ENVIRONMENTAL ASSESSMENT

MAMMAL DAMAGE MANAGEMENT
IN MISSISSIPPI

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

In cooperation with:

TENNESSEE VALLEY AUTHORITY

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ACRONYMS

AMDUCA	Animal Medicinal Drug Use Clarification Act
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWCS	Comprehensive Wildlife Conservation Strategy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLIR	Forward Looking Infrared
FR	Federal Register
FY	Fiscal Year
GnRH	Gonadotropin-releasing Hormone
IC	Intracardiac
IV	Intravenous
MDAC	Mississippi Department of Agriculture and Commerce
MDWFP	Mississippi Department of Wildlife, Fisheries, and Parks
MOU	Memorandum of Understanding
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRP	Natural Resource Plan
NWRC	National Wildlife Research Center
ORV	Oral Rabies Vaccine
PEP	Post - Exposure Prophylaxis
PL	Public Law
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TNR	Trap, Neuter, Release Program
TVA	Tennessee Valley Authority
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Services
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in Mississippi continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with nine-banded armadillos (*Dasypus novemcinctus*), Virginia opossum (*Didelphis virginiana*), little brown bat (*Myotis lucifugus*), Southeastern myotis (*Myotis austroripariuis*), Brazilian free-tailed bats (*Tadarida brasiliensis*), silver-haired bats (*Lasionycteris noctivagans*), Eastern pipistrels (*Pipistrellus subflavus*), big brown bats (*Eptesicus fuscus*), evening bats (*Nycticeius humeralis*), Rafinesque's big-eared bats (*Corynorhinus rafinesquei*), Eastern cottontail rabbits (*Sylvilagus floridanus*), swamp rabbits (*Silvilagus aquaticus*), black bears (*Ursus americanus*), raccoons (*Procyon lotor*), river otters (*Lutra canadensis*), striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), bobcats (*Felis rufus*), woodchucks (*Marmota monax*), Southern flying squirrels (*Glaucomys volans*), gray squirrels (*Sciurus carolinensus*), fox squirrels (*Sciurus niger*), feral swine (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*), feral cats (*Felis domesticus*), and feral dogs (*Canis familiaris*). In addition, WS could occasionally receive requests for assistance with feral or free-ranging non-native mammals[2]. The Tennessee Valley Authority (TVA) also continues to experience damage and threats of damage associated with mammals at facilities or properties they own or manage in Mississippi. The TVA could request the assistance of WS to manage damage or threats of damage at those facilities and properties.

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

This EA analyzes the potential effects of mammal damage management when requested, as coordinated between WS, the TVA, and the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP). In addition to those mammal species listed previously, WS also receives requests to address damage and threats of damage associated with beaver (*Castor canadensis*), nutria (*Myocastor coypus*), and muskrats

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

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

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

(*Ondatra zibethicus*). Activities conducted by WS to alleviate damage or threats of damage associated with beaver, nutria, and muskrats were evaluated in a separate EA (USDA 2015*a*).

WS and the TVA are preparing this EA to 1) facilitate planning; 2) promote interagency coordination; 3) streamline program management; 4) clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities; and 5) evaluate and determine if there would be any potentially significant or cumulative effects from the alternative approaches developed to meet the need for action. The analyses contained in this EA are based on information derived from WS' Management Information System, published documents (see Appendix A), interagency consultations, and public involvement.

This EA evaluates the need for action to manage damage associated with mammals in the State, the potential issues associated with managing damage, and the environmental consequences of conducting different alternatives to meet the need for action while addressing the identified issues. WS, in cooperation with the TVA, initially developed the issues and alternatives associated with managing damage caused by mammals in consultation with the MDWFP. The MDWFP has regulatory authority to manage populations of wildlife in the State. To assist with identifying additional issues and alternatives to managing damage associated with mammals in Mississippi, WS and the TVA will make this EA available to the public for review and comment prior to the issuance of a Decision[4].

WS previously developed an EA that addressed WS' activities to manage damage associated with mammals in the State, including areas managed and owned by the TVA (USDA 2012). Based on the analyses in that EA, a Decision and Finding of No Significant Impact was signed selecting the proposed action alternative. The proposed action alternative implemented a damage management program using a variety of methods in an integrated approach (USDA 2012). This new EA will: (1) assist in determining if the proposed management of damage associated with mammals could have a significant impact on the environment for both people and other organisms, (2) analyze several alternatives to address the need for action and the identified issues, (3) coordinate efforts between WS, the TVA, the MDWFP, and other entities, (4) inform the public, and (5) document the environmental consequences of the alternatives to comply with the NEPA. Since this new EA will re-evaluate activities conducted under the previous EA to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued for this EA will supersede the previous EA that addresses mammal damage management.

1.2 NEED FOR ACTION

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

Animals can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard animals as providing economic, recreational, and aesthetic benefits. Knowing that animals exist in the natural environment provides a positive benefit to some people. However, activities associated with animals may result in economic losses to agricultural resources, natural resources, property, and threaten human safety. Therefore, an awareness of the varying perspectives and values are required to balance the needs of people and the needs of animals. When

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

addressing damage or threats of damage caused by animals, animal damage management professionals must consider not only the needs of those directly affected by animals damage but a range of environmental, sociocultural, and economic considerations as well.

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

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of animals and can be an integral component of animal management (Berryman 1991, The Wildlife Society 2015). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. Those animals have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance with resolving damage or reducing threats to human safety. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to the individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with an animal or animals is actual damage requiring assistance (*i.e.*, has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the aesthetic value of property and other situations where the behavior of an animal or animals was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with mammals in Mississippi arises from requests for assistance[5] received by WS. WS receives requests to reduce or prevent damage from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. In addition, the TVA often experiences damage and threats of damage to property and natural resources, electric system operational reliability, as well as threats to human safety at their facilities. WS and the TVA have identified those mammal species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. WS has provided technical assistance to those persons requesting assistance with resolving damage or the threat of damage. Table 1.1 lists WS' technical assistance projects involving mammal damage or threats of

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

damage to those four major resource types in Mississippi from the federal fiscal year[6] (FY) 2009 through FY 2014.

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

Species	Projects	Species	Projects
Bat (All species)	91	**Nine-banded Armadillo**	63
Black Bear	22	**Raccoon**	121
Bobcat	10	**Red Fox**	34
Coyote	113	**River Otter**	24
Feral Cat	4	**Striped Skunk**	75
Feral Dog	10	**Southern Flying Squirrel**	2
Feral Swine	348	**Virginia Opossum**	15
Fox Squirrel	8	**White-tailed Deer**	36
Gray Fox	9	**Woodchuck**	4
Gray Squirrel	18	**TOTAL**	**1,007**

Technical assistance provides information and recommendations on activities to alleviate mammal damage that the requester could conduct without WS' direct involvement in managing or preventing the damage. This EA discusses technical assistance activities further in Chapter 3. Table 1.1 does not include direct operational assistance projects conducted by WS where a person requested WS' assistance through the direct application of methods. The technical assistance projects conducted by WS are representative of the mammal species that cause damage and threats in Mississippi. As shown in Table 1.1, WS has conducted 1,007 technical assistance projects in Mississippi that addressed damage and threats associated with those mammal species addressed in this assessment from FY 2009 through FY 2014. Nearly 58% of the requests for assistance were associated with feral swine, raccoons, and coyotes.

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

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

Species	Resource[a]				Species	Resource			
	A	**N**	**P**	**H**		**A**	**N**	**P**	**H**
Bat (All species)			X	X	**Nine-banded Armadillo**	X	X	X	X
Black Bear	X		X	X	**Raccoon**	X	X	X	X
Bobcat	X	X	X	X	**Red Fox**	X	X	X	X
Coyote	X	X	X	X	**River Otter**	X		X	
Eastern Cottontail	X		X		**Southern Flying Squirrel**			X	
Feral Cat	X	X	X	X	**Striped Skunk**	X	X	X	X
Feral Dog	X	X	X	X	**Swamp Rabbit**	X		X	
Feral Swine	X	X	X	X	**Virginia Opossum**	X	X	X	X
Fox Squirrel			X		**White-tailed Deer**	X	X	X	X
Gray Fox	X	X	X	X	**Woodchuck**	X		X	
Gray Squirrel			X						

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

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

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

More specific information regarding mammal damage to those main categories, including damages or threats that could occur on properties owned or managed by the TVA, are discussed in the following subsections of the EA.

Need for Mammal Damage Management on TVA Properties and Facilities

The TVA often experiences damage or threats of damage to property and natural resources, electric system operational reliability, as well as threats to human safety at their facilities. WS and the TVA have 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 1.3 summarizes the mammal species and the resource types that those species could damage on TVA-managed lands.

Table 1.3 – Mammal species that WS could address on TVA properties and the resource type damaged by those species

Species	Resource[a]				Species	Resource			
	A	N	P	H		A	N	P	H
Bat (All species)			X	X	**Nine-banded Armadillo**		X	X	X
Black Bear			X	X	**Raccoon**		X	X	X
Bobcat		X	X	X	**Red Fox**		X	X	X
Coyote		X	X	X	**River Otter**			X	
Eastern Cottontail			X		**Southern Flying Squirrel**			X	
Feral Cat		X	X	X	**Striped Skunk**		X	X	X
Feral Dog		X	X	X	**Swamp Rabbit**			X	
Feral Swine		X	X	X	**Virginia Opossum**		X	X	X
Fox Squirrel			X		**White-tailed Deer**		X	X	X
Gray Fox		X	X	X	**Woodchuck**			X	
Gray Squirrel			X						

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

The TVA is responsible for the management of 293,000 acres of public land and 11,000 miles of public shoreline along the Tennessee River system. All of those lands support TVA's goals of power generation and transmission, public recreational use, flood control, and economic development of the Tennessee River Valley. The TVA owns or maintains electrical power substations, switching stations, and the associated transmission lines and rights-of-way easements in Mississippi. In addition, the TVA operates public recreation areas throughout the Tennessee River Valley region, including campgrounds, day-use areas, and boat launching ramps.

Mammal damage and threats of damage occurring at facilities and properties owned or managed by the TVA primarily have occurred to property, human safety, and potential electric system operational reliability impacts. Woodchucks and armadillos burrowing into earthen levees and dikes used to impound water can compromise the integrity of the structures and threaten the safety of people downstream from these impoundments.

Many species of wildlife reside on TVA-managed lands. Those animals frequently become overpopulated or lose their fear of people, sometimes resulting in transmission of zoonotic diseases and aggressive behavior toward people. Many of those lands are considered public or recreational lands and those people using those lands expect the TVA to manage mammal populations and reduce the possibilities of disease transmission and attacks by wildlife. Mammals frequently enter substations and power generation facilities and threaten the interruption of power by chewing on various plastic components or climbing into areas of electric current and shorting out electrical circuits.

All of those damage issues and others occur throughout TVA owned and managed properties. The TVA has requested assistance from WS to address wildlife damage in the past and may request assistance with additional mammal damage issues in the future. As the populations of many of those species increase and thrive in those areas managed or owned by the TVA, both WS and TVA expect increases in the need for mammal damage management in the future.

Need to Protect Human Health and Safety

The primary request for assistance to reduce threats to human safety received by WS is to lessen the threat of diseases transmission from exposure to animals and threats to human safety at air facilities from aircraft striking mammals. Zoonoses (*i.e*., animal diseases transmissible to people) are often a major concern of people when requesting assistance with managing threats from mammals. Disease transmission could occur from direct interactions between people and mammals or from interactions with pets and livestock that have direct contact with wild mammals. Pets and livestock often encounter and interact with wild mammals, which can increase the opportunity of transmission of disease to people. Table 1.4 shows common diseases that could affect people that wild mammals can transmit in addition to diseases that could affect other animals, including domestic species. Those threats include viral, bacterial, mycotic (fungal), protozoal, and rickettsial diseases.

People that request assistance with mammals frequently are concerned about potential disease risks, but are unaware of the types of diseases that can be transmitted by those animals. In those types of situations, people request assistance because of a perceived risk to human health or safety associated with wild animals that live in close association with people, from animals acting out of character by roving in human-inhabited areas during daylight, or from animals showing no fear when people are present. Although animals active during the day are not necessarily acting abnormally, especially in suburban environments, WS could receive requests for assistance associated with resolving those types of risks to human safety.

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

- Exposure of residents to the threat of rabies due to high densities of raccoons or from companion animals encountering infected raccoons.
- Exposure of people to the threat of rabies posed by skunks that den under buildings or from companion animals interacting with infected skunks.
- Threats of parasitic infections to people from *Giardia* spp. that could occur from high feral cat populations in a park or recreation area.
- Concern about the threat of histoplasmosis from the disturbance of a large deposit of guano in an attic where a large colony of bats routinely roost or raise young.

- Accumulated droppings from denning or foraging raccoons and the subsequent exposure of the public to raccoon roundworm in fecal deposits.
- Exposure of domestic livestock to the bacterium, *Brucella suis*, by feral swine. *B. suis* causes swine brucellosis.

The most common disease concern expressed by individuals requesting assistance is the threat of rabies transmission to people, pets, and livestock. Rabies is an acute fatal viral disease of mammals, most often transmitted through the bite of a rabid animal that can pose an indirect and direct threat to people. Indirect threats to people occur from exposure to pets or livestock that bites of a rabid animal have infected. Direct threats can occur from handling infected animals or from aggressive animal behavior caused by rabies. When people identify exposure early, medical staff can effectively treat the rabies virus in people and prevent death. In addition, people can vaccinate domestic animals and pets for rabies. However, the abundant and widely distributed reservoir among wild mammals complicates rabies control. The vast majority of rabies cases reported to the Centers for Disease Control and Prevention (CDC) each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order Chiroptera) (CDC 2011).

Table 1.4 – Animal diseases in the eastern United States that pose potential health risks through transmission to people (Beran 1994, Davidson 2006)†

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

†Table 1.4 is not an exhaustive list of animal diseases considered infectious to people. The zoonoses provided are the more common infectious diseases for the species addressed in this EA and are only a representation of the approximately 100 to 3,000 zoonoses known to exist.

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

Over the last 100 years, the vector of rabies in the United States has changed dramatically. About 90% or greater of all animal cases reported annually to the CDC now occur in wildlife (Krebs et al. 2000, CDC 2011). Before 1960, the majority of cases the CDC received occurred in domestic animals. The principal rabies hosts today are wild carnivores and bats. The number of rabies-related human deaths in the United States has declined from more than 100 annually in the early 1900s to an average of one or two people per year in the 1990s. Modern day prophylaxis, which is the series of vaccine injections given to people who have been potentially or actually exposed, has proven nearly 100% successful in preventing mortality when administered promptly (CDC 2011). In the United States, human fatalities associated with rabies occur in people who fail to seek timely medical assistance, usually because they were unaware of their exposure to rabies. Although human rabies deaths are rare, the estimated public health costs associated with disease detection, prevention, and control have risen, exceeding $300 million annually. Those costs include the vaccination of companion animals, maintenance of rabies laboratories, medical costs, such as those incurred for exposure case investigations, rabies post-exposure prophylaxis (PEP), and animal control programs (CDC 2011).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the United States each year is unknown, it has been estimated to be as high as 40,000. When rabies becomes epizootic (*i.e*., affecting a large number of animals over a large area) or enzootic (*i.e*., present in an area over time but with a low case frequency) in a region, the number of PEPs in that area increases. Although the cost varies, a course of rabies immunoglobulin and five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2011) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in animal populations, the risk of exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increases. One case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for 71 people (CDC 1999). The total cost of this single incident exceeded $160,000 based on a median cost of $2,376 per PEP in Massachusetts. Likely, the most expensive single mass exposure case on record in the United States occurred during 1994 in Concord, New Hampshire when a kitten from a pet store tested positive for rabies after a brief illness. Because of potential exposure to the kitten or to other potentially rabid animals in the store, at least 665 persons received post-exposure rabies vaccinations at a total cost of more than $1.1 million (Noah et al. 1995). The American Veterinary Medical Association (AVMA) estimated the total cost for this specific incident, including investigation, laboratory testing, and rabies immunoglobulin and vaccines was more than $1.5 million (AVMA 2004).

Raccoons have been associated with the spread of rabies throughout the eastern United States, including States adjacent to Mississippi (Mississippi State Department of Health 2008). Rabies in raccoons was virtually unknown prior to the 1950s. The first documented case of rabies occurred in Florida where it spread slowly during the next three decades into Georgia, Alabama, and South Carolina. People likely unintentionally introduced rabies into the Mid-Atlantic States by translocation of infected animals (Krebs et al. 1998). The first cases appeared in West Virginia and Virginia in 1977 and 1978, respectively. Since then, the raccoon variant of rabies expanded to form the most intensive rabies outbreak in the United States. The variant is now enzootic in all of the eastern coastal states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and most recently, parts of Ohio (Krebs et al. 2000). The raccoon rabies epizootic front reached Maine in 1994, reflecting a movement rate of about 30 to 35 miles per year. The westward movement of the raccoon rabies front has slowed, probably in response to both natural geographic and man-made barriers. The Appalachian Mountains and perhaps river systems flowing eastward have helped confine the raccoon variant to the eastern United States. In addition, the USDA has created an oral rabies vaccine (ORV) "*barrier*" of vaccinated wild animals on the western edge of the Appalachian Mountains (USDA 2010*a*). If this combined barrier were breached by raccoon variant rabies, research suggests that raccoon populations would be sufficient for rabies to spread westward at a rate similar to or greater than the rate at which this rabies strain has spread in the eastern United States (Sanderson and Huber 1982, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999).

