolution tools: A satisfaction survey of Massachusetts clients. Center for Animals and Public Policy, Tufts University Cummings School of Veterinary Medicine. 50 pp.

Stansley, W., L. Widjeskog, and D.E. Roscoe. 1992. Lead contamination and mobility in surface water at trap and skeet ranges. Bulletin of Environmental Contamination and Toxicology 49:640-647.

State Farm Mutual Automobile Insurance Company. 2011*a*. U.S. deer-vehicle collisions fall 7 percent- Mishaps most likely in November and in West Virginia. http://www.statefarm.com/aboutus/_pressreleases/2011/october/3/us-deer-collisions-fall.asp. Accessed February 21, 2012.

State Farm Mutual Automobile Insurance Company. 2011*b*. Likelihood of collision with deer. http://www.statefarm.com/aboutus/_pdf/deer-chart-2011.pdf. Accessed February 21, 2012.

Stewart, C. M., and N. B. Veverka. 2011. The extent of lead fragmentation observed in deer culled by sharpshooting. Journal of Wildlife Management 75:1462-1466.

Stoskopf, M.K., and F.B. Nutter. 2004. Analyzing approaches to feral cat management-on size does not fit all. Journal of the American Veterinary Medical Association 225:1361-1364.

Strole, T.A., and R.C. Anderson. 1992. White-tailed deer browsing: species preferences and implications for central Illinois forests. Natural Areas Journal 12:139-144.

Stubbe, M. 1973. The ermine (*Mustela erminea* L.). Pp 288-303 *in* Buch der Hege, Vol. 1: Haarwild (H. Stubbe, ed.). V. E. B. Deutscher Landwirtschaftsverlag, Berlin, 448 pp. (in German).

Swihart, R.K. 1992. Home-range attributes and special structure of woodchuck populations. Journal of Mammalogy 73:604-618.

Swihart, R.K., and P.M. Picone. 1995. Use of woodchuck burrows by small mammals in agricultural habitats. American Midland Naturalist 133:360-363.

Teutsch, S.M., D.D. Juranek, A. Sulzer, J.P. Dubey, and R. K. Sikes. 1979. Epidemic toxoplasmosis associated with infected cats. N. Engl. J. Med. 300:695-699.

The Insurance Institute of Highway Safety. 2005. Human deaths in crashes with animals can be reduced, even without reducing the collisions. Status Report. Vol. 40, No. 1. http://www.iihs.org/externaldata/srdata/docs/sr4001.pdf. Accessed April 9, 2012.

The Wildlife Society. 1990. Conservation Policies of the Wildlife Society. The Wildlife Society, Washington., D.C. 20 pp.

Thompson, J.L. 2008. Density of fisher on managed timberlands in north coastal California. M.S. Thesis, Humboldt State University, Arcata, California.

Thorpe, J. 1996. Fatalities and destroyed civil aircraft due to bird strikes, 1912-1995. Proceedings of the Bird Strike Committee Europe 23:17-31.

Tietjen, H.P. 1976. Zinc phosphide – its development as a control agent for black-tailed prairie dogs. U.S. Fish and Wildlife Service, Special Report on Wildlife 195.

Tietjen, H.P., and G.H. Matschke. 1982. Aerial pre-baiting for the management of prairie dogs with zinc phosphide. Journal of Wildlife Management 46:1108-1112.

Tilghman, N.G. 1989. Impacts of white-tailed deer on forest regeneration in northwestern Pennsylvania. Journal of Wildlife Management 53:524-532.

Till J. A. 1992. Behavioral effects of removal of coyote pups from dens. Proc. Vertebr. Pest Conf. 15:396-399.

Timm, R.M. 1994. Norway rats. Pp B105-B120 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Timm, R.M., R.O. Baker, J.R. Bennett, and C.C. Coolahan. 2004. Coyote attacks: An increasing urban problem. Presented at 69th North American Wildlife and Natural Resources Conference, Spokone, Washington. March 16–20 2004.

Timm, R.M., and W.E. Howard. 1994. White-footed and deer mice. Pp B47-B51 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Trapp, G.R. 1978. Comparative behavioral ecology of the ringtail (*Bassariscus astutu*s) and gray fox *(Urocyon cinereoargenteu*s) in southwestern Utah. Carnivore 1:3–32.

Truyen U., D. Addie, S. Belák, C. Boucraut-Baralon, H. Egberink, T. Frymus, T. Gruffydd-Jones, K. Hartmann, M.J. Hosie, A. Lloret, H. Lutz, F. Marsilio, M.G. Pennisi, A.D. Radford, E. Thiry, and M.C. Horzinek. 2009. Feline panleukopenia. ABCD guidelines on prevention and management. J. Feline Med. Surg. 11:538-46.

Teutsch, S.M., D.D. Juranek, A. Sulzer, J.P. Dubey, and R. K. Sikes. 1979. Epidemic toxoplasmosis associated with infected cats. N. Engl. J. Med. 300:695-699.

Twichell, A.R. 1939. Notes on the southern woodchuck in Missouri. Journal of Mammology 20:71-74.

Twichell, A.R., and H.H. Dill. 1949. One hundred raccoons from one hundred and two acres. Journal of Mammalogy 30:130–133.

United States Census Bureau. 2012. U.S. Census Bureau, State and County Quick Facts. http://quickfacts.census.gov/qfd/states/. Accessed April 3, 2012.

USDA. 2005. Supplemental Environmental Assessment: Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Fox, and Coyotes in the United States. USDA, APHIS, WS, 4700 River Road, Unit 87, Room 2D05, Riverdale, Maryland 20782.

USDA. 2010*a*. USDA-APHIS-Wildlife Services. Managing Wildlife Damage to Crops and Agriculture. http://www.aphis.usda.gov/wildlife_damage/state_report_pdfs/2010/protects_agriculture.pdf. USDA, APHIS, WS, Operational Support Staff, 4700 River Road, Unit 87, Room 2D05, Riverdale, MD 20782. Accessed March 29, 2012.

USDA. 2010*b*. Questions and Answers: GonaconTM-Birth control for deer. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. 3 pp.

USDI. 1979. Mammalian predator damage management for livestock protection in the Western United States. Final Environmental Impact Statement. Washington, D.C. 789 pp.

USDI. 2008. Fish and Wildlife Service, Fergus Falls Wetland Management District - Wetlands. http://www.fws.gov/midwest/FergusFallsWetland/wetland.html. Accessed September 25, 2012.

USFWS. 2001. Inside Region 3: Ohio man to pay more than $11,000 for poisoning migratory birds. Volume 4(2):5.

United States General Accounting Office. 2001. Wildlife Services Program: Information on activities to manage wildlife damage. Report to Congressional Committees. GOA-02-138. 71 pp.