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

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

In an effort to halt the westward spread of the raccoon variant of the rabies virus and to limit the spread of the canine variant from Texas, WS began participating in the distribution of ORV baits (fishmeal polymer containing Raboral V-RG® vaccine [Merial, Athens, Georgia, USA]). Currently, WS participates in the distribution of ORV baits and the surveillance of wildlife rabies vectors in 26 states. Although raccoon strain rabies is not currently known to occur in Mississippi, the raccoon rabies variant is known to occur in adjacent States. A raccoon in Clarke County, Alabama tested positive for rabies in 2004, which is only 25 miles from Wayne County, Mississippi in the southeastern portion of the State (Mississippi State Department of Health 2008). Most incidents of rabies currently occurring in the State are associated with bats (Mississippi State Department of Health 2008).

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

Diseases and parasites affecting feral cats and dogs can have particularly serious implications to human health given the close association of those animals with people and pets. The topic of feral animals and their impacts on native wildlife and human health elicits a strong response in numerous professional and societal groups with an interest in the topic. Most professional wildlife biologists consider feral cats and dogs to be non-native species that can have detrimental effects to the native ecosystems, especially in the presence of a human altered landscape. However, a segment of society views feral animals to be an extension of companion animals that should be cared for and for which affection bonds are often developed especially when societal groups feed and care for individual feral animals. Of special concern are those cats and dogs considered companion animals that are not confined indoors at all times but are allowed to range freely or unrestrained outside the home for extended periods. If interactions occur between companion animals and feral animals of the same species, exposure of companion animals to a wide-range of zoonoses can occur. Companion animals could bring those zoonoses into the home where direct contact between the companion animal and people increases the likelihood of disease transmission. Free-ranging animals that people consider companion animals also are likely to affect multiple people if disease transmission occurs since those animals are likely to come in direct contact with several members of families and friends before diagnosis of a disease occurs. Feral cat colonies have become established at several TVA sites and facilities, including public recreation areas, requiring removal to ensure public safety and biological diversity.

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

Most of the zoonoses known to infect cats and dogs that are infectious to people are not life threatening if diagnosed and treated early. However, certain societal segments are at higher risks if exposed to zoonoses. Women who are pregnant, people receiving chemotherapy for immunologic diseases and organ transplants, and those with weakened immune systems are at increased risk of clinical disease if exposed to toxoplasmosis (AVMA 2004). In 1994, five children in Florida were hospitalized with encephalitis that was associated with cat scratch fever (AVMA 2004). In another example, the daycare center at the University of Hawaii in Manoa was closed for two weeks in 2002 because of concerns about potential transmission of murine typhus (*Rickettsia typhi*) and flea (*Ctenocephalides felis*) infestations afflicting 84 children and faculty. The fleas at the facility originated from a feral cat colony that had grown from 100 cats to over 1,000 cats, despite a trap, neuter, and release effort (AVMA 2004).

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

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

Conflicts involving bats can include property damage, but primarily involve threats to the health of people, pets, and livestock. The buildup of bat droppings and urine in attics and between walls can result in odor problems and discoloration of walls and ceilings (Agency for Toxic Substances and Disease Registry 1998). In addition to the threat of rabies from direct contact or a bat entering the living area of a home, there are other threats associated with bat colonies, including histoplasmosis, fungal spores, and mites.

Bat droppings, particularly when they accumulate over many years, are likely to contain the fungus *Histoplasma capsulatum*, or with fungi species, such as molds, especially in warm, moist conditions. When people disturb fecal accumulations containing *H. capsulatum* and inhale spores from the fungus, they may become ill with a disease known as histoplasmosis. Symptoms of histoplasmosis include some combination of mild, flu-like respiratory illness, a general ill feeling, chest pain, fever, cough, headache, loss of appetite, shortness of breath, joint and muscle pains, chills, and hoarseness. Although there are other, more rare illnesses associated with exposure, the most likely is histoplasmosis. Similarly, mold spores released into the air may result in an increase of asthma attacks (Agency for Toxic Substances and Disease Registry 1998).

Bat bugs (*Cimex adjunctus*) are free-living ectoparasites of bats that feed on blood from bats. They will bite people in the absence of their primary hosts. The main means of dispersal for bat bugs is by clinging to the fur of bats as bats move between locations. Typically, bat bug infestations originate from bat populations established in attics, wall voids, unused chimneys, or uninhabited portions of a house. Bat bugs typically do not wander far from occupied bat roosting sites where they have easy access to food. However, if their normal hosts leave, bat bugs can seek other sources of food and may crawl about and invade living areas within a house and bite people (Jones and Jordan 2004). Although their bite is not particularly harmful, the person may experience an allergic reaction and develop a skin rash in response (Agency for Toxic Substances and Disease Registry 1998).

The intention of this brief discussion on zoonoses is to address the more commonly known zoonoses found in the United States for those species specifically addressed in this EA and is not an exhaustive discussion of all potential zoonoses. Limited information and understanding of disease transmission from wildlife to people exists for most infectious zoonoses. In most cases when human exposure occurs, the presence of a disease vector across a broad range of naturally occurring sources, including occurring in wildlife populations, can complicate determining the origin of the vector. A person with salmonella poisoning, for example, may have contracted salmonella bacterium from direct contact with an infected pet but also may have contracted the bacterium from eating undercooked meat or from other sources.

Public awareness and the health risks associated with zoonoses have increased in recent years; however, disease transmission directly from animals to people is uncommon. However, the infrequency of such transmission does not diminish the concerns of those people fearful of exposure requesting assistance since disease transmission could occur. This EA briefly addresses some of the more commonly known zoonotic diseases associated with mammals. The intention of this brief discussion on zoonoses is to address the more commonly known zoonoses found in the United States for those species specifically addressed in this EA and is not an exhaustive discussion of all potential zoonoses. Those zoonotic diseases remain a concern and continue to pose threats to human safety where people encounter mammals.

Limited information and understanding of disease transmission from animals to people exists for most infectious zoonoses. In most cases when human exposure occurs, the presence of a disease vector across a broad range of naturally occurring sources, including occurring in animal populations, can complicate determining the origin of the vector. For example, a person with salmonella poisoning may have contracted salmonella bacterium from direct contact with an infected pet but also may have contracted the bacterium from eating undercooked meat or from other sources. WS actively attempts to educate the public about the risks associated with disease transmission from animals to people through technical assistance and by providing technical leaflets on the risks of exposure.

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

Overabundant animals that congregate into small areas because of the unlimited amount of food, water, and shelter can confound the prevalence of diseases.

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

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

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

WS could conduct or assist with disease monitoring or surveillance activities for any of the mammal species addressed in this EA. Most disease sampling would occur ancillary to other wildlife damage management activities (*i.e*., disease sampling would occur after wildlife have been captured or lethally removed for other purposes). For example, WS may sample deer harvested during the annual hunting season or collect samples during other damage management programs for Chronic Wasting Disease. WS could collect ticks from the carcasses of raccoons after lethally removing the raccoon to alleviate damage. WS could sample feral swine harvested by private landowners or during damage management activities to test for classical swine fever, swine brucellosis, pseudorabies, or other diseases.

Need to Respond to Emergency Efforts

Both large-scale natural disasters (*e.g*., hurricanes, tornadoes, floods) and small-scale localized emergencies (*e.g*., release of exotic animals, traffic accidents involving animal transport vehicles) may occur in which federal, state, and local governments in charge of responding to those situations request WS' personnel to assist. Those requests for assistance would be on extremely short notice and rare emergencies that would be coordinated by federal, state, and local emergency management agencies. For example, WS' personnel may receive requests to participate in the lethal removal of cattle that were injured or were released from their transport vehicle at the scene of an accident to prevent those animals from endangering other drivers. WS could receive requests to corral those animals that were uninjured and euthanize those animals that have been injured to reduce their suffering. In another example, WS' personnel may receive requests to assist local and state law enforcement in immobilization or lethal control of exotic animals that have been accidentally released in the aftermath of a hurricane or tornado.

Need for Mammal Damage Management at Airports

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

The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2001, Dolbeer 2009). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, 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 2012, there were 2,946 reported aircraft strikes involving terrestrial mammals in the United States (Dolbeer et al. 2013). The number of mammal strikes actually occurring is likely to be much greater, since Dolbeer (2009) estimated that entities reported 39% of actual civil wildlife strikes. Aircraft have collided with a reported 42 species of terrestrial mammals from 1990 through 2012, including white-tailed deer, raccoons, gray fox, red fox, cats, dogs, coyotes, opossum, river otters, rabbits, woodchucks, fox squirrels, feral swine, and striped skunks. In addition, aircraft in the United States have struck 15 species of bats (Dolbeer et al. 2013). Of the terrestrial mammals reported struck by aircraft, 35% were carnivores (primarily coyotes), causing nearly $4.1 million in damages (Dolbeer et al. 2013). Deer accounted for 35% of the reported strikes involving terrestrial mammals in the United States causing over $45 million in damages (Dolbeer et al. 2013). Data also indicates that a much higher percentage of mammal strikes resulted in aircraft damage compared to bird strikes (Dolbeer et al. 2013). Costs of those collisions vary, but data from the Federal Aviation Administration (FAA) reveals that mammal strikes in the United States cost the civil aviation industry approximately 298,603 hours of down time and nearly $62 million in direct monetary losses between 1990 and 2012 (Dolbeer et al. 2013).

From 1990 through 2012, about 34% of terrestrial mammal strikes in the United States have resulted in damage compared to 9% for birds (Dolbeer et al. 2013). In addition to direct damage, an aircraft striking a mammal can pose serious threats to human safety if the damage from the strike causes a catastrophic failure of the aircraft leading to a crash. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft causing additional damage to the aircraft, which can increase the threat to human safety. Nearly 63% of the reported mammal strikes from 1990 through 2012 occurred at night, with 64% occurring during the landing roll or the takeoff run (Dolbeer et al. 2013).

According to reports filed with the FAA (2015), between 1990 and 2015[7], aircraft have struck eight coyotes, six bats, one red fox, one dog, and eight white-tailed deer in Mississippi. Airports in Mississippi have requested assistance with managing threats to human safety and damage to property caused by mammals present inside the area of operations of an airport. The infrequency of mammal strikes does not lessen the need to prevent threats to human safety and the prevention of damage to property. Preventing damage and reducing threats to human safety would be the goal of cooperators requesting assistance at airports in Mississippi given that a potential strike could lead to the loss of human life and considerable damage to property.

[7] Data available from January 1, 1990 through May 31, 2015

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 to Alleviate Damage to Agricultural Resources

Armadillos, opossum, bears, raccoons, otters, skunks, coyotes, fox, bobcats, woodchucks, feral swine, deer, feral cats, and feral dogs can cause losses or injury to crops (*e.g.*, corn), livestock (*e.g.*, sheep, goats, cattle, pigs, horses), and poultry (*e.g.*, chickens, turkeys, geese, ducks) through consumption or predation. During 2001, crop and livestock losses from animals in the United States totaled $944 million, with field crop losses totaling $619 million, livestock and poultry losses totaling $178 million, and losses of vegetables, fruits, and nuts totaling $146 million. Those losses include destruction of or damage to crops in the field and death or injury to livestock. In 2001, the National Agricultural Statistics Service (NASS) reported that raccoons were responsible for 6%, 3%, and 6% of the total damage to field crops; livestock and poultry; and vegetables, fruits, and nuts, respectively, in the United States (NASS 2002). In addition, white-tailed deer accounted for 58% of the total field crop damage and 33% of vegetable, fruit, and nut damage. Feral swine accounted for 3% or $18.5 million in damages to field crops (NASS 2002).

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

In Mississippi, the NASS (2011) reported 800 cattle and 2,800 calves were killed in 2010 by animal predators. The economic loss from animal predators in Mississippi was estimated at over $1.5 million in 2010 (NASS 2011). Coyotes were attributed to 79.3% of the cattle losses and 65.9% of the calves lost in Mississippi. Dogs accounted for 17.2% of the cattle reported lost while 16.0% of the calves lost were attributed to dogs in the State (NASS 2011). Cattle producers in Mississippi reported using a number of non-lethal methods to reduce losses due to predators. The use of exclusion fencing was reported as being employed by 17.2% of Mississippi cattle producers along with 72.4% reporting the use of guard animals (NASS 2011). Cattle producers in the United States indicated mountain lions and bobcats[8] caused 7.8% of the cattle and calf losses attributed to animal predators in 2010 (NASS 2011). Bobcats can also prey on other livestock, such as chickens and domestic waterfowl.

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

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

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

The domestic cat has been found to transmit *Toxoplasma gondii* to both domestic and wild animal species. Cats have been found to be important reservoirs and the only species known to allow for the completion of the life cycle for the protozoan parasite *T. gondii* (Dubey 1973, Teutsch et al. 1979). Both feral and domiciled cats may be infected by this protozoan, but this infection is more common in feral cats. Fitzgerald et al. (1984) documented that feral cats transmitted *T. gondii* to sheep in New Zealand, resulting in ewes aborting fetuses and also found *Sarcocystis* spp. contamination in the musculature of sheep. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *T. gondii* on swine farms in Illinois and the major reservoir for this disease. The main sources for infecting cats are thought to be birds and mice.

Diseases that may be communicable from feral cats to companion cats include feline panleukopenia 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 likely the most serious. Reif (1976) found that during the acute stages of feline panleukopenia, fleas were vectors of this disease to other cats. Feline panleukopenia infection is cyclic in nature, being more prevalent in the July to September period.

Agricultural damage and threats caused by feral swine can occur to a variety of crops, livestock, and other agricultural resources (Beach 1993, Seward et al. 2004, West et al. 2009, Hamrick et al. 2011). Damage occurs from direct consumption of agricultural resources and from trampling, rooting, and/or wallowing that are common activities of feral swine (Beach 1993). Rooting is a common activity of feral swine where they overturn sod and soil in search of food (West et al. 2009, Stevens 2010, Hamrick et al. 2011). Feral swine also wallow in water and mud to regulate body temperature and to ward off skin parasites.

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

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

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

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

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

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

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

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

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

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

Need to Resolve Damage Occurring to Natural Resources

Natural resources can be those assets belonging to the public that government agencies, as representatives of the people, often manage and hold in trust. Such resources may be plants or animals, including threatened and endangered (T&E) species, or habitats in general. Examples of natural resources in Mississippi could include parks and recreational areas, natural areas, including unique habitats or topographic features; threatened or endangered plants and animals; and any plant or animal populations that the public has identified as a natural resource. Those mammal species addressed in this EA can also cause damage to natural resources.

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

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

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

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

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

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

Reptiles may provide an important food source to cats when birds and mammals are less abundant, and in some situations, cats have been observed preying on threatened species of reptiles. Domesticated cats have been identified as major nest and/or hatchling predators of sea turtles. A study by Seabrook (1989) on the Aldabra Atoll, Seychelles found feral cats had an adverse effect on green turtle hatchlings.

Seabrook (1989) found a positive correlation in cat activity and green turtle nesting at Aldabra Atoll. Cats are known to have contributed to the near extirpation of the West Indian rock iguana (*Cyclura carinata*) on Pine Cay in the Caicos Islands (Iverson 1978).

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

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

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

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

One of the more important seasonal food resources used by feral swine is wild fruit and nut crops, especially oak mast (Wood and Roark 1980). Mast crops, such as beechnut (*Fagus* spp.), acorns (*Quercus* spp.), and hickory nuts (*Carya* spp.), are an important food source for deer, turkey, black bear, and squirrels (Knee 2011). Oak mast is an important food source for white-tailed deer and wild turkey (*Meleagris gallopavo*). Each adult feral swine can consume up to 1,300 pounds of mast per year (Knee 2011). When feral swine actively compete for mast, resident deer and wild turkey may enter the winter with inadequate fat reserves, thus threatening the viability of these native wildlife species (Beach 1993).

They can also compete for acorns and hickory nuts with native wildlife during years of poor mast production (Campbell and Long 2009). In years of poor mast production, feral swine were found to have negative effects on white-tailed deer populations due to competition for acorns (Wood and Roark 1980). Due to their acute sense of smell, feral swine more rapidly and efficiently consume fallen mast crop (Beach 1993). Feral swine also have the ability to change to other food sources when acorns were depleted, which deer are often unable to do (Beach 1993). Consumption of hard mast by feral swine in forests also reduces the potential for forest regeneration, further affecting the food chain necessary to maintain species diversity and stable populations (Campbell and Long 2009).

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

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

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

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

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

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

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

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

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

Examples of requests for assistance to resolve or alleviate damage to natural resources that the WS' program in Mississippi has responded to include:

- Alleviating predation of sandhill cranes from bobcats, coyotes, and feral dogs
- Reducing raccoon predation on endangered turtles

Need for Mammal Damage Management to Alleviate Property Damage

Mammals cause damage to a variety of property types in Mississippi each year. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Mammal damage to property occurs primarily through direct damage to structures. One example of direct damage to property occurs when gray squirrels gnaw on the wiring of vehicles. Accumulations of fecal droppings can cause damage to buildings and other structures. For example, fecal droppings from bats roosting in an attic can cause damage to insulation and support structures. Aircraft striking mammals can also cause substantial damage requiring costly repairs and aircraft downtime. Raccoons, skunks, woodchucks, and armadillos can cause damage to property by digging under porches, buildings, homes, and many other places. Armadillos often cause damage to lawns and turf while digging for grubs and insects.

Feral swine can damage landscaping, golf courses, roads, drainage ditches, and cause erosion by feeding in those areas. Feral swine dig or root in the ground with their nose in search of desired roots, grubs, earthworms, and other food sources. The rooting and digging activity of feral swine turns sod and grass over, which often leaves the area bare of vegetation and susceptible to erosion. Feral swine can also pose a threat to property when motor vehicles and aircraft strike swine. Mayer and Johns (2007) collected data on 179 feral swine-vehicle collisions involving 212 feral swine. Mayer and Johns (2007) suggested that vehicular accidents with feral swine are costly due to their mass; and that potentially, the total annual cost of feral swine-vehicle collisions in the United States can be as high as $36 million, roughly $1,173 per vehicle (Mayer and Johns 2007).

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

Deer-vehicle collisions are a serious concern nationwide because of losses to property and the potential for human injury and death (Conover 1997, Conover et al. 1995, Romin and Bissonette 1996, Conover 1997). The economic costs associated with deer-vehicle collisions include vehicle repairs, human injuries and fatalities, and picking up and disposing of deer (Drake et al. 2005). State Farm Mutual Automobile Insurance (2012) estimated that 1.23 million deer-vehicle collisions occur annually in the United States causing approximately 200 fatalities. In 1995, the estimated damage to vehicles associated with vehicles striking deer was $1,500 per strike (Conover et al. 1995). Estimated damage costs associated with deer collisions in 2011 were $3,171 per incident, which was an increase of 2.2% over the 2010 estimate (State Farm Mutual Automobile Insurance 2011). An estimated 16,004 deer-vehicle collisions occurred in Mississippi from July 1, 2011 through June 30, 2012 (State Farm Mutual Automobile Insurance 2012). Based on the average repair costs associated with vehicle strikes estimated at $3,171 in 2010 and the number of strikes that have occurred in the State estimated at 16,004 from July 2010 through June 2011, deer-vehicle collisions resulted in over $50.7 million in damage to property in the State. Often, deer-vehicle collisions go unreported, especially when there was no recovery of a deer carcass or when little vehicle damage occurred. A Cornell University study estimated that the actual number of deer-vehicle collisions could be as high as six times the reported number (Decker et al. 1990).

Incidences of deer-vehicle collisions on highways passing through TVA Dam Reservation properties have been reported to TVA personnel in recent years from public stakeholders. Some of these dam reservation properties have elevated deer populations and WS could be requested to provide assistance to reduce local deer populations on TVA properties.

Airports provide ideal conditions for feeding and bedding sites for deer due to the large grassy areas adjacent to brushy, forested habitat used as noise barriers. Deer living within airport boundaries are usually protected from hunting and many other human disturbances. Deer are currently regarded as the number one hazardous animal species to aircraft across the nation (Dolbeer et al. 2000) and caused damage to aircraft in 86% of the strikes where deer were involved (Wright 2001). In general, deer strikes result in major component damage to the aircraft. Deer-aircraft strikes can also result in loss of human life, injury to passengers or people on the ground, and damage or malfunction of aircraft, aircraft navigational aids, or airport facilities. Mammals colliding with aircraft during the most vulnerable phases of flight, takeoff or landing, can cause the aircraft to crash or sustain physical damage (Dolbeer et al. 2013). Deer are characteristically unpredictable in their initial response to approaching aircraft. Deer may wander onto runway surfaces and be startled into the path of oncoming aircraft, and at night, they may freeze when caught in the beams of landing lights, resulting in a strike.

WS could also be requested to provide assistance associated with mammal damage at historical sites within the State. Woodchucks can cause extensive damage by burrowing and denning in earthen levees and other mounds. Burrowing activities can threaten the integrity of the earthen embankments. In addition, burrows can be aesthetically displeasing to the public and can cause damage to mowing equipment. In addition, there are thousands of archaeological and historical sites on TVA-managed properties, some of which are extremely sensitive and could be disturbed by the burrowing and activities of mammals. Many of those sites, especially earthen mounds, have been damaged by the burrowing of woodchucks and could be damage by similar activities associated with nine-banded armadillos.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA documents the need for managing damage caused by the mammal species identified in Section 1.1, the issues associated with meeting that need, and alternative approaches to address those issues and to meet the need for action. WS' mission is to provide federal leadership with managing damage and threats of damage associated with animals (see WS Directive 1.201). WS would only provide assistance when the appropriate property owner or manager requested WS' assistance. WS could receive a request for assistance from a property owner or manager to conduct activities on property they own or manage, which could include federal, state, tribal, municipal, and private land within the State of Mississippi.

Appendix B of this EA discusses the methods available for use or recommendation under each of the alternative approaches evaluated[9]. The alternatives and Appendix B also discuss how WS and other entities could recommend or employ methods to manage damage and threats associated with mammals in the State. Therefore, the actions evaluated in this EA are the use or recommendation of those methods available under the alternatives and the employment or recommendation of those methods by WS to manage or prevent damage and threats associated with mammals from occurring when requested by the appropriate resource owner or manager. WS' activities that could involve the lethal removal of target

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

mammal species under the alternatives would only occur when agreed upon by the requester and when authorized by the MDWFP, when required, and only at levels authorized.

Federal, State, County, City, and Private Lands

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

Native American Lands and Tribes

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

Period for which this EA is Valid

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

Site Specificity

As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. In addition, WS' activities that could involve the lethal removal of mammals under the alternatives would only occur when authorized by the MDWFP, when required, and only at levels authorized.

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

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

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

The analyses in this EA would apply to any action that may occur by WS in any locale and at any time within Mississippi. In this way, WS and the TVA believes the two agencies meet the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS and the TVA to comply with the NEPA and still be able to accomplish their missions.

Summary of Public Involvement

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

WS will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS and the

TVA will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. WS and the TVA would fully consider new issues, concerns, or alternatives the public identifies during the public involvement period to determine whether WS and the TVA should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Environmental Assessment – Aquatic Rodent Damage Management in Mississippi

WS has developed an EA that analyzed the need for action to manage damage associated with beaver, muskrats, and nutria in the State (USDA 2015*a*). Although this EA does not specifically address beaver, muskrats, and nutria, many of the methods available to alleviate aquatic rodent damage can also be used to alleviate damage associated with other mammal species. Therefore, this EA will evaluate the cumulative use of methods related to aquatic rodent damage management and the methods available under the alternatives in this EA.

WS' Environmental Assessment - Mammal Damage Management in Mississippi

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

Final Environmental Impact Statement - Feral Swine Damage Management

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

TVA's Natural Resource Plan (NRP)

The TVA has developed an extensive plan to strategically evaluate both renewable and nonrenewable resources and fulfill the responsibilities associated with good stewardship of TVA lands and resources. The NRP is designed to integrate the objectives of six resource areas (biological, cultural, recreation, water, public engagement and reservoir lands planning); provide optimum public use benefit; and balance competing and sometimes conflicting resource uses (TVA 2011*a*).

TVA's Environment Impact Statement Assessing the Natural Resource Plan

The TVA has also prepared an EIS to assess the impacts of the NRP and its reasonable alternatives on the environment. It specifically describes the stewardship programs that are ongoing and are being evaluated for future implementation as part of the NRP; and assesses the potential environmental impacts associated with implementing the various alternatives.

Mississippi's Comprehensive Wildlife Conservation Strategy (CWCS)

The MDWFP has developed an extensive wildlife conservation plan that evaluates all species of plant and animal known to exist within the State. This plan identifies all of the species and habitats that are currently listed as endangered, threatened, or species of concern, both federally by the United States Fish and Wildlife Service (USFWS) and at the state level by the MDWFP through the Mississippi Museum of Natural Science (Mississippi Museum of Natural Science 2005). The CWCS creates a comprehensive prioritized list of species in need of conservation and their habitats. WS and the TVA consulted the CWCS as part of this analysis.

Conservation and Management of Black Bears in Mississippi

The MDWFP developed black bear management objectives that included: (1) providing black bear education opportunities to personnel of the MDWFP, (2) training for MDWFP personnel with handling, immobilizing, and data gathering, (3) educating the public, (4) managing human/bear conflicts, (5) outlines priorities for black bear research, and (6) limiting and preventing human-induced mortality of black bears (Young 2006).

1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES

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

WS' Legislative Authority

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

Tennessee Valley Authority

The TVA is a federal corporation created by an Act of Congress in May 18, 1933 [48 Stat. 58-59, 16 USC Sec. 831, as amended]. The TVA provides electricity to 9 million people, businesses and industries, and manages 293,000 acres of public land and 11,000 miles of reservoir shoreline in the seven-state Tennessee Valley Region (Tennessee, Alabama, Mississippi, Kentucky, Georgia, North Carolina, and Virginia – an area of 80,000 square miles). The TVA also provides flood control, navigation, land management, and recreation for the Tennessee River system and works with local utilities and state and local governments to promote economic development across the region.

In Mississippi, the TVA generates electricity at three combustion turbine sites and two solar facilities. The electricity TVA generates is transmitted over 16,000 miles of transmission line across the Valley. TVA also owns or maintains 80 substations and 2,037 circuit miles of transmission lines in Mississippi. The TVA conducts and requests assistance from WS to provide wildlife damage management on land and at facilities owned by the TVA. The TVA also makes its public lands available for use for continuation and expansion of the WS' ORV program across the states within the Tennessee River Basin and Valley.

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.

Mississippi Department of Wildlife, Fisheries, and Parks

The MDWFP authority in wildlife management is given within the Mississippi Code Annotated Section 49-1-1 et seq., the official regulations of the Commission of Wildlife, Fisheries and Parks and applicable federal laws. This legislation covers general provisions; licenses, permits and stamps; wildlife; fish; and wild animals.

Mississippi Department of Agriculture and Commerce (MDAC)

The Pesticide Program of the MDAC enforces state laws pertaining to the use and application of pesticides. Under the Mississippi Pesticide Application Act (Sections 69-23-101 through 69-23-133) this section monitors the use of pesticides in a variety of pest management situations. It also licenses private and commercial pesticide applicators and pesticide contractors. Under the Mississippi Pesticide Law (Section 69-23-1 through 69-23-27) the program licenses restricted use pesticide dealers and registers all pesticides for sale and distribution in the state of Mississippi.

1.6 COMPLIANCE WITH LAWS AND STATUTES

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

National Environmental Policy Act

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

Pursuant to the NEPA and the CEQ regulations, this EA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that WS and the TVA infuse the policies and goals of the NEPA into agency actions. WS and the TVA prepared this EA by integrating as many of the natural and social sciences as warranted, based on the potential effects of the alternatives, including the potential direct, indirect, and cumulative effects of the alternatives.

Endangered Species Act

Under the Endangered Species Act (ESA), all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS and the TVA conducts consultations with the USFWS pursuant to Section 7 of the ESA to ensure that "*any action authorized…funded or carried out by such an agency…is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency will use the best scientific and commercial data available*" (Sec.7 (a)(2)). Evaluation of the alternatives in regards to the ESA will occur in Chapter 4 of this EA.

Federal Insecticide, Fungicide, and Rodenticide Act

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

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

The NHPA and its implementing regulations (see 36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Section 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106. None of the mammal damage management methods described in this EA that would be available cause major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor would involve the sale, lease, or transfer of ownership of any property. In general, the use of such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas that could result in effects on the character or use of historic properties. Therefore, the methods that would be available under the alternatives would not generally be the types of methods that would have the potential to affect historic properties. If WS and/or the TVA planned an individual activity with the potential to affect historic resources under an alternative selected because of a decision on this EA, WS and/or the TVA would conduct the site-specific consultation, as required by Section 106 of the NHPA, as necessary.

The use of noise-making methods, such as firearms, at or in close proximity to historic or cultural sites for the purposes of removing wildlife have the potential for audible effects on the use and enjoyment of historic property. However, WS would only use such methods at a historic site at the request of the owner or manager of the site to resolve a damage problem, which means such use, would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually all the methods involved would only have temporary effects on the audible nature of a site and could be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. WS and/or the TVA would conduct site-specific consultation as required by the Section 106 of the NHPA, as necessary, in those types of situations.

The Native American Graves and Repatriation Act of 1990

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

Occupational Safety and Health Act of 1970

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

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

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

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

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

Animal Medicinal Drug Use Clarification Act of 1994

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

Airborne Hunting Act

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

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

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

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

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

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. WS and the TVA make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. WS and the TVA 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 is highly unlikely that activities conducted pursuant to the alternatives would adversely affect children. For these reasons, WS and the TVA conclude that it would not create an environmental health or safety risk to children from implementing the alternatives. Additionally, the need for action identified a need to reduce threats to human safety, including risks to children; therefore, cooperators could request WS' assistance with reducing threats to the health and safety of children posed by mammals.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. Pursuant to Executive Order 13112, the National Invasive Species Council has designated feral swine as meeting the definition of an invasive species. In addition, Lowe et al. (2000) ranked feral swine as one of the 100 worst invasive species in the world.

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

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

Wildlife Definitions and Interpretations (Mississippi Code Annotated §49-7-1, as amended)

Section 49-7-1 of the Mississippi Code of 1972 defines those mammal species that are considered game species, fur-bearing species, and nuisance animals. Of those species addressed in this EA, game species include white-tailed deer, rabbits, and squirrels while fur-bearing species include opossums, otters, raccoons, and bobcats. Wildlife defined as nuisance animals include fox, skunks, feral swine, and coyotes (Public Notice LE4-3779). People may remove nuisance animals at any time subject to certain provisions.

1.7 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. The TVA owns and operates numerous electrical power generation sites and transmission structures within Mississippi, including electrical substations and transmission lines. In addition, the TVA manages lands within the State for recreational, natural, and cultural resources. Many of these sites experience damage associated with mammals within the State. The TVA would be the primary decision-maker for mammal damage management activities occurring on sites owned or managed by the TVA. The MDWFP is responsible for managing wildlife in the State of Mississippi, including those wildlife species addressed in this EA. As the authority for the management of wildlife populations in the State, the MDWFP 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 MDWFP establishes and enforces regulated hunting and trapping seasons in the State. The lethal removal of many of the species addressed in this EA can only occur when authorized by the MDWFP; therefore, the lethal removal of those species to alleviate damage or reduce threats of damage would only occur at the discretion of MDWFP and only at the levels the MDWFP authorizes. Those activities that WS could conduct pursuant to the respective alternatives to reduce and/or prevent mammal damage in the State would be coordinated with the MDWFP, which would ensure the MDWFP has the opportunity to incorporate any activities WS' conducts into population objectives established for mammal populations in the State.

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

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

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

2.1 AFFECTED ENVIRONMENT

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

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

In addition, mammal damage management could occur at facilities owned or managed by the TVA when mammal species addressed in this assessment damage or pose threats of damage to property, to natural resources, to human safety, or to the reliability of electric system transmission. Damage management activities could be conducted at any of the three combustion turbine sites owned by the TVA in Mississippi known as the Caledonia, Southaven, and Kemper sites. The Caledonia Plant occupies 120 acres near Steens, Mississippi. The Southaven Plant occupies 118 acres in Desoto County, Mississippi while the Kemper Plant occupies 197 acres in Kemper County, Mississippi near the City of DeKalb. The TVA also operates two solar facilities in Mississippi on the campuses of the University of Mississippi in Oxford, Mississippi and a location at Mississippi State University in Starkville, Mississippi. The TVA also owns or manages 76 electrical substations and 2,038 circuit miles of transmission lines in Mississippi.

Activities to reduce damage or threats of damage could also be conducted on recreational, natural, and cultural lands owned or managed by the TVA. The TVA owns 90 miles of public shoreline on Pickwick Reservoir in northeastern Mississippi that provides camping, fishing, boating, swimming, and other recreational opportunities. The TVA also owns and manages 1,700 acres of public land in Mississippi adjacent to Pickwick Reservoir.

Environmental Status Quo

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

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

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

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

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

2.2 ISSUES ASSOCIATED WITH MAMMAL DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns regarding potential effects that might occur from a proposed action. Federal agencies must consider such issues during the NEPA decision-making process. Initially, WS, in cooperation with the TVA, developed the issues related to managing damage associated with mammals in Mississippi in consultation with the MDWFP. In addition, WS and the TVA will invite the public to review and comment on the EA to identify additional issues.

Chapter 4 discusses the issues, as those issues relate to the possible implementation of the alternatives, including the proposed action. WS and the TVA evaluated, in detail, the following issues:

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

Under certain alternatives, WS could employ methods available to resolve damage and reduce threats to human safety that target an individual animal of a mammal species or a group of animals after applying the WS Decision Model (Slate et al. 1992) to identify possible techniques. A common issue when addressing damage caused by animals is the potential impacts of management actions on the populations of target species. Lethal and non-lethal methods would be available to resolve mammal damage or threats to human safety. Non-lethal methods could disperse, translocate, or otherwise make an area unattractive to target species causing damage, which could reduce the presence of those species at the site and potentially the immediate area around the site where an entity employed those methods. Employing lethal methods could remove a mammal or those mammals responsible for causing damage or posing threats to human safety. Therefore, the use of lethal methods could result in local population reductions in the area where damage or threats were occurring. The number of individual animals from a target species that WS could remove from the population using lethal methods would be dependent on the number of requests for assistance received, the number of individual animals involved with the associated damage or threat, the efficacy of methods employed, and the number of individuals the MDWFP authorizes WS to remove.

Another concern is that activities conducted by WS would affect the ability of persons to harvest wildlife during the regulated hunting and/or trapping seasons either by reducing local populations through the lethal removal of mammals or by reducing the number of mammals present in an area through dispersal techniques. People in the State can harvest many of the mammal species addressed in this EA during annual hunting and/or trapping seasons. White-tailed deer, eastern cottontails, swamp rabbits, fox squirrels, and gray squirrels are game species in the State, which people can harvest annually during hunting seasons. Virginia opossum, river otters, raccoons, and bobcats are furbearing species in the State that people can harvest during annual hunting and trapping seasons. In addition, fox, skunks, coyotes, and feral swine are "*nuisance*" animals in the State, which allow private landowners or their designated agents to hunt, trap, take, kill, chase, or pursue those species throughout the year subject to certain provisions. People can also lethally remove nine-banded armadillos and woodchucks at any time in the State. The only mammal species addressed in the EA that do not have hunting and trapping seasons in the State are bats, black bears, southern flying squirrels, feral cats and feral dogs.