Uresk, D.W., R.M. King, A.D. Apa, M.S. Deisch, and R.L. Linder. 1988. Rodenticidal effects of zinc phosphide and strychnine on notarget species. Pp. 57-63 *in* D. W. Uresk, G. L. Schenbeck, and R. Cefkin, tech. coordinators. Eighth Great Plains Wildlife Damage Control Workshop Proceedings, Fort Collins, Colorado, USA. GTR RM-154. USDA Forest Service Rocky Mountain Forest and Range Experiment Station.

Vaisfeld, M.A. 1972. Ecology of the ermine in the cold season in the European North. Pp 1-10 *in* C.M. King, ed. Biology of Mustelids, some Soviet research: vol. 2 (1980), Sciences Information Division, Dept. Scientific and Industrial Research, Wellington, New Zealand.

VanDruff , L.W. 1971. The ecology of the raccoon and opossum, with emphasis on their role as waterfowl nest predators. Ph.D. Thesis. Cornell University, Ithaca, N.Y. 140 pp.

Vaughn, J.B. 1976. Cat rabies. Pp 139-154 *in* G.M. Baer, ed. The Natural History of Rabies. Vol. II. Academic Press, New York.

Virginia Department of Game and Inland Fisheries. 1999. Virginia deer management plan. Virginia Department of Game and Inland Fisheries, Wildlife Division, Wildlife Information Publication No. 99-1. Richmond, Virginia. 68 pp.

Vermont Fish and Wildlife. 2012. Vermont Wildlife Fact Sheet-Snowshoe Hare. http://www.vtfishandwildlife.com/vtcritters/factsheets/Mammals/Snowshoe%20Hare/Snowshoe%20Hare.pdf. Accessed February 17, 2012.

Ver Steeg, J.M., J.H. Witham, and T.J. Beissel. 1995. Use of bowhunting to control deer in suburban park in Illinois. Pp 110-116 *in* J.B. McAninch, ed. Urban deer: A manageable resource? Proceedings 1993 Symposium North Central Section, The Wildlife Society. 12-14 December 1993, St. Louis, Missouri.

Verts, B.J. 1963. Movements and populations of opossums in a cultivated area. Journal of Wildlife Management 27:127129.

Virchow, D., and D. Hogeland. 1994. Bobcats. Pp. C35-C45 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Voigt, D.R. 1987. Red fox. Pp 378-392 *in* M. Novak, J. A. Baker, M.E. Obbard, and B. Mallock, eds., Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Voigt, D.R., and R.L. Tinline. 1980. Strategies for analyzing radio tracking data. Pp 387–404 *in* C. J. Amlaner, Jr., and D. W. Macdonald, eds. A handbook on biotelemetry and radio tracking. Pergamon Press, Oxford, United Kingdom.

Voigt, D.R, and B.D. Earle. 1983. Avoidance of coyotes by red fox families. Journal of Wildlife Management 47:852–857.

Voigt, D.R, and D.W. MacDonald. 1984. Variation in the spatial and social behavior of the red fox, *Vulpes vulpes.* Acta Zool. Fenn. 171:261-265.

Voigt, D.R, and W.E. Berg. 1987. Coyote. Pp 345-357 *in* M. Novak, J. A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Wade, D.E., and C.W. Ramsey. 1986. Identifying and managing mammals in Texas: beaver, nutria and muskrat. Texas Agricultural Extension Service and Texas Agriculture Experimental Station. Texas A&M University in cooperation with USDI-USFWS Pub. B-1556, College Station, Texas.

Waller, D.M., and W.S. Alverson. 1997. The white-tailed deer: a keystone herbivore. Wildlife Society Bulletin 25:217-226.

Warren, R.J. 1991. Ecological justification for controlling deer populations in eastern national parks. Trans. North Am. Wildl. Nat. Resour. Conf. 56:56-66.

Waters, J.H. 1962. Range of *Peromyscus maniculatus* in Southern New England. Journal of Mammalogy 43:102.

Weisman, A.D. 1991. Bereavement and companion animals. Omega: Journal of Death & Dying 22: 241-248.

Whitaker, Jr., J.O. 1972. Mammalian Species. *Zapus hudsonius*. The American Society of Mammalogists 11:1-7.

Whitaker, Jr., J.O., and W.L.J. Hamilton, Jr. 1998. Mammals of the Eastern United States. Cornell University Press, Ithaca, New York. 583 pp.

Whitaker, Jr., J.O., and R.E. Wrigley. 1972. Mammalian Species. *Napaeozapus insignis*. The American Society of Mammalogists 14:1-6.

White, D.H., L.E. Hayes, and P.B. Bush. 1989. Case histories of wild birds killed intentionally with famphur in Georgia and West Virginia. Journal of Wildlife Diseases 25:144-188.

Wilcove, D.S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. Ecology 66: 1211-1214.

Williams, A.B. 1936. The composition and dynamics of a beech-maple climax community. Ecological Monographs 6:317-408.

Williams, D.E., and R.M. Corrigan. 1994. Pp B13-B16 *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds. Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebraska.

Windberg, L.A., and F.F. Knowlton. 1988. Management implications of coyote spacing patterns in southern Texas. Journal of Wildlife Management 52:632-640.

Winter, L. 2004. Trap-neuter-release programs: The reality and the impacts. Journal of the American Veterinary Medical Association 225:1369-1376.

Wiseman G.L., and G.O. Hendrickson. 1950. Notes on the life history of the opossum in southeast Iowa. Journal of Mammalogy 31:331-337.

Wood, G. W., L. A. Woodward, and G. Yarrow. 1994. The Clemson beaver pond leveler. Clemson University Department of Aquaculture, Fisheries and Wildlife Extension Leaflet 1, March 1994. 4 pp.

Woodward, D. K., J. D. Hair, and B. P. Gaffney. 1976. Status of beaver in South Carolina as determined by a postal survey of landowners. Proceedings of the Annual Conference of Southeast Fish and Wildlife Agencies 30:448-54.

Woodward, D. K., R. B. Hazel, and B. P. Gaffney. 1985. Economic and environmental impacts of beavers in North Carolina. Proceedings of the Eastern Wildlife Damage Management Conference 2:89-96.

Woolington, J.D. 1984. Habitat use and movements of river otters at Kelp Bay, Baranof Island, Alaska. M.S. Thesis, University of Alaska, Fairbanks, Alaska.

WPRI. 2009. Fisher cat attacks boy waiting for bus. WPRI Channel 12 News. http://www.wpri.com/dpp/news/local_news/local_wpri_hopkinton_fisher_cat_attacks_boy_waiting_for_bus20090623_tro. Accessed April 6, 2012.

Wright, J. P., C. G. Jones, and A. S. Flecker. 2002. An ecosystem engineer, the beaver, increases species richness on a landscape scale. Oecologia 132:96-101.

Wrigley, R.E., J.E. Dubois, and H.W.R. Copland. 1979. Habitat, abundance, and distribution of six species of shrews in Manitoba. Journal of Mammalogy 60:505-520.