When authorized by the MDWFP, people can also address some of the species using available methods themselves or seek assistance from other entities when those species cause damage or pose threats of damage outside of the annual hunting and/or trapping season. Some species (*e.g.*, "*nuisance*" animals) do not require authorization from the MDWFP when causing damage or posing threats of damage. Therefore, any damage management activities conducted by WS under the alternatives addressed would be occurring along with other natural process and human-induced events, such as natural mortality, human-induced mortality from private damage management activities, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

The analysis will measure the number of individual animals lethally removed in relation to that species' abundance to determine the magnitude of impact to the populations of those species from the use of lethal methods. Magnitude may be determined either quantitatively or qualitatively. Determinations based on population estimates, allowable harvest levels, and actual harvest data would be quantitative. Determinations based on population trends and harvest trend data, when available, would be qualitative. Chapter 4 analyzes the effects on the populations of target mammal populations in the State from implementation of the alternatives addressed in detail, including the proposed action.

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

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

The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. WS conducts consultations with the USFWS pursuant to Section 7 of the ESA to ensure compliance. The WS program also conducts consultations to ensure that *"any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available"* [Sec. 7(a)(2)]. As part of the scoping process for this EA, WS consulted with the USFWS pursuant to Section 7 of the ESA to facilitate interagency cooperation between WS and the USFWS. Chapter 4 discusses the potential effects of the alternatives on this issue.

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

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

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

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

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

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

Repellents for many mammal species contain different active ingredients with most ingredients occurring naturally in the environment. The most common ingredients of repellents are coyote urine, putrescent whole egg solids, and capsaicin. Repellents for mammals are not generally restricted-use products; therefore, a person does not need a pesticide applicators license to purchase or apply those products. People generally apply repellents directly to affected resources, which elicits an adverse taste response when the target animal ingests the treated resource or the ingestion of the repellent causes temporary sickness (*e*.*g*., nausea). Products containing coyote urine or other odors associated with predatory wildlife are intended to elicit a fright response in target animals by imitating the presence of a predatory animal (*i*.*e*., animals tend to avoid areas where predators are known to be present). WS could employ or recommend for use those repellents that were available for use in the State (*i.e*., registered with the EPA pursuant to the FIFRA and registered with the MDAC for use in Mississippi).

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

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

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

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

Another concern is the threat to human safety from not employing methods or not employing the most effective methods to reduce the threats that mammals could pose. The need for action in Chapter 1 addresses the risks to human safety from diseases associated with certain mammal populations. The low risk of disease transmission from mammals does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

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

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

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target mammals to the public, resource owners, or neighboring residents. People generally regard animals as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that animals exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

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

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

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

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

In some cases, the presence of overabundant mammal species offends people, such as raccoons, armadillos, gray squirrels, coyotes, or feral species, such as cats or dogs. To such people, those species represent pests that are nuisances, which upset the natural order in ecosystems, and are carriers of diseases transmissible to people or other animals. In those situations, the presence of overabundant species can diminish their overall enjoyment of other animals by what they view as a destructive presence of such species. They are offended because they feel that those mammal species proliferate in such numbers and appear to remain unbalanced.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that people can interpret in a variety of ways. Schmidt (1989) indicated that vertebrate damage management for societal benefits could be compatible with animal welfare concerns, if "…the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process."

The AVMA (1987) has previously described suffering as a "…highly unpleasant emotional response usually associated with pain and distress." However, suffering "…can occur without pain…," and "…pain can occur without suffering…". Because suffering carries with it the implication of a time frame, a case could be made for "…little or no suffering where death comes immediately…" (California Department of Fish and Game 1991). Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering can occur when a person does not take action to alleviate conditions that cause pain or distress in animals.

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior in animals can be indicators of pain. However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991).

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

Pain and suffering, as it relates to methods available for use to manage mammals has both a professional and lay point of arbitration. Wildlife managers and the public must recognize the complexity of defining suffering, since *"…neither medical nor veterinary curricula explicitly address suffering or its relief"* (California Department of Fish and Game 1991). Research suggests that with some methods (*e.g.*, foothold traps) changes in the blood chemistry of trapped animals indicate the existence of some level of "*stress*" (Kreeger et al. 1990). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011).

The decision-making process involves tradeoffs between the above aspects of pain and humaneness. Therefore, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering. Chapter 4 further discusses the issue of humaneness and animal welfare. Chapter 3 discusses SOPs intended to alleviate pain and suffering.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

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

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

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

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

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

WS' Impact on Biodiversity

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

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

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

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

Chapter 4 evaluates the environmental consequences of the alternatives on the populations of target and non-target species based on available quantitative and qualitative parameters. The permitting of lethal removal by the MDWFP would ensure cumulative removal levels would occur within allowable levels to maintain species' populations and meet population objectives for each species. Therefore, activities conducted pursuant to any of the alternatives would not adversely affect biodiversity in the State.

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA processes is a concern that WS or other entities should establish a threshold of loss before employing lethal methods to resolve damage and that mammal damage should be a cost of doing business. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In some cases, any loss in value of a resource caused by wildlife could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking mammals could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of wildlife strikes prior to an actual strike occurring would be appropriate.

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

Mammal Damage Management Should Not Occur at Taxpayer Expense

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

Additionally, damage management activities are an appropriate sphere of activity for government programs, since managing wildlife is a government responsibility. Treves and Naughton-Treves (2005) and the International Association of Fish and Wildlife Agencies (2005) discuss the need for wildlife damage management and that an accountable government agency is best suited to take the lead in such activities because it increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall.

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives WS and the TVA are considering. However, the methods determined to be most effective to reduce damage and threats to human safety caused by mammals and that prove to be the most cost effective would likely receive the greatest application. As part of an integrated approach and as part of the WS Decision Model, evaluation of methods would continually occur to allow for those methods that were most effective at resolving damage or threats to be employed under similar circumstance where mammals were causing damage or posing a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. Therefore, the cost of methods can often influence the availability of methods to resolve damage, which can influence the effectiveness of methods.

Mammal Damage Should be managed by Private Nuisance Wildlife Control Agents

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

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

Effects from the Use of Lead Ammunition in Firearms

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

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

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

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

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

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

Of concern under this issue would be the consumption of deer meat donated to a charitable organization after WS lethally removed the deer. Of recent concern is the potential for lead and other contaminants to be present in the deer meat processed for human consumption. The potential for the spreading of zoonotic diseases in deer processed and donated for human consumption is also a concern. Under the proposed action alternative, WS could donate meat from deer lethally removed during damage management activities to charitable organizations for human consumption (see WS Directive 2.510). The WS program in Mississippi would only donate meat from deer under the proposed action alternative. WS could recommend the donation or consumption of meat under the technical assistance only alternative but WS' personnel would not provide direct operational assistance under a technical assistance only alternative.

Stewart and Veverka (2011) documented that white-tailed deer shot with lead ammunition in the head or extreme upper neck in sharpshooting situations showed no deposition of lead fragments in the meat of the animals that people would process for human consumption. Lower neck shots do frequently experience lead fragmentation in the loin muscle and Stewart and Veverka (2011) recommended removing the loins prior to processing to ensure that people did not ingest the fragments. WS' personnel would receive training to shoot and target the head and upper neck of white-tailed deer. WS would not donate any deer shot in the lower neck or would process those deer to avoid the areas that could contain lead fragments.

If WS donated deer for human consumption, WS' personnel would follow WS' policies pertaining to the testing or labeling of meat in order to address potential health concerns. The testing of deer donated for exposure to substances such as organophosphate and carbamate insecticides, lead, mercury, arsenic, organochlorines, and organic chemicals could occur prior to distribution for human consumption. WS would not donate deer immobilized using immobilizing drugs or euthanized using euthanasia chemicals for human consumption. WS would dispose of carcasses of deer euthanized with euthanasia chemicals pursuant to WS Directive 2.515. Deer removed by any method for disease sampling or in an area where zoonotic diseases of concern were known to be prevalent and of concern to human health after consuming processed deer meat would not be donated for consumption and would be disposed of by deep burial or incineration. WS' adherence to policy would not result in adverse effects to human health from the donation of deer meat.

Donation of Feral Swine Removed Through Management Activities for Human Consumption

Under the Federal Meat Inspection Act, inspectors must inspect all swine prior to the swine entering into any establishment for slaughter. Inspections occur by the Food Safety and Inspection Services under the

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

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

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

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

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

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

Coordination between agencies and local entities would ensure people could identify and address any dispersing feral swine when they cause damage or threaten human safety. The limited use of methods that disperse feral swine should further ensure they do not displace to other areas within Mississippi. In addition, the passiveness of the primary methods proposed for use should limit dispersal of feral swine. Feral swine also occur statewide in the State; therefore, dispersal is not likely to disperse feral swine into areas where they are not already present.

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

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

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

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

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

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

CHAPTER 3: ALTERNATIVES

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

3.1 DESCRIPTION OF THE ALTERNATIVES

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

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

The proposed action/no action alternative would continue the current implementation of an adaptive integrated methods approach utilizing non-lethal and lethal techniques when WS receives a request for assistance in the State. This approach to managing damage associated with mammals would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by a site-specific evaluation for each request. WS' personnel would determine the appropriate methods to reduce damage and threats of damage by using the WS Decision Model (see discussion below on the WS Decision Model).

A major goal of the program would be to resolve and prevent damage caused by mammals and to reduce threats to human safety. To meet this goal, WS would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding[10] was available, operational damage management. WS would provide those entities requesting assistance with information regarding the use of appropriate non-lethal and lethal techniques.

Under this alternative, WS could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by mammals, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The removal of many of the mammal species addressed in this EA can only legally occur under authorization by the MDWFP and only at levels authorized, unless the MDWFP affords those mammal species no protection, in which case, no authorization for lethal removal would be required. To meet the need for action, the objectives of this alternative would be to assist all of the people requesting WS' assistance, within the constraints of available funding and workforce.

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

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

The WS Decision Model would be the implementing mechanism for a damage management program under the proposed action alternative that could be adapted to an individual damage situation. This

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

alternative would allow WS to use the broadest range of methods to address damage or the threat of damage. When WS received a request for direct operational assistance, WS would conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage. Discussion of the Decision Model and WS' use of the Model under the proposed action occurs below. In addition, WS would give preference to non-lethal methods when practical and effective (see WS Directive 2.101). When receiving requests for assistance associated with squirrels and woodchucks, the WS program in Mississippi would follow WS Directive 2.345. When receiving requests for assistance associated with feral or free-ranging dogs, the WS program would follow WS Directive 2.340.

Non-lethal methods that would be available for use by WS under this alternative include, but are not limited to minor habitat modification, behavior modification, lure crops, visual deterrents, live traps, drop nets, cannon nets, translocation, exclusionary devices, frightening devices, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods that would be available to WS under this alternative include body-gripping traps, cable restraints, the recommendation of harvest during hunting and/or trapping seasons, fumigants, euthanasia chemicals, and shooting, including the use of firearms from aircraft. Target mammal species live-captured using non-lethal methods (*e.g.*, live-traps, immobilizing drugs) could be euthanized. The lethal control of target mammals would comply with WS Directive 2.505.

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

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

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

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

WS could employ lethal methods to resolve damage associated with those mammals identified by WS as responsible for causing damage or threats to human safety under this alternative[11]; however, WS would only employ lethal methods after receiving a request for the use of those methods. The use of lethal methods could result in local population reductions in the area where damage or threats were occurring since people could remove individual mammals from the population. WS and other entities often employ lethal methods to reinforce non-lethal methods and to remove mammals that WS or other entities identify as causing damage or posing a threat to human safety. The number of mammals removed from the population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed.

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

Most lethal and non-lethal methods currently available provide only short-term benefits when addressing mammal damage. The intent of those methods would be to reduce damage occurring at the time those methods were employed but do not necessarily ensure mammals would not return once those methods were discontinued. Long-term solutions to resolving mammal damage would often be difficult to implement and can be costly. In some cases, long-term solutions involve exclusionary devices, such as 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.

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

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

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

Technical Assistance Recommendations

Under the proposed action, WS could provide technical assistance to those persons requesting assistance with managing damage as part of an integrated methods approach. Technical assistance could occur as described in Alternative 2 of this EA. From FY 2009 through FY 2014, WS conducted 1,007 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety (see Table 1.1).

Direct Operational Assistance

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

Educational Efforts

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

Research and Development

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

WS' Decision Making Procedures

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

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

1. **Receive Request for Assistance:** WS would only provide assistance after receiving a request for such assistance. WS would not respond to public bid notices.
2. **Assess Problem:** First, WS would make a determination as to whether the assistance request was within the authority of WS. If an assistance request were within the authority of WS, WS' employees would gather and analyze damage information to determine applicable factors, such as what species was responsible for the damage, the type of damage, the extent of damage, and the magnitude of damage. Other factors that WS' employees could gather and analyze would include the current economic loss or current threat (*e.g.*, threat to human safety), the potential for future losses or damage, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.
3. **Evaluate Management Methods:** Once a problem assessment was completed, a WS' employee would conduct an evaluation of available management methods. The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on biological, environmental, social, and cultural factors.
4. **Formulate Management Strategy:** A WS' employee would formulate a management strategy using those methods that the employee determines to be practical for use. The WS employee would also consider factors essential to formulating each management strategy, such as available expertise, legal constraints on available methods, costs, and effectiveness.
5. **Provide Assistance:** After formulating a management strategy, a WS employee could provide technical assistance and/or direct operational assistance to the requester (see WS Directive 2.101).
6. **Monitor and Evaluate Results of Management Actions:** When providing direct operational assistance, it is necessary to monitor the results of the management strategy. Monitoring would be important for determining whether further assistance was required or whether the management strategy resolved the request for assistance. Through monitoring, a WS' employee would continually evaluate the management strategy to determine whether additional techniques or modification of the strategy was necessary.

7. **End of Project:** When providing technical assistance, a project would normally end after a WS' employee provided recommendations or advice to the requester. A direct operational assistance project would normally end when WS' personnel stop or reduce the damage or threat to an acceptable level to the requester or to the extent possible. Some damage situations may require continuing or intermittent assistance from WS' personnel and may have no well-defined termination point.

Community-based Decision Making

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

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

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

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

Private Property Decision-makers

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

Public Property Decision-makers

The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. WS could provide technical assistance to this person and make recommendations to reduce damage. WS could provide direct operational assistance when requested; however, WS would only provide assistance if the requested management actions were in accordance with WS' recommendations.

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

Under this alternative, WS would provide those cooperators requesting assistance with technical assistance only. Similar to Alternative 1, WS could receive requests for assistance from community representatives, private individuals/businesses, or from public entities. Technical assistance would provide those cooperators experiencing damage or threats associated with mammals with information, demonstrations, and recommendations on available and appropriate methods. The implementation of methods and techniques to resolve or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, WS would describe several management strategies to the requester for short and long-term solutions to managing damage. WS would base those strategies on the level of risk, need, and the practicality of their application. WS would use the Decision Model to recommend those methods and techniques available to the requester to manage damage and threats of damage. Those persons receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from other entities, or take no further action.

Under a technical assistance only alternative, WS would recommend an integrated approach similar to the proposed action alternative (Alternative 1) when receiving a request for assistance; however, WS would not provide direct operational assistance under this alternative. WS would give preference to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). WS would base method and technique recommendations on information provided by the individual(s) seeking assistance using the WS Decision Model. In some instances, wildlife-related information provided to the requester by WS would result in tolerance/acceptance of the situation. In other instances, WS would discuss and recommend damage management options. WS would only recommend or loan those methods legally available for use by the appropriate individual. Similar to Alternative 1, those methods described in

Appendix B would be available to those persons experiencing damage or threats associated with mammals in the State; however, Gonacon™ (deer only), immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability to the public and other entities under this alternative and Alternative 3. Licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. The availability of aircraft would also be limited, especially shooting from an aircraft (feral swine and coyotes only). Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage associated with feral swine and coyotes would require authorization from the MDWFP. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the MDWFP or those persons under the supervision of the MDWFP. At the time this EA was developed, Gonacon™ was not registered for use in the State.

The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing mammal damage. Technical assistance would include collecting information about the species involved, the extent of the damage, and previous methods that the cooperator had attempted to resolve the problem. WS would then provide information on appropriate methods that the cooperator could consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues. Between FY 2009 and FY 2014, WS has conducted 1,007 technical assistance projects that involved mammal damage to agricultural resources, property, natural resources, and threats to human safety.

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

Alternative 3 – No Mammal Damage Management Conducted by WS

This alternative would preclude all activities by WS to reduce threats to human health and safety, and to alleviate damage to agricultural resources, property, and natural resources. WS would not provide assistance with any aspect of managing damage caused by mammals in the State. WS would refer all requests for assistance to resolve damage caused by mammals to the MDWFP, other governmental agencies, and/or private entities.