Yates, T.L., and D.J. Schmidly. 1978. Mammalian Species. *Scalopus aquaticus*. The American Society of Mammalogists 105:1-4.

Yeager, L.E., and R.G. Rennels. 1943. Fur yield and autumn foods of the raccoon in Illinois river bottom lands. Journal of Wildlife Management 7:45–60.

Zasloff, R.L. 1996. Human-animal interactions. Special Issue. Applied Animal Behaviour Science 47:43-48.

APPENDIX B

METHODS AVAILABLE FOR RESOLVING OR PREVENTING MAMMAL DAMAGE IN RHODE ISLAND

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 wildlife while minimizing harmful effects of damage reduction measures on humans, 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 Rhode Island 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 Rhode Island. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

Non-chemical Wildlife Damage Management Methods

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

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing of small critical areas can sometimes prevent animals that cannot climb from entering areas of protected resources. Fencing of culverts, drainpipes, and other water control structures can sometimes prevent beaver from building dams that plug those devices. Fencing installed with an underground skirt can prevent access to areas for many mammal species that dig, including fox, feral cats, and striped skunks. Areas such as airports, yards, or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and gnawing of valuable trees and to prevent the entry of mammals into buildings through existing holes or gaps. Construction of concrete spillways may reduce or prevent damage to dams by burrowing aquatic rodent species. Riprap can also be used on dams and levees to deter muskrat, woodchuck, and other burrowing rodents. Electric fences of various constructions have been used effectively to reduce damage to various crops by deer, raccoons, and other species (Boggess 1994*a*, Craven and Hygnstrom 1994).

Beaver exclusion and the use of water control devices could be recommended or implemented by WS to alleviate flooding damage without removing beaver under the alternatives. Although dams could be breached/removed manually, those methods are usually ineffective because beaver quickly repair or replace the dam (McNeely 1995). Damage may be effectively reduced in some situations by installing exclusion and water control devices. Exclusion and water control devices can be designed so that the level of the beaver-created pond can be managed to eliminate or minimize damage while retaining the ecological and recreational benefits derived from beaver ponds. WS could also recommend that modifications occur to culvert design (Jensen et al. 1999) as a non-lethal way of reducing problems with beaver dams at culverts.

Beaver exclusion generally involves the placement of fencing to prevent beaver from accessing water intake areas, such as culverts. A variety of exclusion systems could be recommended or implemented by WS, including the Beaver Deceiver™, Beaver Bafflers™, and pre-dams (Lisle 1996, Brown and Brown 1999, Lisle 1999, Brown et al. 2001, Partington 2002, Lisle 2003). The Beaver Deceiver™ is a fencing system that is installed to prevent beaver blockage of culverts by minimizing environmental cues that stimulate beaver to construct dams, and by making culverts less attractive as dam construction sites (Lisle 1996, Lisle 1999, Lisle 2003). Beaver can be deterred from blocking culverts by the installation of a fence on the upstream end of the culvert. Installation of a fence increases the length of the area that must be dammed to impound water, and if beaver build along the fence, may increase the distance between the beaver and the source of the cues that stimulate damming behavior (*e.g.*, water moving through culvert) (Lisle 1996, Lisle 1999, Lisle 2003, Callahan 2005). Beaver prefer to build dams perpendicular to water flow, so fences can be oriented at odd angles to water flow and can be set so that they do not block the stream channel. Fencing can also be used to cover the up and downstream ends of the culverts to prevent beaver from entering the deceiver from the downstream side of the culvert and to prevent any beaver that might make it past the outer fence from plugging the interior of the culvert. Efforts can also be made to reduce the sound of water flowing through the culvert by raising the water level on the down-stream side of the culvert with dam boards or beaver-made dams; by constructing flumes to replace waterfalls, or, in extreme cases, by resetting the culvert (Lisle 1996). To ensure sufficient water flow through the culvert, Beaver Deceivers™ may be used in combination with water control devices (see discussion on Beaver Deceivers™ below).

Cylindrical exclusion devices like the Beaver Bafflers™ can be attached to culvert openings to reduce the likelihood that beaver plug a culvert by spreading the water intake over a larger area (Brown et al. 2001). While cylindrical exclusion devices can be effective in some situations (Partington 2002), in a study of beaver exclusion and water control devices, cylindrical shapes attached in-line with a culvert had a higher failure rate (40%) than trapezoidal shapes (*e.g.*, Beaver Deceivers™; 3% failure rate) and use of the cylindrical devices was discontinued in favor of trapezoidal fences (Callahan 2005).

Unlike Beaver Deceivers™ and cylindrical fences, pre-dam fences (*e.g.*, deep-water fences, diversion dams) (Brown and Brown 1999) can be designed with the specific intention that the beaver build the dam along the fence. Pre-dam fences can be short semicircular or circular fences that are built in an arc around a water inlet. The fence serves as a dam construction platform that allows beaver to build a dam and pond at the site but prevents beaver from plugging the water intake. If the size of the upstream pond created from the impounded water were not a concern, no further modifications of the pre-dam would be needed. However, in most cases, pre-dams would be used in combination with water control devices to manage the size of the upstream pond to alleviate flooding concerns.

Fence mesh size can be selected to minimize risks to beaver and non-target species. Brown et al. (2001) noted that beaver occasionally became stuck in 6-inch mesh and that the risk of beaver entrapment was lower with 5-inch mesh. Lisle (1999) noted that the size of the mesh on the fence of the Beaver Deceivers™ (6-inch mesh) was such that it allowed most species to pass through the fence except beaver and big turtles. In some remote areas where vehicular traffic is infrequent, it may be acceptable for animals that cannot pass through the fence mesh to travel across the road. However, for culverts under busy roads, it may be necessary to design special "*doors*" that allow the passage of beaver, large turtles, and other non-targets through the device. For example, T-joints 30 centimeters in diameter have been used to allow access through Beaver Deceiver™ fences. The T-shape reduces the likelihood that beaver can haul woody debris for dam construction inside the device (Lisle 2003). Fence caps would not be attached to the up and down-stream ends of a culvert when it is necessary to allow passage of species like large turtles and beavers through a culvert.

Water control devices (*e.g.*, pond levelers) are systems that allow the passage of water through a beaver dam. The devices could be used in situations where the presence of a beaver pond is desired but it is necessary to manage the level of water in the pond. Various types of water control devices have been described (Arner 1964, Roblee 1984, Laramie and Knowles 1985, Miller and Yarrow 1994, Wood et al. 1994, Lisle 1996, Organ et al. 1996, Brown and Brown 1999, Lisle 1999, Brown et al. 2001, Close 2003, Lisle 2003, Clemson University 2006, Simon 2006, Spock 2006, Perry 2007). The devices generally involve the use of one or more pipes installed through the beaver dam to increase the flow of water through the dam. Height and placement of pipes can be adjusted to achieve the desired water level in the beaver pond. Beaver generally only check the dam for leaks, so, when site conditions permit, the inlet of the pipe is placed away from the dam to make the source of the water flow more difficult to detect and decrease the likelihood that beaver will attempt to plug the device. To minimize the sound/sensation of water movement and the associated beaver damming behavior, the end of the pipe may be capped with a series of holes or notches cut in the pipe, which allows water to flow into the pipe. Holes and notches may be placed on the underside of the pipe to reduce the sound of water movement. Alternatively, 90-degree elbow joints can be placed facing downward on the upstream end of the pipes to prevent the noise of running water and attracting beaver. A protective cage can be placed around the upstream end of the inlet pipe to prevent beaver from blocking the pipe and to reduce problems with debris blocking the pipe. As noted above, water control systems can be combined with exclusion devices to prevent beaver from blocking culverts while still maintaining a beaver pond at an acceptable level.

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. Continual destruction of beaver dams and removal of dam construction materials on a daily basis will sometimes cause beavers to move to other locations. Water control devices such as the 3-log drain (Roblee 1983), the T-culvert guard (Roblee 1987), wire mesh culvert (Roblee 1983), and the Clemson beaver pond leveler (Miller and Yarrow 1994) can sometimes be used to control the water in beaver ponds to desirable levels that do not cause damage. Removal of trees from around buildings can sometimes reduce damage associated with tree squirrels and raccoons.

Some mammals that cause damage in urban environments 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.

Beaver dam breaching/removal is generally conducted to maintain existing stream channels and drainage patterns, and reduce floodwaters that have affected established silviculture, agriculture, or drainage structures, such as culverts. Beaver dams are made from natural debris such as logs, sticks and mud that beaver take from the immediate area and impound water, creating habitat that they utilize to build lodges and bank dens to raise their young and/or provide protection from predators. The impoundments that WS could remove or breach would typically be created by recent beaver activity, which have not been in place long enough to take on the qualities of a true wetland (*e.g*., hydric soils, aquatic vegetation, pre-existing function). Unwanted beaver dams can be removed by hand with a rake or power tools (*e.g.*, a winch). Beaver dam removal or breaching by hand would not affect the substrate or the natural course of a stream. Removing or breaching dams would return an area back to its pre-existing condition with similar flows and circulations. Because beaver dams involve waters of the United States, removal is regulated under Section 404 of the Clean Water Act (see Appendix D).

Supplemental feeding is sometimes used to reduce damage by wildlife, such as lure crops. Food is provided so that the animal causing damage would consume it rather than the resource being protected. In feeding programs, target wildlife would be offered an alternative food source with a higher appeal with the intention of luring them from feeding on affected resources.

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. Those techniques are usually aimed at causing target animals to respond by fleeing from the site or remaining at a distance. They usually employ extreme noise or visual stimuli. Unfortunately, many of these techniques are only effective for a short time before wildlife habituate to them (Conover 1982). Devices used to modify behavior in mammals include electronic guards (siren strobe-light devices), propane exploders, pyrotechnics, laser lights, human effigies, effigies of predators, and the noise associated with the discharge of a firearm.

Live Capture and Translocation can be accomplished using hand capture, hand nets, catch poles, cage traps, suitcase type traps, 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 Rhode Island 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 humans. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. The AVMA, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission (CDC 1990). Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise in Rhode Island 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 RIDEM.

Trapping can utilize a number of devices, including foothold traps, cage-type traps, and body gripping (Conibear) traps, snap traps, and glue traps. Those techniques would be implemented by WS' personnel because of the technical training required to use such devices.

Foothold Traps can be effectively used to capture a variety of mammals. Foothold traps would 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 foothold trap's selectivity. An additional advantage would be that foothold traps can allow for the on-site release of non-target animals since animals would be captured alive. The use of foothold traps requires more skill than some methods. Foothold traps would only be used by WS when authorized by the RIDEM through the issuance of a permit pursuant to State law.

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.

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; and 4) some animals will fight to escape and may become injured; 5) expense of purchasing traps. Disadvantages associated with corral traps include: 1) the expense of purchasing the materials to construct trap, 2) once constructed, corral traps are not moveable until disassembled and transported, and 3) in remote areas, getting all the required equipment to the location can be difficult.

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

Trap monitoring devices would be employed, when applicable, that indicate when a trap has been activated. Trap monitoring devices would allow personnel to prioritize trap checks and decrease the amount of time required to check traps, which decreases the amount of time captured target or 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.

Hancock/Bailey Traps (suitcase/basket type cage traps) are designed to live-capture beaver. The trap is constructed of a metal frame that is hinged with springs attached and covered with chain-link fence. The trap's appearance is similar to a large suitcase when closed. When set, the trap is generally baited and opened to allow an animal to enter. When tripped, the panels of the trap close around the animal capturing the animal. One advantage of using the Hancock or Bailey trap is the ease of release of beaver or non-target animals. Beaver caught in Hancock or Bailey traps could also be humanely euthanized. Disadvantages are that those traps are very expensive (>$300 per trap), cumbersome, and difficult to set (Miller and Yarrow 1994). The trap weighs about 25 pounds and is relatively bulky to carry and maneuver. Hancock and Bailey traps can also be dangerous to set (*i.e.*, hardhats are recommended when setting suitcase traps), are less cost and time-efficient than foothold traps, body-grip traps, or cable restraints and may cause serious and debilitating injury to river otters (Blundell et al. 1999).

Body-grip Traps are designed to cause the quick death of the animal that activates the trap. Body-grip traps may include conibear traps, snap traps, and mole traps. The conibear trap consists of a pair of rectangular wire frames that close like scissors when triggered, killing the captured animal with a quick body blow. For conibear traps, the traps should be placed so ensure the rotating jaws close on either side of the neck of the animal to ensure a quick death. Conibear traps are lightweight and easily set. Snap traps are common household rat or mouse traps. Body-grip traps are designed to cause the quick death of the animal that activates the trap. Placement is along travel corridors or they may be baited. The animal is captured as crosses over the triggering mechanism or while it feeds on the bait. Snap traps are small, designed for mice and rats, and safety hazards and risks to humans are usually low and are related to setting, placing, checking, or removing the 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 humans 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. For example, conibear traps set to capture beaver can be placed underwater to minimize risks to non-targets. 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.

Drop nets are nylon or cloth nets that would be suspended above an area actively used by an animal or group of animals where target individuals have been conditioned to feed (Ramsey 1968). The area would be baited and once feeding occurs under the net, the net would be released. Drop nets require constant supervision by personnel to drop the net when target individuals are present and when animals are underneath the net. This method has limited use due to the time and effort required to condition animals to feed in a location and the required monitoring of the site to drop the net when target wildlife are present. Nets are used to live-capture target individuals and if any 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. Only personnel trained in the safe handling of explosive charges will be allowed to employ rocket nets when explosive charges are used. Pneumatic cannon nets can 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 not be available for use by the public and would not be available for use by the public under. A permit may be required from the RIDEM to use cannon nets.