Despite no involvement by WS in resolving damage and threats associated with mammals in the State, those persons experiencing damage caused by mammals could continue to resolve damage by employing those methods legally available since the removal of mammals to alleviate damage or threats could occur despite the lack of involvement by WS. The removal of mammals by a property owner or another entity could occur after authorization by the MDWFP, when required, and during the hunting and/or trapping seasons. Landowners, agricultural leaseholders, and their designated agents can lethally remove coyotes, fox, skunks, and feral swine at any time when those species are causing damage in accordance with appropriate regulations. Similar to Alternative 2, those methods described in Appendix B would be available to those people experiencing damage or threats associated with mammals in the State; however, Gonacon™ (deer only), immobilizing drugs, euthanasia chemicals, and the use of aircraft would have limited availability to the public and other entities under this alternative. Licensed veterinarians or people under their supervision would be the only entities that could use immobilizing drugs and euthanasia chemicals. The availability of aircraft would also be limited, especially shooting from an aircraft.

Shooting from an aircraft by entities other than WS to alleviate damage or threats of damage would require authorization from the MDWFP. Under this alternative, the reproductive inhibitor available under the trade name of Gonacon™ would only be available for use by the MDWFP or those persons under the supervision of the MDWFP. At the time this EA was developed, Gonacon™ was not registered for use in the State.

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

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

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

Non-lethal Methods Implemented Before Lethal Methods

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

Those people experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, WS could only evaluate the presence or absence of non-lethal methods. The proposed action (Alternative 1) and the technical assistance only alternative (Alternative 2) would be similar to a non-lethal before lethal alternative because WS would give preference to the use of non-lethal methods before lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not contribute additional information to the analyses in the EA.

Use of Non-lethal Methods Only by WS

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

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

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

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

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with mammals. However, non-lethal methods can be effective in preventing damage in certain instances. For example, the use of one-way exclusion devices can be effective with allowing bats to exit a structure but prevent re-entry. Once bats have exited the structure, the owner could complete structural repairs to prevent re-entry of bats. In those situations where damage could be alleviated effectively using non-lethal methods, WS would employ or recommend those methods as determined by the WS Decision Model. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Non-lethal methods have been effective in alleviating mammal damage. Therefore, WS did not consider this alternative in detail.

Live-capture and Translocation of Mammals Only

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods and WS would translocate all target mammals live-captured. Mammals could be live-captured using immobilizing drugs, cage traps, foothold traps, cable restraints, cannon nets, or rocket nets and WS would translocate those mammals to appropriate habitat for release. The success of translocation efforts would depend on efficiently capturing target mammal species and the existence of an appropriate release site (Nielsen 1988). Translocation sites would be identified and have to be approved by the MDWFP and/or 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 MDWFP. Therefore, the translocation of mammals by WS would only occur as directed by the MDWFP. When requested by the MDWFP, WS could translocate mammals or recommend translocation under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, translocation by other entities could occur under Alternative 3.

Translocation may be appropriate in some situations when the population of a species is low. However, most of the target mammal species are abundant in much of the suitable habitat in Mississippi, and translocation is not necessary for the maintenance of viable populations for those species in the State. Because those mammal species are abundant in Mississippi, the mammals that WS translocated and released into suitable habitat would very likely encounter other mammals of the same species with established territories. For example, even if the MDWFP authorized WS to translocate a coyote, the release of the coyote into suitable habitat would likely occur in areas where other coyotes already occur.

Coyotes are territorial, and introducing a translocated coyote into a new area often disorientates the coyote because they are unfamiliar with their surroundings. Therefore, a translocated coyote would often be at a disadvantage. Territorial coyotes often viciously attack other coyotes that wander into their territories. Survival of translocated animals is generally very poor due to the stress of translocation, and in many cases, released animals suffer mortality in a new environment (Craven et al. 1998).

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

Use of Non-lethal Methods and Approved Euthanasia Only

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

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

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

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

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

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

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

Compensation for Mammal Damage

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

Short Term Eradication and Long Term Population Suppression

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

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

Bounties

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

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

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

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

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

TNR programs are often not as successful as desired and needed to reduce immediate threats posed by wildlife, especially when human safety is a concern (AVMA 2003, Barrows 2004, Levy and Crawford 2004, Jessup 2004, Winter 2004, AVMA 2014). Feral animals subjected to a TNR program would continue to cause the same problems[12] 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).

[12] 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.

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

3.3 STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT

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

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

- WS' employees would consistently use and apply the WS Decision when addressing mammal damage to identify effective strategies to managing wildlife damage and their potential impacts.

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

- WS' employees would use immobilizing drugs and euthanasia chemicals according to the United States Drug Enforcement Administration, United States Food and Drug Administration, and WS' directives and procedures.

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

- WS' employees would follow approved procedures outlined in the WS' Field Manual for the Operational Use of Immobilizing and Euthanizing Drugs (Johnson et al. 2001).

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

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

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

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

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

- WS' employees participating in any aspect of aerial wildlife operations receive training and/or would receive certification in their role and responsibilities during the operations. All WS' personnel would follow the policies and directives set forth in WS' Directive 2.620; WS'

Aviation Operations Manual; WS' Aviation Safety Manual and its amendments; Title 14 CFR; and Federal Aviation Regulations, Part 43, 61, 91, 119, 133, 135, and 137.

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

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

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

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

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

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

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

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

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

- The WS program in Mississippi would report annual activities to the MDWFP so the MDWFP has the opportunity to evaluate population trends and the magnitude of WS' activities 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.

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

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

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

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

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

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

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

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

- WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g*., drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g*., cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once every 24 hours or in accordance with Mississippi laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner.

- WS has consulted with the USFWS and the MDWFP to evaluate activities to resolve mammal damage and threats to ensure the protection of T&E species. WS would abide by those recommendations made by the USFWS during consultation to ensure activities were not likely to adversely affect T&E species.

- WS' personnel would dispose of carcasses mammals retrieved after damage management activities in accordance with WS Directive 2.515.

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

- WS' personnel would review all projects proposed for implementation for potential to take[13] bald eagles in accordance with the provisions of the Bald and Golden Eagle Protection Act. If WS' personnel identify potential risks of take, WS would work with the USFWS on measures to reduce risks and the need for a non-purposeful take permit.

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

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

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

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

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

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

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

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

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

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

- WS' personnel would direct management actions to reduce or prevent damage caused by mammals toward specific individuals identified as responsible for the damage, identified as posing a threat to human safety, or identified as posing a threat of damage.

- WS and the entity requesting assistance would agree upon all methods or techniques applied to resolve damage or threats to human safety by signing a work initiation document, MOU, or comparable document prior to the implementation of those methods.

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

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

- WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g*., drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g*., cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once every 24 hours or in accordance with Mississippi laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner.

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

- The NWRC is continually conducting research to improve the selectivity and humaneness of 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.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions when selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as that alternative relates to the issues identified. The WS program does not expect the alternatives to affect soils, geology, minerals, water quality/quantity, flood plains, wetlands, designated critical habitats, visual resources, air quality, prime/unique farmlands, aquatic resources, timber, and range significantly. Therefore, no further analysis associated with those resources occurs.

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

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

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

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

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

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

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

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

In addition to non-lethal methods available to disperse, exclude, or harass wildlife, another non-lethal method that could be available under the alternatives would be the reproductive inhibitor under the trade name Gonacon™. The EPA has classified Gonacon™ as a restricted-use pesticide by the EPA that is only available for use by WS and the wildlife management agency within a state. Only people who have successfully completed a pesticide applicators course to use restricted-use pesticides can purchase and/or apply those products. The MDAC administers training and testing requirements for applicators to purchase and apply restricted-use pesticides in the State. WS and/or the MDWFP would be the only entities that could use Gonacon™ under Alternative 1. Gonacon™ would only be available for use by the MDWFP or their designated agents if the decision-maker selected Alternative 2 or Alternative 3. However, Gonacon™ is not currently registered for use in Mississippi; therefore, is not currently available for use by WS or the MDWFP under any of the alternatives. However, this assessment discusses the product to evaluate the potential use of the chemical if it becomes available for use in the future.

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

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

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

The use of lethal methods by any entity could result in local population reductions in the area where damage or threats were occurring since target individuals would be removed from the population. Lethal methods could be employed or recommended to remove mammals that have been identified as causing damage or posing a threat to human safety. Therefore, the use of lethal methods could result in local reductions of mammals in the area where damage or threats were occurring. The number of mammals removed from the population annually by WS using lethal methods under Alternative 1 would be dependent on the number of requests for assistance received, the number of mammals involved with the associated damage or threat, and the efficacy of methods employed. The number of mammals removed by other entities under Alternative 2 and Alternative 3 would be unknown but would likely be similar to the removal that could occur under Alternative 1. In addition, a person experiencing damage could remove target wildlife after seeking and receiving authorization from the MDWFP. People could also seek assistance from the private entities, such as Nuisance Wildlife Control Operators, to manage damage.

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

The use of firearms could reduce the number of mammals using a location (similar to dispersing mammals) by lethally removing those target animals causing damage or posing a threat of damage. The capture of mammals using live-traps and subsequently euthanizing those mammals would be employed to reduce the number of mammals using a particular area where damage was occurring. Similarly, the recommendation that mammals be harvested during the regulated hunting and/or trapping season for those species in the State would be intended to manage those populations in the area where damage was occurring.

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

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

WS may recommend under Alternative 1 and Alternative 2 that property owners or managers, that request assistance, allow people to harvest certain mammal species during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of mammals causing damage on their properties. Managing localized mammal populations by allowing hunting and/or trapping could lead to a decrease in the number of mammals causing damage. Establishing hunting and trapping seasons and the allowed harvest during those seasons is the responsibility of the MDWFP. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons. However, the harvest of those mammals during hunting and/or trapping seasons in the State would be occurring in addition to any removal that could occur by WS under the alternatives or recommended by WS.

Population and density information specific to Mississippi for many of the target species is not available and is unknown. Frequently, population information is not available for a species and people can calculate conservative estimates based upon the density of a species, the availability of habitat, and a species use of the habitats available. To evaluate the potential impacts to a target species population and to evaluate the magnitude of the potential impacts from activities that could be conducted by WS under the proposed action alternative, a statewide population estimate for many of the target species has been calculated using available information from published literature and other sources. The analyses primarily derive the population estimates from available density data for individual species, when available, and their distribution within the State. When density data was available, the analyses based population estimates on those species occupying a certain percentage of the land area within the State. Since information on actual populations and densities was not available for most target species in Mississippi, calculating a statewide population estimate based on a species only occupying a certain percentage of the land area would likely represent a worst-case scenario since most target species occur statewide throughout the year.

For example, the analysis estimated the statewide population of gray fox based on the species occupying only 50% of the land area within the State, which excluded urban areas. Gray fox occur statewide in a variety of habitats, including urban areas, so gray fox occupying only 50% of the land area of the State is unlikely. However, similar to many of the target species, the analyses evaluated gray fox occupying only 50% of certain land classifications to evaluate potential impacts based on a worst-case scenario and a minimum population estimate.

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

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

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

Alternative 1 - Continue the Current Adaptive Integrated Methods Approach to Managing Mammal Damage (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.

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

Nine-banded Armadillo Population Information and Effects Analysis

People often easily recognize the nine-banded armadillo due to its unique appearance. An opossum sized animal, the armadillo has a "*shell*", which is composed of ossified dermal plates covered by a leathery epidermis (Layne 2003). The armadillo is the only North American mammal that has heavy bony plates (National Audubon Society 2000). Originally thought to occur in Central and South America, including Mexico, the nine-banded armadillo has undergone a northward and eastward expansion into the United States since the late-1800s, likely through natural dispersal from Mexico and release of captive armadillos (Layne 2003). Today, the armadillo can be found across the southern portion of the United States with additional dispersal northward and eastward in the United States likely in the future (Layne 2003). The reduced food availability and the colder temperatures experienced during the winter months are likely the only limitations preventing further range expansion.

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

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

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

The other limiting factor in armadillo expansion and for maintaining populations is the presence of sandy or clay soils. Armadillos are prolific diggers and damages attributed to armadillos are often associated with their digging behavior. Armadillos will dig out shelters and dig while rooting out invertebrates in the soil and leaf litter. This digging and rooting behavior are the most common complaints from resource owners in Mississippi. Most requests for assistance associated with armadillos involve damage to landscaping. Sandy soils are conducive to digging and armadillos can occur in those areas of Mississippi where sandy soils are present.

Female armadillos produce one litter of young per year, which are identical quadruplets (National Audubon Society 2000). Population estimates for armadillos in the United States range from 30 to 50 million armadillos (Gilbert 1995). However, population estimates in Mississippi are not currently available. Therefore, the analysis will consider a population estimate based on the best available information for armadillos to provide an indication of the magnitude of lethal removal proposed by WS to alleviate damage and threats of damage. In Mississippi, winter temperatures are relatively sufficient to maintain armadillo populations. Periods of extreme cold or prolonged periods of cold temperatures may temporarily reduce local populations. Armadillos occur statewide across Mississippi throughout the year in suitable habitat (Layne 2003).

Population densities for armadillos can range from 0.004 to 1.4 armadillos per acre with an average of 0.25 armadillos per acre (Mengak 2005). The estimated land area of Mississippi is 46,923.27 mi^2 (United States Census Bureau 2011), which is approximately 30,030,893 acres. Using a population density estimated at 0.004 to 1.4 armadillos per acre, the statewide population could range from approximately 120,000 armadillos to approximately 42 million armadillos. With an average of 0.25 armadillos per acre, the estimated statewide population could be 7.5 million armadillos. As stated previously, the actual number of armadillos in the State is currently unknown. Under a worst-case scenario, if armadillos occupied only 50% of the land area of Mississippi, the lowest estimated population could be 60,000 armadillos. Armadillos occur in a variety of habitats, including urban areas, throughout the State; therefore, armadillos likely occupy more than 50% of the land area in the State. However, armadillos occupying only 50% of the land area will provide a minimum population estimate to determine the magnitude of the proposed annual removal by WS to alleviate or prevent damage.

Since FY 2009, the WS program in Mississippi has lethally removed 323 armadillos, which is an average of 54 armadillos removed annually. The lethal removal of armadillos has occurred primarily from the use of firearms. The highest level of removal occurred during FY 2010 when WS' personnel lethally removed 119 armadillos using firearms. Of those armadillos lethally removed, WS' personnel removed five armadillos unintentionally during damage management activities targeting other animals. Discussion of the unintentional removal of armadillos occurs in this analysis to ensure a cumulative evaluation occurs. The number of armadillos lethally removed by other entities to alleviate damage is currently unknown. Armadillos are an unregulated species in the State and people can remove armadillos at any time.

Based on previous requests for assistance received by WS and in anticipation of additional requests for assistance, WS could lethally remove up to 200 armadillos annually in the State as part of efforts to alleviate and prevent damage. Given the range of population estimates in the State, the lethal removal of 200 armadillos by WS annually would represent 0.2% of the statewide population based on a population estimated at 120,000 armadillos if the overall population remains at least stable. Under the worst-case scenario, with a population estimated at 60,000 armadillos statewide, lethal removal of up to 200 armadillos would represent 0.3% of the estimated population. Although the number of armadillos lethally removed by other entities in the State to alleviate damage is unknown, the cumulative removal of armadillos, including the proposed removal of up to 200 armadillos annually by WS, is likely of low magnitude when compared to the actual statewide population of armadillos. Although WS' personnel could lethally remove armadillos unintentionally during other damage management activities, the cumulative lethal removal of armadillos is not likely to exceed 200 armadillos.

Virginia Opossum Population Information and Effects Analysis

Opossum are the only marsupials (*i.e*., possess a pouch in which young are reared) found north of Mexico (Seidensticker et al. 1987, Gardner and Sunquist 2003). They frequent most of the eastern and central United States, except the northern portions of Minnesota, Michigan, Vermont, and New Hampshire, and most of Maine, extending west to Wyoming, Colorado, and central New Mexico (Gardner and Sunquist 2003). Opossums also occur in parts of the southwestern United States, California, Oregon, and Washington (Gardner and Sunquist 2003). Adults range in size from less than 1 kg (2.2 lbs) to about 6 kg (13 lbs), depending on sex and time of year. They grow throughout life (Seidensticker et al. 1987, Gardner and Sunquist 2003). They have a broad range of pelage colors, but are generally either a "*gray*" or "*black*" phase. Their fur is grizzled white above with long white hairs covering black tipped fur below. They climb well and feed on a variety of foods, including carrion, which forms much of its diet. In addition, opossum eat insects, frogs, birds, snakes, small mammals, earthworms, corn, berries, and other fruits, such as persimmons and apples (Gardner and Sunquist 2003). They use a home range of 4 to 20 hectares (10 to 50 acres), foraging throughout this area frequently (Jackson 1994), but concentrating on a few sites where fruits abound, when they are in season (Seidensticker et al. 1987, Gardner and Sunquist 2003).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude (Gardner and Sunquist 2003). Gestation is short (average of 12.8 days) with 1 to 17 young born in an embryonic state that climb up the mothers belly to the marsupium (pouch), attach to teats, and begin to suckle (Gardner and Sunquist 2003). Those young remain in the pouch for about two months. After two months, the young begin to explore and may travel on their mother's back with their tails grasping hers (Whitaker, Jr., and Hamilton, Jr. 1998). Opossum live for only one to two years, with as few as 8% of a population of those animals surviving into the second year in a study in Virginia conducted by Seidensticker et al. (1987). In that five-year study, Seidensticker et al. (1987) noted there was a wide variation in opossum numbers, in what they considered excellent habitat for the species. Those variations occurred seasonally and in different years. However, the mean density during the study was 10.1 opossum per square mile with a range of 1.3 opossum per square mile to 20.2 opossum per square mile (Seidensticker et al. 1987). This was comparable to other opossum population densities in similar habitats in Virginia. Verts (1963) found a density estimate of 10.1 opossum per square mile in farmland areas of Illinois, while Wiseman and Hendrickson (1950) found a density of 6.0 opossum per square mile in mixed pasture and woodlands in Iowa. However, VanDruff (1971) found opossum densities in waterfowl nesting habitat as high as 259 opossum per square mile.

Opossum are common throughout Mississippi in appropriate habitat. Population estimates for opossum in the State are not available. Therefore, the analysis will consider an estimated population based on the best available information for opossum to evaluate the magnitude of lethal removal. The land area of Mississippi covers approximately 46,923 square miles. If opossum only occurred on 50% of the land area using a mean density of 10.1 opossum per square mile found by Seidensticker et al. (1987) in Virginia, the estimated population would be 237,000 opossum. Using the range of opossum densities found by Seidensticker et al. (1987) of 1.3 opossum per square mile to 20.2 opossum per square mile and only 50% of the land area of the State being occupied by opossum, the statewide population would range from a low of 30,500 opossum to a high of nearly 474,000 opossum. Opossums can occur in a variety of habitats, including urban areas, so opossum occupying only 50% of the land area of the State would be unlikely, since opossums can occur almost statewide.

Opossums are a furbearing species in the State and people can harvest opossum during annual hunting and trapping seasons. During the development of the EA, hunters and trappers could harvest opossums during the open seasons with no limit on the number of opossum that people can harvest during those seasons. In addition, opossums can be lethally removed when causing damage or posing a threat of damage when authorized by the MDWFP. As shown in Table 4.1, trappers have harvested an estimated 24,186 opossum in the State between the 2009-2010 trapping season and the 2013-2014 trapping season. The number of opossum harvested by hunters during the annual hunting season and the number of opossum lethally removed by other entities to alleviate damage or threats of damage is unknown in the State.

During activities conducted by WS in the State, WS has lethally removed 13 opossum and live-captured and released 2 opossum intentionally from FY 2009 through FY 2014. In addition, WS has lethally removed four opossum unintentionally during damage management activities targeting other animals. WS has also live-captured nine opossum unintentionally during activities targeting other animals but WS released those opossum unharmed. The highest level of lethal removal occurred in FY 2009 when WS lethally removed six opossum intentionally and unintentionally (see Table 4.1). Although WS has infrequently addressed opossum between FY 2009 and FY 2014, WS has previously received requests for assistance that could involve the lethal removal of a higher number of opossum to reduce damage or threats of damage adequately. For example, in FY 2006, WS lethally removed 136 opossum in the State to alleviate damage or threats of damage.

Table 4.1 – Cumulative removal of Virginia opossum from known sources in Mississippi, 2009-2015

Year[a]	Harvest[b,c]	WS' Removal[d]	Total Removal	WS % Removal
2009-10	5,234	6	**5,240**	0.1%
2010-11	7,647	5	**7,652**	0.1%
2011-12	4,947	2	**4,949**	0.04%
2012-13	7,818	1	**7,819**	0.01%
2013-14	8,540	3	**8,543**	0.04%
2014-15	N/A[†]	0	**-**	-
TOTAL	**34,186**	**17**	**34,203**	**0.1%[‡]**

[a]Harvest seasons often begin in the fall/winter of one year and end before spring the following year (*e.g.*, the trapping season for opossum began during the fall of 2009 and ended in 2010)

[b]Harvest data reported by trapping season; the number of opossum that people harvest during the hunting season in unknown

[c]Harvest data provided by the MDWFP

[d]WS' removal is reported by FY; includes target and non-target removal

[†]N/A=Information is not available

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

Based on previous requests for assistance received by WS and in anticipation of additional requests for assistance, WS could lethally remove up to 150 opossum annually in the State as part of efforts to reduce damage and threats of damage. Given the range of population estimates in the State, the lethal removal of 150 opossum by WS annually would represent from 0.03% to 0.5% of the estimated statewide population if the overall population remains at least stable.

Between the 2009-2010 trapping season and the 2013-2014 trapping season, trappers harvested an average of 6,837 opossum in the State. Combining the average harvest of 6,837 opossum by trappers and the anticipated annual removal by WS of 150 opossum would represent 1.5% to 22.9% of a statewide population that ranged from 30,500 to 474,000 opossum. Combining the highest annual harvest of opossum that occurred during the 2013-2014 trapping season with WS' anticipated annual removal of up to 150 opossum would represent a cumulative removal of 1.8% to 28.5% of the population. Since the statewide population of opossum likely exceeds 30,500 opossums, the cumulative removal likely represents a much smaller percentage of the actual population.

The MDWFP allows people to harvest an unlimited number of opossum during the annual hunting and trapping season in the State, which provides an indication the population of opossum is not likely to decline from overharvest. The authorizing of the lethal removal by the MDWFP ensures cumulative removal would occur within population objectives established by the Department. Although the number of opossum lethally removed in the State during the annual hunting season and for damage management is unknown, the cumulative removal of opossum, including the proposed removal of up to 150 opossum annually by WS, would be of a low magnitude when compared to the actual statewide opossum population. Based on the limited removal proposed by WS and the oversight by the MDWFP, WS' removal of opossum annually would have no effect on the ability of those persons interested to harvest opossum during the regulated harvest season.

Bat Population Information and Effects Analysis

The WS program in Mississippi occasionally receives requests for assistance associated with bats. Those requests have been primarily associated with bats that have entered inside buildings or with bats that have been found in public areas where people may encounter bats. Of the 15 species of bats found in Mississippi, WS has previously addressed requests for assistance and anticipates future requests for assistance associated with eight species of bats (see Table 4.2). Those species of bats can be found in buildings and other man-made structures. WS has previously addressed requests for assistance associated with bats by providing recommendations through technical assistance and on occasion, through direct operational assistance.

Most requests for WS' operational assistance would likely occur in relation to bats inhabiting human-occupied buildings. WS has previously and anticipates continuing to recommend and provide assistance using only non-lethal methods to alleviate damage and threats of damage associated with bats. WS has addressed previous requests for assistance through the recommendation or direct application of structural repairs and exclusionary methods. Exclusion has occurred previously using one-way bat exclusion devices that allow bats to exit a building but prevents re-entry. WS has also worked with cooperators to identify access points that require repair to prevent bats from further accessing buildings. Under the proposed action alternative, WS would continue to assist property owners with the implementation of exclusionary devices and to identify structural repairs required to prevent bat entry.

Bat species that may be removed include the little brown bat, southeastern myotis, Brazilian free-tailed bat, silver-haired bat, eastern pipistrelle, big brown bat, evening bat, and Rafinesque's big-eared bat. Bat species that are listed by the USFWS pursuant to the ESA and by the Mississippi Museum of Natural Science are not generally associated with man-made structures. For that reason, it is unlikely that those species listed as threatened or endangered by the USFWS and/or the Mississippi Museum of Natural Science would be encountered during activities to address bats in the State. No threatened or endangered species have been encountered by WS during previous activities to alleviate damage or threats associated with bats. If the need arises, WS would consult with a qualified biologist to positively identify bats prior to removing them in order to eliminate any chance of addressing a T&E species.

The USFWS has listed the northern long-eared bat (*Myotis septentrionalis*) as threatened pursuant to the ESA. In general, the long-eared bat is more common in the northern portion of their range than the southern and western portion. During the winter, long-eared bats are found in hibernacula that include caves and abandoned mines, but have been observed in abandoned railroad tunnels, storm sewers, hydroelectric dam facilities, and wells. During the summer, long-eared bats are most commonly found roosting individually or in small colonies underneath bark or in cavities or crevices of live trees and snags. However, long-eared bats have also been observed roosting in caves, mines, and man-made structures, such as buildings, barns, park pavilions, sheds, cabins, and under the eaves of buildings, behind window shutters, and bat houses, during the summer. Currently, there are no summer records of long-eared bats in Mississippi (see 78 FR 61046-61080). Based on the lack of summer records in the State and the species being uncommon in the State, WS is not likely to encounter long-eared bats when addressing requests for assistance associated with bats. Further discussion on long-eared bats occurs below under the non-target and T&E species discussions.

In most cases, a single bat found in a building would be provided an escape route (*e.g*., opening a door or window) or would be live captured and released outside on site if there was no possibility of an exposure to people or pets. If the bat appeared sick, acted unusually, or if there was a known bite or possible exposure to people or pets, the bat would be euthanized and submitted for rabies testing. Those bats euthanized by WS for disease testing would likely be euthanized and submitted for testing by other entities in the absence of WS' involvement given the risk to human safety associated with exposure. Therefore, lethal removal by WS for disease testing would not be additive to removal that would likely occur in the absence of involvement by WS.

Table 4.2 – Bats in Mississippi that are associated with requests for assistance received by WS[1]

Common Name	Conservation Status[2]	Roost Preferences
Little Brown Bat	Special Concern	caves, mines, buildings
Southeastern Myotis	Special Concern	caves, buildings, hollow trees
Brazilian Free-tailed Bat	Common	buildings, caves
Silver-haired Bat	Special Concern	loose tree bark, buildings, rock crevices
Eastern Pipistrelle	Common	trees, caves, mines, rock crevices
Big Brown Bat	Common	attics, barns, man-made structures, caves, mines
Evening Bat	Common	tree cavities, buildings
Rafinesque's Big-eared Bat	Special Concern	buildings, bridges, caves, cisterns, hollow trees

[1]Adapted from Mississippi Museum of Natural Science (2008)

[2]Species of special concern are determined by the USFWS

No lethal removal of bats has occurred by WS from FY 2009 through FY 2014 and WS does not anticipate using lethal methods to address damage or threats of damage associated with bats, unless human/pet exposure has occurred or WS' personnel or the entity requesting assistance suspects human/pet exposure. In those cases, an individual bat would likely be live-captured and euthanized for testing because bats are known to carry rabies. Based on previous requests for assistance received by WS and in those cases where exposure may require a bat be tested, WS does not anticipate live capturing and euthanizing more than five bats total annually, consisting of the little brown bat, southeastern myotis, Brazilian free-tailed bat, silver-haired bat, eastern pipistrelle, big brown bat, evening bat, and Rafinesque's big-eared bat. If a threatened or endangered bat were encountered, WS would contact the USFWS and/or the Mississippi Museum of Natural Science to determine the appropriate action.

WS would continue to provide escape routes or live-capture and release bats in those instances where no human or pet exposure could be assured. When considering the use and/or recommendation of exclusionary methods and structural repairs, WS would also consider the potential for maternal colonies to be present in buildings and other structures to ensure those damage management activities employed or recommended would not result in the abandonment of young if adults were excluded from returning to maternal colonies. Bats typically give birth from May through July and weaning occurs in July and August. Young bats grow rapidly and are able to fly generally within three weeks. When providing direct operational assistance to cooperators, WS would attempt to survey the roosting colony for the presence of young. If young were present or if observance of the roosting colony was not possible, WS would not conduct direct operational assistance from May through August. Similarly, property owners requesting technical assistance would also be advised about the possibility of a maternal colony being present from May through August. Recommendations would be for property owners to conduct structural repairs and exclusion activities during those months when young would be able to exit the structure or would not be present.

In those cases where human/pet exposure occurred or where WS' personnel or the entity requesting assistance suspect human/pet exposure, those bats euthanized by WS for disease testing would likely be euthanized and submitted for testing by other entities in the absence of WS' involvement given the risk to human safety associated with exposure. Therefore, the lethal removal of target bat species by WS would not be additive to removal that would likely occur in the absence of involvement by WS. The lethal removal of up to five individuals from a single species is unlikely; however, if the lethal removal of five individuals of a single species occurred, the removal would be of a low magnitude. Previous requests for assistance have been associated with colonies of bats that consisted of several hundred individuals. Although unlikely, if five individuals were removed from a colony of 100 bats, the removal would represent 5% of that local colony. Most incidents involving exposure or suspected exposure involve a single bat that has entered inside the living space of a residence. Therefore, the lethal removal of five bats from a single colony is unlikely.

On occasion, WS could be requested to retrieve a dead bat for disease testing. In those cases, WS' activities would not result in additional mortality since WS would only retrieve the carcass of the bat and WS' activities would not have resulted in the lethal removal of the bat; therefore, the environmental status quo would remain unchanged by WS' retrieval of the bat.

Regionally, some bats species are being adversely affected by the fungal disease known as white-nose syndrome, an emerging disease causing unprecedented morbidity and mortality among bats in eastern North America. The disease is characterized by cutaneous infection of hibernating bats by the psychrophilic fungus *Psuedogymnoascus destructans*. However, WS' limited lethal removal of bats would not adversely affect overall populations of bat species in the State. Impacts to bats would be minimal because any bat removal would be localized and limited in scope. In addition, euthanizing and submitting bats for testing would likely occur in the absence of WS' participation due to the risks to human safety.

Rabbit Population Information and Effects Analysis

There are nine species of cottontail rabbits in North America, north of Mexico. The eastern cottontail is the most abundant and widespread of all those species while the swamp rabbit is generally the largest member of the cottontail genus (Chapman and Litvaitis 2003). The eastern cottontail and the swamp rabbit are both present in Mississippi (Chapman and Litvaitis 2003). Both eastern cottontails and swamp rabbits occur statewide and occur in a wide variety of disturbed, early successional or shrub-dominated habitats (Chapman and Litvaitis 2003).

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). Males and females are basically the same size and color. Cottontails do not distribute themselves evenly across the landscape, but tend to concentrate in favorable habitats such as brushy fence rows or field edges, gullies filled with debris, brush piles, areas of dense briars invaded with Japanese honeysuckle, or landscaped backyards where food and cover are suitable. Cottontails rarely occur in dense forest or open grasslands, but fallow crop fields may provide suitable habitat. Within these habitats, they spend their entire lives in an area of 10 acres or less. Occasionally they may move a mile or so from summer range to winter cover or to a new food supply. In suburban areas, 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). Cottontails live only 12 to 15 months, yet make the most of time available reproductively. They 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).

As their name implies, swamp rabbits are never far from water and are primarily associated with wooded wetlands and canopy gaps in bottomland forests (Chapman and Litvaitis 2003). Terrel (1972) found the home ranges of swamp rabbits never extended more than 2 km from a major body of water. Swamp rabbits have a similar appearance to cottontails but are generally larger and often lack the distinct rusty patch of fur on the upper neck that is generally present on the fur of cottontails.

No population estimates are available for cottontails and swamp rabbits in Mississippi. Information on population densities of cottontails and swamp rabbits is also unavailable. People can harvest cottontails and swamp rabbits in the State during statewide hunting seasons. The number of cottontails and swamp rabbits that people can harvest per day is limited to eight in any species combination (combined species total cannot exceed eight). However, the MDWFP allows a person to harvest an unlimited number of cottontails and swamp rabbits throughout the duration of the season. As shown in Table 4.3, people have harvested over 1.2 million cottontails and swamp rabbits in the State from 2009 through 2014, which is an average annual harvest of 250,317 cottontails and rabbits. The highest harvest level occurred during the 2011-2012 season when people harvested 333,590 cottontails and rabbits in the State. Harvest data combines the two rabbit species (eastern cottontail and swamp rabbit). Harvest totals that only represent eastern cottontails or swamp rabbits are not currently available.

Table 4.3 – Cumulative rabbit removal from known sources in Mississippi, 2009-2015

Year	Harvest[a,b]	WS' Removal[c]	Total Removal
2009-10	237,080	2	**237,082**
2010-11	225,113	1	**225,114**
2011-12	333,590	2	**333,592**
2012-13	265,287	4	**265,291**
2013-14	190,516	1	**190,517**
2014-15	N/A[†]	0	**-**
TOTAL	**1,251,586**	**10**	**1,251,596**

[a]Harvest data reported by hunting season

[b]Harvest data provided by the MDWFP ; includes both cottontails and swamp rabbits

[c]WS' removal is reported by FY; includes both cottontails and swamp rabbits

[†]N/A=Information is not available

From FY 2009 through FY 2014, WS has lethally removed 10 cottontails to alleviate damage and threats of damage in the State. In addition, WS dispersed one rabbit to alleviate damage or threats of damage in the State. Based on the locations where WS' personnel addressed those rabbits from FY 2009 through FY 2014, those rabbits were eastern cottontails. Overall, WS' removal of rabbits previously has represented a very small percentage of the estimated number of cottontails and rabbits that people harvested in the State from 2009 through 2014. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 50 rabbits (combined species total would not exceed 50) annually to alleviate damage and threats of damage, primarily at airports where rabbits may act as attractants for other wildlife that could pose aircraft strike hazards. WS' personnel are most likely to receive requests for assistance associated with eastern cottontails based on the locations where WS is likely to receive requests for assistance (*e.g.*, at airports, military facilities) and the habitat types associated with those locations.

On average, people have harvested 250,317 cottontails and swamps rabbits in the State annually from 2009 through 2014. Based on the average number of rabbits harvested, WS' lethal removal of up to 50 rabbits would represent 0.02% of the annual rabbit harvest. The lowest harvest level occurred during the 2013-2014 season when people harvested 190,516 cottontails and rabbits in the State. If WS had lethally removed 50 cottontails and swamp rabbits during FY 2013, the removal would have represented 0.03% of the lowest harvest level. Studies show that even if hunters harvest as many as 40% of the rabbits available in autumn, the rabbit population the following year would not decline because of the tremendous reproductive potential of rabbits (Fergus 2006). Based on the limited removal proposed by WS and the oversight by the MDWFP, WS' removal of rabbits annually would have no effect on the ability of those persons interested to harvest rabbits during the regulated harvest season.