Species Specific Traps can be effectively used specifically to capture raccoons. Traps specific to species would be either placed beside travel ways or foraging areas being actively used by raccoons. These types of traps require bait to be placed inside the trap and the raccoon is required to reach in with its paw in an attempt to access the bait resulting in capture.

Glue Traps also called glue boards or sticky traps are designed to capture mice and rats that cross over them in an extremely sticky glue. They do not cause a quick death of the animal trapped which generally die from dehydration and may be considered inhumane if they are not checked regularly and trapped animals humanely euthanized or released (the glue can be deactivated with vegetable oil). Placement is along travel corridors used by the target species. Safety hazards and risks to humans are very low.

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, illuminating devices, bait, firearm suppressors, night vision/thermal equipment, and elevated platforms. Shooting is an effective method in some circumstances, and can often provide immediate relief from the problem. Shooting may at times be one of the only methods available to effectively and efficiently resolve a wildlife problem.

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

Shooting can also be used in conjunction with an illumination device at night, which is especially useful for nocturnal mammals, such as deer. Spotlights may or may not be covered with a red lens, which nocturnal animals may not be able to see, making it easier to locate them undisturbed. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and Forward Looking Infrared (FLIR) devices can also be used to detect and shoot mammals at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and FLIR equipment aid in locating wildlife at night when wildlife may be more active. Night vision and FLIR equipment could be used during surveys and in combination with shooting to remove target mammals at night. WS' personnel most often use this technology to target mammals in the act of causing damage or likely responsible for causing damage. Those methods aid in the use of other methods or allow other methods to be applied more selectively and efficiently. Night vision and FLIR equipment allow for the identification of target species during night activities, which reduces the risks to non-targets and reduces human safety risks. Night vision equipment and FLIR devices only aid in the identification of wildlife and are not actual methods of take. 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 or T&E species 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 or kits will often stop depredations even if the adults are not taken (Till 1992). Pups or kits are typically euthanized by digging out the den or setting box traps and euthanizing the pups or kits with sodium pentobarbital.

Hunting/Trapping: WS sometimes recommends that 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 areas, it can be used to reduce some populations of mammals.

Chemical Wildlife Damage Management Methods

All pesticides used by WS are registered under the FIFRA and administered by the EPA and the RIDEM. All WS personnel in Rhode Island who apply restricted-use pesticides would be certified pesticide applicators by RIDEM and have specific training by WS for pesticide application. The EPA and RIDEM 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 FDA and/or DEA.

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.

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 (Fowler and Miller 1999). 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 (Fowler and Miller 1999). 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 2007). Sodium Pentobarbital would only be administered after deer have been live-captured and properly immobilized to allow for direct injection. There are DEA 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 DEA and state regulations. All animals euthanized using sodium pentobarbital and all of its dilutions (*e.g.* Beuthanasia-D, Fatal-Plus) would be 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 (2007). Animals that have been euthanized with this chemical experience cardiac arrest followed by death, and are not toxic to predators or scavengers.

Beuthanasia®-D combines pentobarbital with another substance to hasten cardiac arrest. Intravenous (IV) and intracardiac (IC) are the only acceptable routes of injection. As with pure sodium pentobarbital, IC injections with Beuthanasia®-D are only acceptable for animals that are unconscious or deeply anesthetized. With other injection routes, there are concerns that the cardiotoxic properties may cause cardiac arrest before the animal is fully unconscious. It is a Schedule III drug, which means it can be obtained directly from the manufacturer by anyone with a DEA registration. However, Schedule III drugs are subject to the same security and record-keeping requirements as Schedule II drugs.

Fatal-Plus® combines pentobarbital 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 DEA 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. CO_2 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. CO_2 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 CO_2 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, phosphate gas is released, which may account in a large part for observed toxicity. Animals that ingest lethal amounts of bait usually succumb overnight with terminal symptoms of convulsions, paralysis, coma, and death from asphyxia. If death is prolonged for several days, intoxication that occurs is similar to intoxication with yellow phosphorous, in which the liver is heavily damaged. Prolonged exposure to phosphine can produce chronic phosphorous poisoning.

Although zinc phosphide baits have a strong, pungent, phosphorous-like odor (garlic like), this characteristic seems to attract rodents, particularly rats, and apparently makes the bait unattractive to some other animals. For many uses of zinc phosphide formulated on grain or grain-based baits, pre-baiting is recommended or necessary for achieving good bait acceptance. Primary toxicity risks to non-target species from the direct consumption of treated bait can be minimized by using bait stations to prevent access by non-target species such as birds.

Because zinc phosphide is not stored in muscle or other tissues of poisoned animals, there is no secondary poisoning with this rodenticide. The bait however, remains toxic up to several days in the gut of the dead rodent. Other animals can be poisoned if they eat enough of the gut content of rodents recently killed with zinc phosphide.

Aluminum phosphide is an inorganic phosphide used to control insects and rodents in a variety of settings. It is mainly used as an indoor fumigant at crop transport, storage or processing facilities (or in ship holds, railcars) for both food and non-food crops. It may also be used as an outdoor fumigant for burrowing rodent and mole control, or in baits for rodent control in crops. Aluminum phosphide is available in pellet and tablet form, and is available in porous blister packs, sachets, or as dusts. As in the case of Phostoxin, it may be formulated as 55% active ingredient along with ammonium carbamate and inert ingredients.

Aluminum phosphide causes acute toxicity with the main routes of exposure occurring through ingestion and inhalation. Dermal absorption is not known to occur. The reported rodent oral LD_{50} is 11.5 mg/kg for Phostoxin. Aluminum phosphide ingested orally reacts with water and stomach acids to produce phosphine gas, which may account in a large part for the observed toxicity. Phosphine generated in the gastrointestinal tract is readily absorbed in to the bloodstream, and it is readily absorbed through the lung epithelium.

In chronic toxicity studies, rats fed chow fumigated with aluminum phosphide that averaged 0.51 ppm phosphine residues (approximately 0.43 mg/kg/day) showed no differences from the control animals with respect to blood or urine chemistry and no observable differences in tissue structure. It was reported that workers had probably encountered similar exposures on an intermittent basis (in some cases over as long as a 20-year period) and had yet to show signs of toxicity, which suggests that chronic effects may be minor or have a very long latency period. Inhalation studies were conducted on the effects of phosphine gas on male and female rats exposed at levels of 0.5, 1.5, and 4.5 mg/meters cubed for six hours per day over a 13-week period. Higher exposure groups (7.5 and 15 mg/meters cubed) were added following preliminary acute test results.

Results indicated that 15 mg/m^3 were lethal to 4 out of 10 female rats following 3 days of exposure. Significant treatment-related effects on body weight and decreased food consumption were seen across all treatment groups and sexes, but were reversible. Decreases in red-blood cell counts, hemoglobin, hematocrit, and increased platelet counts were seen in male rats of the 4.5 mg/m^3 group.

Dose-related changes in blood urea nitrogen and other clinical parameters were also seen across exposure groups. Post-mortem examination of test animals revealed microscopic lesions in the outer cortex of the kidneys of rats exposed to 15 mg/m^3, but not at lower exposure levels. All of those effects were apparently reversible following a four-week recovery period.

Aluminum phosphide would be used by WS in Rhode Island primarily as a fumigant for small field rodents and moles. Products would be used in accordance with label restrictions in a manner defined by application guidelines on the label. Use in Rhode Island would be infrequent and amounts used would be very small.

Anticoagulant rodent baits with warfarin, brodifacoum, or diphacinone as active ingredients could be used in bait stations to target small rodents. Warfarin, Brodifacoum and Diphacinone are anticoagulant rodenticides used to control commensal rodents and some field rodents around buildings and other structures. Anticoagulants are normally classified as multiple dose toxicants and to be effective, animals must feed on the bait more than once. Bait for rats and mice must be continuously available for 2 to 3 weeks for effective population control. WS would utilize locking bait stations to restrict access of non-target species to rodenticides such as anticoagulants. The use and proper placement of bait stations would minimize the likelihood that the bait would be consumed by non-target species. There may be secondary hazards from anticoagulant baits. Those risks would be reduced somewhat by the fact that the predator scavenger species would usually need exposure to multiple carcasses over a period of days. Areas where anticoagulants are used would be monitored and carcasses picked up and disposed of in accordance with label directions.

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 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.

Fumigants such as the large gas cartridge (EPA Reg. No. 56228-1) and gas cartridge (EPA Reg. No. 56228-2) are registered by WS with the RIDEM and 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*a*, EPA 1986*b*). 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 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).

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 Gonadotropin-releasing hormone (GnRH) vaccine on California ground squirrels, Norway rats, feral cats and dogs, feral swine, wild horses, and white-tailed deer. Infertility among treated female swine and white-tailed deer has been documented for up to two years without requiring a booster vaccination (Miller et al. 2000). This vaccine overcomes one of the major obstacles of previous two dose vaccines since target wildlife need to be captured only once for vaccination instead of twice. A single-injection vaccine would be much more practical as a field delivery system for use on free-ranging animals.

GonaCon™ was officially registered by the EPA in 2009 for use in reducing fertility in female white-tailed deer under EPA registration number 56228-40. GonaCon™ is registered as a restricted-use pesticide available for use by WS' personnel and personnel of a state wildlife management agency or persons under their authority. Additionally, in order for GonaCon™ to be used in any given state, the product must also be registered with the state and approved for use by the appropriate state agency responsible for managing wildlife. GonaCon™, when injected into the body, elicits an immune response that neutralizes the GnRH hormone being produced naturally by deer. The GnRH hormone in deer stimulates the production of other sexual hormones, which leads to the body reaching a reproductive state. The vaccine neutralizes the GnRH hormone being produced, which then prevents the production of other sexual hormones in the deer vaccinated; thereby, preventing the body of the deer from entering into a reproductive state (USDA 2010*b*).

APPENDIX C

THREATENED AND ENDANGERED SPECIES THAT ARE LISTED IN THE STATE OF RHODE ISLAND

RARE NATIVE ANIMALS OF RHODE ISLAND
Revised: March, 2006

ABOUT THIS LIST

The list is divided by vertebrates and invertebrates and is arranged taxonomically according to the recognized authority cited before each group. Appropriate synonymy is included where names have changed since publication of the cited authority.

The Natural Heritage Program's *Rare Native Plants of Rhode Island* includes an estimate of the number of "extant populations" for each listed plant species, a figure which has been helpful in assessing the health of each species. Because animals are mobile, some exhibiting annual long-distance migrations, it is not possible to derive a population index that can be applied to all animal groups. The status assigned to each species (see definitions below) provides some indication of its range, relative abundance, and vulnerability to decline. More specific and pertinent data is available from the Natural Heritage Program, the Rhode Island Endangered Species Program, and the Rhode Island Natural History Survey.

STATUS The status of each species is designated by letter codes as defined:

(FE) **Federally Endangered** (7 species currently listed)
(FT) **Federally Threatened** (2 species currently listed)
(SE) **State Endangered** Native species in imminent danger of extirpation from Rhode Island. These taxa may meet one or more of the following criteria:

1. Formerly considered by the U.S. Fish and Wildlife Service for Federal listing as endangered or threatened.
2. Known from an estimated 1 to 2 total populations in the state.
3. Apparently globally rare or threatened; estimated at 100 or fewer populations range-wide.

Animals listed as State Endangered are protected under the provisions of the Rhode Island State Endangered Species Act, Title 20 of the General Laws of the State of Rhode Island. This law states, in part (20-37-3):

"No person shall buy, sell, offer for sale, store, transport, export, or otherwise traffic in any animal or plant or any part of any animal or plant whether living or dead, processed, manufactured, preserved or raw if such animal or plant has been declared to be an endangered species by either the United States secretaries of the Interior or Commerce or the Director of the R. I. Department of Environmental Management."

(ST) **State Threatened:** Native species that are likely to become State Endangered in the future if current trends in habitat loss or other detrimental factors remain unchanged. In general, these taxa have 3-5 known or estimated populations and are especially vulnerable to habitat loss.

(C) **Concern:** Native species not considered to be State Endangered or State Threatened at the present time, but are listed due to various factors of rarity and/or vulnerability. Species listed in this category may warrant endangered or threatened designation, but status information is presently not well known.

(SH) **State Historical:** Native species which have been documented for the state during the last 100 years, but which are currently unknown to occur. When known, the year of the last documented occurrence in Rhode Island is included.

FUTURE REVISIONS
The listing of rare species is an ongoing process requiring annual revisions to reflect the best scientific information available concerning the circumstances of rarity, as well as our increased knowledge of the native fauna. Submission of additional data on species currently listed, or on other species which may warrant listing, is encouraged.

Information may be sent to:

Rhode Island Natural Heritage Program
Rhode Island Dept. of Environmental Management
Division of Planning & Development
235 Promenade Street
Providence, Rhode Island 02908
Telephone: (401) 222-2776 ext.4308

Rhode Island Endangered Species Program
Rhode Island Dept. of Environmental Management
Division of Fish and Wildlife
Great Swamp Management Area
West Kingston, Rhode Island 02892
Telephone: (401) 789-0281

INVERTEBRATES

The task of evaluating the status of invertebrates in Rhode Island has been initiated for several selected groups. At this time the list primarily includes freshwater bivalves (clams and mussels) and the following insect groups: lepidopterans (moths and butterflies), odonates (dragonflies and damselflies), silphids (burying beetles), and cicindelids (tiger beetles). Additional taxa will be added in the future upon the completion of further research and inventory. The following publications are a partial listing of taxonomic references:

Boyd, H.P. and Associates. 1982. *Checklist of Cicindelidae: The Tiger Beetles*. Plexus Publishing, Marlton, New Jersey. 1-31.