Black Bear Population Information and Effects Analysis

The black bear has a wide but patchy distribution in the United States with populations found primarily in areas of dense forest, swamps, and thickets. Black bears can be found throughout the Rockies and West Coast mountain ranges; the lower Mississippi Valley, Gulf Coast, and Florida; and the northern Great Lakes area, Appalachian Mountains, and Northeastern States. In those areas, bears can also be found in a variety of other habitats as they forage for food, including cropland, orchards, and forest plantations. Bears are omnivorous; feeding on a variety of food sources, including berries, fruits, nuts, and grasses. Bears are also predators feeding on wildlife and domestic livestock, including sheep, goats, and cattle. Bears can also cause damage to telephone poles and tree plantings through clawing activities, raid apiaries in search of honey, and rummage through human refuse.

Female black bears reach reproductive maturity at 3 to 4 years (Pelton 2003). Following a 7- to 8-month gestation period, they may have one to five cubs (Rogers 1976, Alt 1981, Kolenosky and Strathearn 1987). Juvenile black bear annual mortality ranges between 20 and 70%, with orphaned cubs having the highest mortality (Kolenosky and Strathearn 1987). Natural mortality in adult black bears is approximately 10 to 20% (Fraser et al. 1982). Densities of bears vary between 0.3 and 3.4 per square mile, depending on habitat. Black bears can live up to 25 years (Rogers 1976).

Due to over harvest and habitat loss, the black bear was nearly eliminated from Mississippi by the 1900s with very isolated and small populations occurring in a few counties of the Delta region through the early-1920s (Young 2006). When hunting of black bears in the State was prohibited in 1932, fewer than 12 bears were thought to be present in the State, which lead to the black bear being included on the first rare and threatened list compiled in the State during 1975 (Young 2006). Black bears were further classified as endangered in the State when the endangered list was published for the State in 1984 (Young 2006).

There are two subspecies of black bears that are currently known to occur in the State. The American black bear (*U. a. americanus*) historically occurred throughout much of eastern North America, the Great Plains, and Canada, including the northern portion of Mississippi. The Louisiana black bear (*U. a. luteolus*) historically occurred in eastern Texas, Louisiana, southern Arkansas, and the southern portion of Mississippi. The Louisiana black bear was formally listed as threatened in 1992 under the ESA by the USFWS within the historic range of the subspecies. In addition, the USFWS listed other bear subspecies within the historic range of the Louisiana black bear due to the similarities in appearance, including the American black bear. The historic range of the Louisiana black bear in Mississippi has been designated as those counties south of Highway 82, which includes Washington, Humphreys, Holmes, Attala, Neshoba, and Lauderdale Counties (see 57 FR 588-595). In 2009, the USFWS designated critical habitat for the Louisiana black bear; however, no critical habitat was designated in Mississippi (see 74 FR 10350-10409).

Although the statewide population of bears is unknown and likely fluctuates based on time of year, food availability, and changing habitat, the population has been estimated at approximately 50 bears with populations likely increasing in the State (Young 2006). Bears are generally found along the Gulf Coast region, the Loess Bluffs in southwestern Mississippi, and the Delta Region of the State with an estimated 80% of the American black bear population in the State occurring within the listed range of the Louisiana black bear (Young 2006). Previously, the majority of the bears found in the State were thought to be males dispersing from populations outside the State; however, more female bears are being located in the State (Young 2006). In addition, more female bears with cubs are being located within the State. During surveys conducted in 2011, females with newborn cubs were documented in Bolivar County along the Mississippi River, as well as litters in Sharkey, Issaquena, and Warren Counties in the south Delta Region (Young 2011).

As bear populations increase in the State, the likelihood of conflicts between people and bears is also likely to increase. Damage is usually associated with bears obtaining or trying to access a food source. Bears are known to cause damage to agricultural crops, such as corn, wheat, and rice by consuming the crop and by trampling crops as they forage. Bears will also feed on pet food, livestock feed, garbage, and bee hives. Although not common, bears are also known to prey upon livestock. Conflicts between people and bears in Mississippi have been primarily associated with bears causing damage to apiaries, as the bears tear open beehives to obtain honey (Young 2006).

WS could be requested to provide technical assistance and/or limited direct operational assistance at the request of the USFWS and/or the MDWFP when managing damage associated with black bears in the State. Direct operational assistance would be limited to WS providing equipment to the USFWS and/or the MDWFP to live-capture bears or could include providing/loaning electric fence to property owners or managers. In addition, WS could be requested to employ live-capture methods, limited to culvert traps and foot snares, and to participate in aversion techniques once bears were released. WS would provide assistance when requested in accordance with the SOPs established by the MDWFP for addressing interactions between bears and people.

Raccoon Population Information and Effects Analysis

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

The raccoon is one of the most omnivorous of animals. Raccoons will eat 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).

The raccoon occurs throughout most of the United States, with the exception of the higher elevations of mountainous regions and some areas of the arid southwest (Boggess 1994, Gehrt 2003). Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains (Boggess 1994), and are frequently found in cities or suburbs as well as rural areas (Gehrt 2003). Movements and home ranges of raccoons vary according to sex, age, habitat, food sources, season, and other factors. In general, males have larger home ranges than females. 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 or estimated. In addition, it can be difficult to determine how large an area the raccoons are using (Sanderson 1987). Due to their adaptability, raccoon densities reach higher levels in urban areas than that of rural areas. Relative raccoon population densities have been variously inferred by removal 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 1938-39, 170 in 1939-1940, and 60 in 1940-1941. Slate (1980) estimated one raccoon per 7.8 ha (19.3 acres) in New Jersey in predominantly agricultural land on the inner coastal plain. Raccoon densities of 100 per square mile (1 raccoon per 6.4 acres) have been attained around abundant food sources (Kern 2002). Riley et al. (1998) summarized rural raccoon densities based on published literature that ranged from 2 to 650 per square mile in rural habitats, with an average of 10 to 80 raccoons per square mile.

In Mississippi, raccoons can cause damage to gardens, residential and non-residential buildings, fish, domestic fowl, and pets, as well as general property damage. Results of their feeding may be the total loss of ripened sweet corn in a garden. Damage to buildings generally occurs when they seek to gain entry or begin denning in those structures. Raccoons may den in uncapped chimneys, or may tear off shingles or fascia boards to gain access to attics or wall spaces. They may also damage or destroy sod by rolling it up in search of earthworms and other invertebrates (Boggess 1994).

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

Raccoons can be found throughout the State and thrive in a variety of habitats including rural, suburban, and urban areas. However, the statewide population of raccoons is currently unknown. Using the summarized density ranges for raccoons in rural areas provided by Riley et al. (1998) and the assumption that raccoons only inhabit 50% of the land areas of Mississippi, a statewide population could be estimated to range from a low of nearly 47,000 raccoons to a high of over 15 million raccoons. Using the average number of raccoons per square mile of 10 to 80 raccoons, the statewide population could be estimated at 235,000 to 1.9 million raccoons if raccoons only occupied 50% of the available land area in the State. Similar to estimates derived for the other mammal species in this EA, estimating that raccoons inhabit only 50% of the land area of the State is intended to determine a minimum population estimate to compare the potential range of WS' proposed removal of raccoons and to determine the magnitude of WS' proposed removal.

Raccoons are classified as furbearers in Mississippi with regulated annual hunting and trapping seasons with unlimited removal allowed during the length of those seasons, although daily limits may apply during the annual hunting seasons. Table 4.4 shows the number of raccoons reported as harvested in the State during the annual hunting and trapping seasons from 2009-2010 through 2013-2014. Reported harvest of raccoons during the trapping season is based on a voluntary trapper survey; therefore, harvest is considered as minimum harvest that likely occurred. As with other furbearing species, people can lethally remove raccoons to alleviate damage or threats of damage when authorized by the MDWFP. The total number of raccoons lethally removed annually in the State to alleviate damage or threats of damage is currently unknown.

Table 4.4 - Cumulative raccoon removal from known sources in Mississippi, 2009-2015

Year	Type of Harvest		WS' Removal[1,2]	TOTAL	WS % of Total
	Hunting	Trapping			
2009-10	53,853	8,390	63	**62,306**	0.1%
2010-11	70,857	12,569	62	**83,488**	0.1%
2011-12	85,666	10,608	117	**96,391**	0.1%
2012-13	75,558	12,397	37	**87,992**	0.04%
2013-14	56,416	18,423	39	**74,878**	0.1%
2014-15	N/A[†]	N/A	60	-	-
TOTAL	**342,350**	**62,387**	**378**	**405,115[*]**	**0.1%[‡]**

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

[2]WS' lethal removal includes all removal including unintentional removal during other damage management activities

[†]N/A=Information is not available

[*]Total includes WS' removal during FY 2014

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

Of the 378 raccoons lethally removed by WS from FY 2009 through FY 2014, WS removed 110 raccoons unintentionally during other damage management activities, primarily activities to alleviate damage associated with aquatic rodents. In addition, WS' personnel live-captured nine raccoons unintentionally between FY 2009 and FY 2014 and personnel released those raccoons unharmed. WS also live-captured one raccoon intentionally during FY 2014 and released the raccoon unharmed. WS' annual removal of raccoons during all projects from FY 2009 through FY 2013 never exceeded 0.1% of the annual reported harvest for the corresponding year. The average number of raccoons reported harvested in the State during the annual hunting and trapping seasons from 2009-2010 through 2013-2014 is 80,947 raccoons per year.

Based on previous requests for assistance received by WS to alleviate damage and in anticipation of receiving additional requests for assistance with managing damage, up to 150 raccoons could be lethally removed by WS annually under all wildlife damage management activities, including unintentional removal during other wildlife damage management activities. Using the lowest population estimate of 47,000 raccoons in the State, the lethal removal of 150 raccoons would represent 0.3% of the population. However, the number of raccoons harvested annually in the State has exceeded the minimum population estimated, which provides an indication that the population is higher than 47,000 individuals. Using a population estimated at 235,000 raccoons, the lethal removal of up to 150 raccoons by WS would represent 0.1% of the estimated population. People have harvested approximately 80,947 raccoons per year between 2009 and 2014, with the highest annual harvest occurring in 2011-2012 when people harvested 96,274 raccoons. If the average number of raccoons harvested annually were representative of future harvest levels, the cumulative removal of raccoons (*i.e.*, WS' removal of 150 raccoons and the harvest of 80,947 raccoons annually) would represent 34.5% of a statewide population estimated at 235,000 raccoons. If the statewide population of raccoons was 1.9 million, the cumulative removed would represent 4.3% of the statewide population. If WS lethally removed 150 raccoons and the annual harvest reached 96,274 raccoons, the cumulative removal would range between 5.1% and 41% of a statewide population ranging from 235,000 raccoons to 1.9 million raccoons.

Raccoon populations can remain relatively abundant if annual harvest levels are below 49% (Sanderson 1987). In addition, the statewide population is likely more than 1.9 million raccoons. As with many of the other mammals species harvested for fur in the State, the unlimited harvest levels allowed by the MDWFP during the length of the hunting and trapping seasons provides an indication that cumulative removal, including removal for damage management, would not reach a level where overharvest of the raccoon population would occur. The MDWFP has regulatory authority over the management of wildlife within the State, including raccoons, and all removal by WS has occurred and would continue to occur only after the MDWFP authorized the removal and WS' removal would only occur at levels the MDWFP authorized. Based on the limited removal proposed by WS and the oversight by the MDWFP, WS' removal of raccoons annually would have no effect on the ability of those persons interested to harvest raccoons during the regulated harvest season.

River Otter Population Information and Effects Analysis

Historically, river otters inhabited aquatic ecosystems throughout much of North America, excluding the frozen Arctic and arid Southwest (Melquist et al. 2003). Information on historic numbers and distribution is limited. As its broad geographic distribution suggests, the river otter is able to adapt to diverse aquatic habitats. Otters are found in both marine and freshwater environments, ranging from coastal to high mountainous habitat. Riparian vegetation adjacent to lakes, streams, and other wetland areas is a key component of otter habitat.

Human encroachment, habitat destruction, and overharvest have eliminated river otters from marginal portions of their range. However, present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987, Melquist et al. 2003). River otters remained relatively abundant in Mississippi despite declines in other parts of the country. River otter are known to occur throughout Mississippi where habitat exists. However, the number of otters present in the State is currently unknown. Melquist and Dronkert (1987) summarized studies estimating river otter densities, which showed that densities were about 1 per 175 to 262 acres in Texas coastal marshes, and ranged from 1 per 1.8 miles to 1 per 3.6 miles of waterway (stream or river), which is an average of 1 otter per 2.4 miles of waterway. Density information for otter specific to Mississippi is not currently available. To provide an indication of the potential magnitude of lethal removal that could occur by WS, this analysis will use the available otter densities to estimate a statewide otter population.

There are over 2.7 million acres of freshwater wetlands in Mississippi along with 83,674 miles of rivers and streams in the State (Alley and Segrest 2008). Using the lowest otter density per linear measure derived from other studies of one otter per 3.6 stream mile and using the assumption that all stream miles in Mississippi are suitable otter habitat and occupied by otter, a statewide population of otter in Mississippi could be estimated at 23,000 otter. Of the 83,674 miles of streams and rivers in the State, 53,754 miles are considered intermittent streams where water is not present throughout the year. Using only those river miles with water throughout the year, an otter population in the State could be estimated at 8,300 otter using the lowest densities of otter per stream mile. Using the average otter density of one otter per 2.4 miles of stream and using only those permanent streams, the statewide population could be estimated at 12,500 otters.

River otters are a state-regulated furbearer in Mississippi with a regulated annual trapping season. During the trapping season, people can harvest an unlimited number of otter. During the annual trapping season from 2009 through 2014, people harvested 9,891 otters in the State with a range of 1,470 otters harvested during 2010 to 2,362 otters harvested during 2012 (see Table 4.5). Trappers in the State harvested an average of 1,978 otters annually from 2009 through 2014.

In addition to the annual harvest during the trapping season, WS has also lethally removed otter during damage management activities. WS lethally removed one otter during FY 2010 to alleviate damage based on requests for assistance received. Unintentional lethal removal of otter has also occurred by WS during other damage management activities, primarily aquatic rodent damage management, which is reflected in Table 4.5. In addition, WS' personnel live-captured 54 river otters unintentionally between FY 2009 and

FY 2014 during activities targeting other animal species. WS' personnel released those otters unharmed. Based on previous activities conducted by WS and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 120 river otters annually in the State, including unintentional lethal removal that could occur during other damage management activities.

Table 4.5 – Cumulative river otter removal from known sources in Mississippi, 2009-2015

Year	Harvest[a,b]	WS' Removal[c]	Total Removal	WS % Removal
2009-10	1,690	82	**1,772**	4.6%
2010-11	1,470	74	**1,544**	4.8%
2011-12	2,010	64	**2,074**	3.1%
2012-13	2,362	38	**2,400**	1.6%
2013-14	2,359	42	**2,401**	1.7%
2014-15	N/A[†]	41	**-**	-
TOTAL	**9,891**	**341**	**10,232**[*]	**3.3%**[‡]

[a]Harvest data reported by trapping season

[b]Harvest data provided by the MDWFP

[c]WS' removal is reported by FY

[†]N/A=Information is not available

[*]Total includes WS' removal during FY 2014

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

If the lowest derived population estimate were reflective of the actual statewide population of otter in the State, removal of up to 120 otter by WS would represent 1.8% of the population estimated at 8,300 otter. Based on an otter population estimated at 23,000 otter using the total stream miles in the State and the lowest population density estimates, removal of up to 120 otter would represent 0.5% of the population. Removal of up to 120 otter would represent 1.0% of the population estimated at 12,500 otters based on the average density of one otter per 2.4 miles of streams and including only those streams with permanent water.

Overall, WS' lethal removal of otter has not exceeded 4.8% of the total number of otter harvested in the State from 2009-2010 through 2013-2014. On average, WS' annual removal has represented 3.3% of the annual harvest of otters in the State. If WS had lethally removed 120 otters annually from FY 2009 through FY 2013, the total removal would have represented 5.7% of the total harvest of otter in the State. The lowest harvest of otter during the annual trapping season from 2009-2010 through 2013-2014 occurred in 2010-2011 when trappers harvested 1,470 otters. If WS had lethally removed 120 otter during FY 2010, WS' removal would have represented 8.2% of the overall harvest of otter in the State.

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

Striped Skunk Population Information and Effects Analysis

Although easily recognized by their black and white fur, the striped skunk may be most readily recognized by the odiferous smell of their musk. Skunks 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, skunks may become temporarily dormant. The striped skunk is an omnivore, feeding heavily on insects such as grasshoppers, crickets, beetles, bees, and wasp (Rosatte and Lariviere 2003). The diet of striped skunks also includes small mammals, the eggs of ground-nesting birds, and amphibians. Striped skunks are typically non-aggressive and will often flee when approached by people (Rosatte 1987). However, when provoked, skunks will give a warning and assume a defensive posture prior to discharging their foul-smelling musk. This musk is comprised of sulfur-alcohol compounds known as butylmercaptan (Rosatte and Lariviere 2003).

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

Population estimates for striped skunks in Mississippi are currently not available. Striped skunks can be found in a variety of habitats across the State. If skunks only inhabit 50% of the land area of the State and densities occur at one skunk per 77 acres, the statewide population could be approximately 195,000 skunks based on the land area of the State. Similar to other furbearing species, skunks occur throughout the State and the intent of the estimate is to evaluate the magnitude of lethal removal proposed under the proposed action under a worst-case scenario. The statewide population of skunks is likely higher than 195,000 skunks.