Hodges, R.W., et. al. 1983. *Check list of the Lepidoptera of America north of Mexico*. E.W. Classey Ltd. and Wedge Entomological Research Foundation. 1-284.

Johnson, R.I. 1980. *Zoogeography of North American Unionacea (Mollusca: Bivalvia) north of the maximum Pleistocene glaciation*. Bull. Museum Comparative Zoology. 149:77-189.

Paulson, D.R. and S.W. Dunkle. 1999. *A checklist of North American Odonata, including English name, etymology, type locality, and distribution*. Slat. Mus. Nat. Hist. Occ. Pap. 56.

BIVALVE MOLLUSKS		
Unionoida (freshwater mussels)		
Margaritiferidae (pearlshells)		
Margaritifera margaritifera	Eastern Pearlshell	SE
Unionidae (unionid mussels)		
Alismidonta varicosa	Brook Floater	SH (1897)
Lampsilis radiata	Lampmussel	C
Ligumia nasuta	Eastern Pond Mussel	C
Strophitus undulatus	Squawfoot	C
CRUSTACEANS		
Amphipoda (amphipods)		
Crangonyctidae (freshwater amphipods)		
Synurella chamberlaini	Coastal Swamp Amphipod	C
INSECTS		
Coleoptera (beetles)		
Cicindelidae (tiger beetles)		
Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	FT/SH (1978)
Cicindela formosa generosa	Pine Barrens Tiger Beetle	ST
Cicindela hirticollis	Seabeach Tiger Beetle	ST
Cicindela limbalis	Claybanks Tiger Beetle	C
Cicindela marginata	Salt Marsh Tiger Beetle	ST
Cicindela patruela	Barrens Tiger Beetle	SH (1921)
Cicindela purpurea	Purple Tiger Beetle	C
Cicindela rufiventris	Red-bellied Tiger Beetle	C
Cicindela tranquebarica	Dark-bellied Tiger Beetle	ST
Silphidae (burying beetles)		

Nicrophorus americanus	American Burying Beetle	FE
Staphylinidae (rove beetles)		
Lordithon niger	Black Lordithon Rove Beetle	C
Lepidoptera (butterflies and moths)		
Lycaenidae (coppers, hairstreaks, elfins, & blues)		
Lycaena epixanthe	Bog Copper	C
Satyrium acadica	Acadian Hairstreak	C
Satyrium caryaevorum	Hickory Hairstreak	C
Mitoura hesseli	Hessel's Hairstreak	C
Incisalia henrici	Henry's Elfin	C
Incisalia irus	Frosted Elfin	ST
Incisalia polia	Hoary Elfin	C
Fixsenia favonius ontario	Northern Hairstreak	C
Parrhasius m-album	White M Hairstreak	C
Nymphalidae (brush-footed butterflies)		
Speyeria idalia	Regal Fritillary	SH (1990)
Boloria bellona	Meadow Fritillary	C
Enodia anthedon	Northern Pearly Eye	C
Hesperiidae (skippers)		
Erynnis brizo	Sleepy Duskywing	C
Erynnis persius	Persius Duskywing	SH (1950)
Poanes massasoit	Mulberry Wing	C
Poanes viator zizaniae	Broad Winged Skipper	C
Atrytonopsis hianna	Dusted Skipper	C
Noctuidae (noctuid moths)		
Abagrotis crumbi benjamini	Benjamin's Abagrotis	C
Acronicta lanceolaria	A Noctuid Moth	C
Apharetra purpurea	Blueberry Sallow	C
Aplectoides condita	A Noctuid Moth	C
Grammia speciosa	An Arctiid Moth	C
Lithophane viridipallens	Pale Green Pinion Moth	C
Metarranthis pilosaria	Coastal Swamp Metarranthis	C
Papaipema appassionata	Pitcher Plant Borer	C
Papaipema leucostigma	Columbine Borer	SH
Spartiniphaga inops	Spartina Borer	C
Zale sp. (*)	Pine Barrens Zale	C
Zale submediana	A Noctuid Moth	C

(*) a full scientific name for this species has not been published.

Saturniidae (saturnid moths)		
Citheronia regalis	Royal Walnut Moth	SH (1939)
Citheronia sepulcralis	Pine Devil	SH
Hemileuca maia maia	Barrens Buckmoth	C
Odonata (dragonflies and damselflies)		
Coenagrionidae (pond damselflies)		
Enallagma pictum	Scarlet Bluet	C
Enallagma recurvatum	Pine Barrens Bluet	C
Lestes unguiculatus	Lyre-tipped Spreadwing	C
Nehalennia integricollis	Southern Sprite	ST
Gomphidae (clubtails)		
Ophiogomphus aspersus	Brook Snaketail	ST
Progomphus obscurus	Common Sanddragon	C
Stylurus scudderi	Zebra Clubtail	ST
Stylurus spiniceris	Arrow Clubtail	C

Aeshnidae (darners)		
Aeshna mutata	Spatterdock Darner	C
Anax longipes	Comet Darner	C
Corduliidae (emeralds)		
Cordulegaster obliqua	Arrowhead Spiketail	C
Neurocordulia obsoleta	Umber Shadowdragon	C
Somatochlora georgiana	Coppery Emerald	C
Williamsonia lintneri	Ringed Boghaunter	SE
Libellulidae (common skimmers)		
Leucorrhinia glacialis	Crimson-ringed Whiteface	ST
Libellula auripennis	Golden-winged Skimmer	C
FISH		
Petromyzontidae (lampreys)		
Lampetra appendix	American Brook Lamprey	ST
Acipenseridae (sturgeons)		
Acipenser oxyrhynchus	Atlantic Sturgeon	SH
Acipenser brevirostrum	Shortnose Sturgeon	FE (SH)
AMPHIBIANS		
Plethodontidae (lungless salamanders)		
Gyrinophilus porphyriticus	Northern Spring Salamander	C
Pelobatidae (spadefoot toads)		
Scaphiopus holbrookii	Eastern Spadefoot	SE
Ranidae (true frogs)		
Rana pipiens	Northern Leopard Frog	C
REPTILES		
Cheloniidae (sea turtles) - offshore waters only.		
Caretta caretta	Loggerhead Sea Turtle	FT
Eretmochelys imbricata	Hawksbill Sea Turtle	FE
Lepidochelys kempii	Kemp's Ridley Sea Turtle	FE
Dermochelyidae (leatherback turtles) - offshore waters only.		
Dermochelys c. coriacea	Atlantic Leatherback	FE
Emydidae (turtles)		
Clemmys guttata	Spotted Turtle	P
Clemmys insculpta	Wood Turtle	C/P
Malaclemys t. terrapin	Northern Diamondback Terrapin	SE/P
Terrapene carolina	Eastern Box Turtle	P
Colubridae (colubrid snakes)		
Carphophis amoenus	Eastern Worm Snake	C
Elaphe obsoleta	Black Rat Snake	C
Heterodon platirhinos	Eastern Hognose Snake	C
Thamnophis sauritus	Eastern Ribbon Snake	C
Viperidae (vipers)		
Crotalus horridus	Timber Rattlesnake	SH(1972)/P
BIRDS		
Podicipedidae (grebes)		
Podilymbus podiceps	Pied-billed Grebe	SE
Ardeidae (herons)		
Botaurus lentiginosus	American Bittern	SE
Ixobrychus exilis	Least Bittern	ST
Ardea herodias	Great Blue Heron	C
Ardea albus	Great Egret	C

Egretta caerulea	Little Blue Heron	C
Egretta thula	Snowy Egret	C
Bubulcus ibis	Cattle Egret	C
Nycticorax nycticorax	Black-crowned Night Heron	C
Nyctanassa violacea	Yellow-crowned Night Heron	C
Threskiornithidae (ibises)		
Plegadis falcinellus	Glossy Ibis	C
Anatidae (swans, geese, ducks)		
Anas crecca	Green-winged Teal	C
Anas discors	Blue-winged Teal	C
Anas strepera	Gadwall	C
Lophodytes cucullatus	Hooded Merganser	C
Accipitridae (eagles, hawks)		
Haliaeetus leucocephalus	Bald Eagle	FT*
Pandion haliaetus	Osprey	C
Circus cyaneus	Northern Harrier	SE
Accipiter striatus	Sharp-shinned Hawk	SH (1939)
Accipiter cooperii	Cooper's Hawk	C
Accipiter gentilis	Northern Goshawk	C
Falco peregrinus	Peregrine Falcon	SE
Rallidae (rails, gallinules)		
Rallus elegans	King Rail	C
Rallus longirostris	Clapper Rail	C
Porzana carolina	Sora	C
Gallinula chloropus	Common Moorhen	SH (1970)
Charadriidae (plovers)		
Charadrius melodus	Piping Plover	FT
Haematopodidae (oystercatchers)		
Haematopus palliatus	American Oystercatcher	C
Scolopacidae (sandpipers)		
Catoptrophorus semipalmatus	Willet	C
Bartramia longicauda	Upland Sandpiper	SE
Laridae (gulls, terns)		
Sterna dougallii	Roseate Tern	FE/SH (1979)
Sterna antillarum	Least Tern	ST
Tytonidae (barn owls)		
Tyto alba	Barn Owl	SE
Strigidae (owls)		
Asio otus	Long-eared Owl	C
Aegolius acadicus	Northern Saw-whet Owl	C
Caprimulgidae (goatsuckers)		
Chordeiles minor	Common Nighthawk	C
Picidae (woodpeckers)		
Dryocopus pileatus	Pileated Woodpecker	C
Tyrannidae (flycatchers)		
Empidonax virescens	Acadian Flycatcher	C
Alaudidae (larks)		
Eremophila alpestris	Horned Lark	C
Hirundinidae (swallows)		
Hirundo pyrrhonota	Cliff Swallow	SH (1991)
Troglodytidae (wrens)		
Troglodytes troglodytes	Winter Wren	C
Cistothorus palustris	Marsh Wren	C

Parulidae (warblers)		
Vermivora chrysoptera	Golden-winged Warbler	SH (1960)
Parula americana	Northern Parula	ST
Dendroica caerulescens	Black-throated Blue Warbler	ST
Dendroica cerulea	Cerulean Warbler	SE
Dendroica fusca	Blackburnian Warbler	ST
Protonotaria citrea	Prothonotary Warbler	C
Helmitheros vermivorus	Worm-eating Warbler	C
Icteria virens	Yellow-breasted Chat	SE
Emberizidae (sparrows)		
Pooecetes gramineus	Vesper Sparrow	SH (1984)
Ammodramus henslowii	Henslow's Sparrow	SH (1940)
Ammodramus savannarum	Grasshopper Sparrow	ST
Ammodramus maritimus	Seaside Sparrow	C
Zonotrichia albicollis	White-throated Sparrow	C
Junco hyemalis	Dark-eyed Junco	C
*Bald Eagles have been removed from the federal endangered species list		
MAMMALS		
Soricidae (shrews)		
Sorex fumeus	Smoky Shrew	C
Sorex palustris	Water Shrew	C
Leporidae (rabbits, hares)		
Sylvilagus transitionalis	New England Cottontail	C
Muridae (mice)		
Synaptomys cooperi	Southern Bog Lemming	C
Felidae (cats)		
Lynx rufus	Bobcat	ST
Balaenopteridae (rorquals)		
Balaenoptera physalus	Fin Whale	FE
Megaptera novaeangliae	Humpback Whale	FE
Balaenidae (right whales)		
Eubalaena glacialis	North Atlantic Right Whale	FE

APPENDIX D

CRITERIA FOR BEAVER DAM BREACHING/REMOVAL

In most instances, Rhode Island regulates beaver dam removal through the RIDEM, Office of Water Resources, Freshwater Wetlands Program. The Freshwater Wetlands Program is responsible for reviewing proposals and issuing permits for proposed alterations to any inland freshwater wetland based on the Rhode Island Rules and Regulations Governing the Administration and Enforcement of The Freshwater Wetlands Act. Applications to alter Freshwater Wetlands in the Vicinity of the Coast may be regulated by the Rhode Island Coastal Resource Management Council (CRMC) (M. Wencek, RIDEM, pers. comm. 2012).

RIDEM DFW does not have any restrictions or regulations regarding breeching or removing beaver dams in the State as a wildlife issue (C. Brown, RIDEM, pers. comm. 2012). Responsibility for regulating and managing such activity is the sole responsibility of the RIDEM Office of Water Resources, which has promulgated the rules and regulations that regulate this activity.

No permit is required from the U.S. Army Corps of Engineers (USACE) for removal or modification of a beaver dam in Rhode Island unless the removal or modification will require the placing of fill in a water or wetland of the United States (M. Elliott, USACE, pers. comm. 2012).

WS would consult with the RIDEM, Office of Water Resources, Freshwater Wetlands Program prior to modifying or removing any beaver dam in Rhode Island, and would not proceed with any activity until appropriate authorization is obtained. If there are any additional questions regarding the status of a beaver dam or the potential for adding fill to a water or wetland of the United States, WS would consult with the USACE.