Skunks are considered "*nuisance animals*" in the State (Public Notice LE4-3779) and can be lethally removed throughout the year with no limit on the number that can be removed. In addition, people can trap skunks during an annual season that places no limit on the number of skunks that people can harvest daily and no limit on the number of skunks that people can possess throughout the trapping season. Table 4.6 shows the reported number of skunks harvested during the annual trapping seasons in the State. Like most furbearing species, the number of skunks harvested annually is based on mail-in surveys. Other entities besides WS also likely lethally remove skunks to alleviate damage or threats of damage; however, the number of skunks lethally removed annually in the State to alleviate damage or threats of damage is currently unknown and Table 4.6 does not include removal reported by other entities to alleviate damage or threats of damage.

As shown in Table 4.6, the WS program in Mississippi has lethally removed 35 striped skunks to alleviate damage or threats of damage in the State between FY 2009 and FY 2014. The highest annual removal by WS occurred during FY 2009 when personnel removed 13 striped skunks in the State. Based on previous requests for assistance received by WS to alleviate damage and in anticipation of receiving additional requests for assistance with managing damage, up to 50 skunks could be lethally removed by WS annually, when requested, including skunks that are unintentionally lethally removed during other wildlife damage management activities.

Using the lowest population estimate of 195,000 skunks, the take of 50 skunks would represent 0.03% of the estimated statewide population. People have harvested at least 3,566 striped skunks in the State between the 2009-2010 harvest season and the 2013-2014 seasons, which is an average of 713 skunks harvested annually. The actual harvest level is unknown since people can lethally remove skunks throughout the year in the State. The highest harvest level occurred during 2013-2014 harvest season when people reported harvesting 1,042 skunks. If WS had lethally removed 50 skunks during the 2013-2014 harvest season, the cumulative removal would have represented 0.6% of the statewide population estimated at 195,000 skunks. Combining the average annual harvest of 713 skunks in the State with WS' potential removal of 50 skunks annually, the cumulative removal would represent 0.4% of the lowest population estimate in the State.

Table 4.6 – Cumulative striped skunk removal from known sources in Mississippi, 2009-2015

Year	Harvest[a,b]	WS' Removal[c]	Total Removal	WS % to Total
2009-10	455	13	**468**	2.8%
2010-11	655	6	**661**	0.9%
2011-12	598	0	**598**	-
2012-13	816	0	**816**	-
2013-14	1,042	8	**1,050**	0.8%
2014-15	N/A[†]	8	-	-
TOTAL	**3,566**	**35**	**3,601**[*]	**1.0%**[‡]

[a]Harvest data reported by trapping season
[b]Harvest data provided by the MDWFP
[c]WS' removal is reported by FY
[†]N/A=Information is not available
[*]Total includes WS' removal during FY 2014
[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

The MDWFP has classified the striped skunk as a nuisance species in the State, which people can remove at any time throughout the year. In addition, the MDWFP places no limits on the number of skunks that people can harvest during the annual trapping season in the State. As with many of the mammal species addressed in this document, the unlimited removal allowed by the MDWFP provides an indication that annual removal is not likely to reach a level where overharvest would occur.

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, ranging 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). Coyotes 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).

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

Coyotes breed between January and March and are able to breed before their first birthday (Kennely and Johns 1976), but the percentage of yearlings having litters varies from zero to 80% in different populations (Gier 1968). This variation is influenced by a number of factors that cause large annual variations in total number of coyotes breeding. In a study in Texas, the percentage of females having litters varied from 48% to 81% (Knowlton 1972). Pups are born after a gestation period of 60 to 63 days, with litter sizes varying primarily with prey availability. 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 1 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).

Similar to striped skunks, the MDWFP has classified coyotes as "*nuisance animals*" that people can lethally remove throughout the year with no limit on the number that people can remove. In addition, people can harvest coyotes during the annual trapping season. Table 4.7 shows the estimated harvest of coyotes during by hunting and during the trapping season from 2009 through 2014. The number of coyotes lethally removed to alleviate damage by entities other than WS is currently unknown. Between 2009 and 2014, hunters in Mississippi harvested an average of 23,744 coyotes in the State. Between 2009 and 2014, trappers harvested an average of 3,508 coyotes per year during the annual trapping season. The highest harvest level occurred during the 2011-2012 harvest season when a hunters and trappers harvested an estimated 40,786 coyotes.

Table 4.7 - Cumulative coyote removal from known sources in Mississippi, 2009-2015

Year	Type of Harvest		WS' Removal[1]	TOTAL	WS % of Total
	Hunting	Trapping			
2009-10	19,123	2,571	27	**21,721**	0.1%
2010-11	25,429	3,374	25	**28,828**	0.1%
2011-12	37,212	3,574	21	**40,807**	0.1%
2012-13	18,883	3,818	10	**22,711**	0.04%
2013-14	18,072	4,204	26	**22,302**	0.1%
2014-15	N/A[†]	N/A	7	**-**	-
TOTAL	**118,719**	**17,541**	**116**	**136,376[*]**	**0.1%[‡]**

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

[†]N/A=Information is not available

[*]Total includes WS' removal during FY 2014

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

Between FY 2009 and FY 2014, WS has lethally removed 116 coyotes in the State to alleviate damage or threats of damage. The highest level of removal occurred during FY 2009 when WS' personnel lethally removed 27 coyotes to alleviate damage. Overall, WS has lethally removed an average of 19 coyotes per year from FY 2009 through FY 2014. As a percentage of the overall harvest of coyotes during the hunting and trapping season in the State, WS' removal of coyotes has represented 0.1% of the harvest. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance in the future, WS predicts that WS' personnel could lethally remove up to 100 coyotes annually during all damage management activities within the State.

The coyote is probably the most extensively studied carnivore (Bekoff and Gese 2003), and considerable research has been conducted on population dynamics. Because determinations of absolute coyote densities are frequently unknown (Knowlton 1972), many researchers have estimated coyote populations using various methods (Clark, 1972, Knowlton 1972, Camenzind 1978, Pyrah 1984). The cost to accurately determine absolute coyote densities over large areas is 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). Knowlton (1972) concluded that coyote densities may 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 throughout much of their range. Such an estimate is speculative but represents some of the best available information for estimating coyote populations.

Although coyote densities vary considerably between habitat types and vary based on numerous environmental variables, Knowlton (1972) estimated an average population density was likely 0.5 to 1.0 coyote per square mile over the entire range of the coyote in the United States. Exact coyote population densities in Mississippi are unknown. Using a coyote population density of 0.5 to 1.0 coyote per square mile and the total area of Mississippi of 46,923 square miles (United States Census Bureau 2011), a statewide coyote population could be estimated at 23,500 to 47,000 coyotes. If the population density were half of the lowest estimated population density determined by Knowlton (1972), the statewide coyote population would be estimated at 11,750 coyotes based on 0.25 coyotes per square mile. Population modeling suggests that a viable coyote population can withstand an annual removal of 70% of their population without causing a decline in the population (Connolly and Longhurst 1975, Connolly 1995).

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).

Based on available information, a statewide coyote population could range from 23,500 to 47,000 coyotes with a population estimate of 11,750 coyotes representing a worst-case scenario. If the coyote population remains stable or increases annually, WS' lethal removal of up to 100 coyotes to alleviate damage or threats would range from 0.2% to 0.4% of the estimated population and 0.9% under a worst case scenario. Based on the annual harvest of coyotes in the State, the population exceeds 23,500 coyotes and likely exceeds 47,000 coyotes. Therefore, any removal by WS would be an even smaller percentage of the actual coyote population in the State. During the development of this document, there was no evidence to suggest that coyote populations were declining rapidly in the State from overharvest. In addition, if WS had lethally removed 100 coyotes annually between FY 2009 and FY 2013, WS' annual removal would have represented 0.4% of the harvest of coyotes in the State between 2009 and 2014.

Gray Fox Population Information and Effects Analysis

The gray fox is common in many parts of the United States where deciduous woodlands provide habitat; yet, the secretive grey fox is seldom observed in the wild. The gray fox is somewhat smaller in stature than the red fox, having shorter legs and extremities. Gray fox exhibit striking pelage 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 from three to seven kg (6.5 to 15 lbs), with males being slightly larger than females. Generally, adult gray fox measure 80 to 113 cm (31.5 to 44 inches) from the tip of the nose to the tip of the tail. They inhabit wooded, brushy, and rocky habitats from extreme southern Canada to northern Venezuela and Colombia, excluding portions of the mountainous northwestern United States, the Great Plains, and eastern Central America. Gray fox occur over most of 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, gray fox are 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). Gray fox 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. Published estimates of gray fox density vary from 1.2 to 2.1 per square kilometer (3.1 to 5.4/mi^2) depending on location, season, and method of estimation (Errington 1933, Gier 1948, Lord, Jr. 1961, Trapp 1978). Over areas larger than 5,000 km^2 (1,930 mi^2) in which habitat quality varies, densities are likely lower. However, exceptionally high fox densities have been recorded in some situations (Grinnell et al. 1937, Hallberg and Trapp 1984).

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

Gray fox feed on a wide variety of plant and animal matter and are considered to be more omnivorous 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, insects, and plant material, including corn, apples, persimmons, nuts, cherries, grapes, pokeweed fruit, grass, and blackberries. Grasshoppers and crickets are often a very important part of the diet in late summer and autumn (National Audubon Society 2000).

The MDWFP has classified the gray fox as a "*nuisance animal*" in the State that people can lethally remove throughout the year with no limit on the number that people can remove. People can also harvest gray fox during annual trapping seasons. During the annual trapping season, people can harvest an unlimited number of fox during the length of the season. Table 4.8 shows the total number of gray fox harvested during the annual hunting and trapping seasons from 2009 through 2014. The number of gray fox lethally removed to alleviate damage is currently unknown.

Table 4.8 - Cumulative gray fox removal from known sources in Mississippi, 2009-2015

Year	Type of Harvest		WS' Removal[1]	TOTAL	WS % of Total
	Hunting	Trapping			
2009-10	1,798	1,066	4	**2,868**	0.1%
2010-11	1,403	1,435	2	**2,840**	0.1%
2011-12	826	1,609	0	**2,435**	-
2012-13	3,811	2,139	0	**5,950**	-
2013-14	2,314	2,632	1	**4,947**	0.02%
2014-15	N/A[†]	N/A	0	**-**	-
TOTAL	**10,152**	**8,881**	**7**	**19,040**	**0.04%[‡]**

[1]WS' removal is reported by federal fiscal year
[†]N/A=Information is not available
[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

In total, people have harvested 10,152 gray fox during hunting seasons in the State from 2009 through 2014. In addition, people have harvested 8,881 gray fox from 2009 through 2014 during the trapping season. The highest level of harvest occurred during the 2012-2013 seasons when hunters and trappers harvested 5,950 gray fox in the State. WS also removed gray fox to alleviate damage and threats of damage in the State. From FY 2009 through FY 2014, WS lethally removed seven gray fox in the State with the highest annual removal level occurring in FY 2009 when WS lethally removed four gray fox. WS did not address gray fox during FY 2011, FY 2012, and FY 2014.

As a percentage of the cumulative removal of gray fox in the State, WS' lethal removal has represented a high of 0.1% of the annual gray fox harvest in the State. Between FY 2009 and FY 2013, WS' annual removal of gray fox has represented 0.04% of the annual harvest of gray fox in the State from 2009 through 2014. Based on the number of gray fox lethally removed by WS previously and in anticipation of receiving additional requests to lethally remove gray fox, WS anticipates that up to 50 gray fox could be lethally removed annually by WS' personnel in the State to alleviate damage and threats of damage.

Gray fox can be found statewide in Mississippi in areas with suitable habitat. If gray fox only occupy 50% of the land area of Mississippi and the density of gray fox in the State was 3.1 gray fox per square mile, the statewide population could be approximately 72,700 gray fox. Gray fox can be found in a variety of habitats, including urban areas, so gray fox occupying only 50% of the land area of the State is unlikely since fox can be found 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 determine the magnitude of the proposed lethal removal by WS to alleviate or prevent damage.

Using the lowest population estimate of 72,700 fox, the lethal removal of 50 gray fox by WS would represent 0.1% of the population. If the average number of gray fox harvested annually were representative of future harvest levels, the cumulative removal of gray fox (*i.e*., WS' removal of 50 gray fox and the harvest of 3,807 gray fox annually) would represent 5.3% of a statewide population estimated at 72,700 gray fox. The highest annual harvest of gray fox in the State occurred in 2012-2013 when trappers harvested 5,950 gray fox. If WS lethally removed 50 gray fox and the annual harvest reached 5,950 gray fox, the cumulative removal would represent 8.3% of the estimated statewide population. Like other mammal species addressed in this EA, the unlimited removal allowed by the MDWFP during the harvest seasons and the permitting of lethal removal to alleviate damage by the MDWFP provides an indication that gray fox populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely.

Red Fox Population Information and Effects Analysis

The red fox is a typically proportioned member of the dog family. The bushy and unusually long tail, pointed ears, slender muzzle, and slanted eyes coupled with its small dog size and typical reddish coloration, make the red fox instantly recognizable to most people. Red fox are 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 as adults (Voigt 1987). They occur over most of North America, north and east from southern California, Arizona, and central Texas. Red fox are found throughout most of the United States with the exception of a few isolated areas. Prehistoric fossil records suggest the red fox may not have inhabited much of the United States, but fox were plentiful in many parts of Canada. However, it has been suggested that climatic factors, interbreeding with the introduced European red fox, extirpation of the gray and red wolf, and clearing of land for agriculture has possibly contributed to the present-day expansion and range of red fox in North America (Voigt 1987).

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 year-round food resources and the presence or absence of other canids. Because those two factors strongly influence red fox survival, habitat limits fox numbers but seldom limits distribution (Voigt 1987).

Red fox mate from January through March and produce litters of one to 10 kits after a gestation period of 51 to 53 days. Fox rear young in a maternity den, commonly an enlarged woodchuck or badger den, usually in sparse ground cover on a slight rise, with a good view of all approaches (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. Fox are also an efficient scavenger, and in parts of the world, garbage and carrion are extremely important to its diet (Voigt 1987). Fox 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 (goat), 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 square kilometer (78 per mi^2) have been reported (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986), while in southern Ontario, densities of about 1 fox per square kilometer (2.6 per mi^2) occur during spring. This includes both pups and adults. In small areas of the best habitat, three times as many fox have been observed (Voigt 1987). However, those densities rarely occur extensively because of the dispersion of unsuitable habitat, high mortality, or from competition with coyotes (Voigt and Earle 1983). Cyclical changes in fox numbers occur routinely and complicate density estimates as well as management. Those cycles can occur because of changes in prey availability, or disease outbreaks, especially rabies, among red fox. For fox populations to remain relatively stable, mortality and reproduction must balance approximately.

Home ranges for red fox in the eastern United States are usually from 500 to 2,000 hectares (1,235 to 4,940 acres) in rural settings such as farmland (Voigt and Tinline 1980), but such sizes may not apply among fox populations in urban settings. Red fox can be found statewide in Mississippi in suitable habitat. If red fox only occupied 50% of the land area of the State and the density of red fox in Mississippi were 2.6 red fox per square mile, the statewide population could be estimated at nearly 61,000 red fox.

The MDWFP has classified the red fox as a "*nuisance animal*" in the State that people can lethally remove throughout the year with no limit on the number that people can remove. People can also harvest red fox during an annual trapping season in the State. People can harvest an unlimited number of fox during the length of the season. Table 4.9 shows the number of red fox reported as harvested from 2009 through 2014. People may also remove red fox to alleviate damage and threats of damage; however, the number of fox lethally removed annually to alleviate damage or threats of damage is currently unknown.

Between 2009 and 2014, people harvested 7,224 red fox in the State during hunting seasons while people harvested 1,521 red fox in the State during the annual trapping season. The highest level of harvest occurred in 2011-2012 when people harvested 2,688 fox during hunting seasons and during the annual trapping season. As shown in Table 4.9, WS has lethally removed three red fox in the State from FY 2009 through FY 2014 with the highest level of lethal removal occurring in FY 2010 when WS' personnel lethally removed two red fox to alleviate damage. When lethal removal has occurred by WS, the removal of red fox to alleviate damage or threats of damage has represented 0.1% of the total harvest of red fox. The lethal removal of three red fox by WS from FY 2009 through FY 2014 represented 0.03% of the cumulative removal of red fox from 2009 through 2014 in the State.

Table 4.9 - Cumulative red fox removal from known sources in Mississippi, 2009-2015

Year	Type of Harvest		WS' Removal[1]	TOTAL	WS % of Total
	Hunting	Trapping			
2009-10	1,020	174	1	**1,195**	0.1%
2010-11	1,512	229	2	**1,743**	0.1%
2011-12	2,450	238	0	**2,688**	-
2012-13	336	316	0	**652**	-
2013-14	1,906	564	0	**2,470**	-
2014-15	N/A[†]	N/A	0	-	-
TOTAL	**7,224**	**1,521**	**3**	**8,748**	**0.03%[‡]**

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

[†]N/A=Information is not available

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

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 lethally remove up to 50 red fox total annually to alleviate damage and threats of damage during all activities. Using a statewide red fox population estimated at 61,000 fox, lethal removal of up to 50 red fox annually by WS would represent 0.1% of the estimated population. If the average number of red fox harvested annually were representative of future harvest levels, the cumulative removal of red fox (*i.e.*, WS' removal of 50 red fox and the harvest of 1,749 red fox annually) would represent 3.0% of a statewide population estimated at 61,000 red fox. The highest annual harvest of red fox in the State occurred during the 2011-2012 season when people harvested 2,688 red fox. If WS lethally removed 50 red fox and the annual harvest reached 2,688 red fox, the cumulative removal would represent 4.5% of the estimated statewide population.

Although exact population estimates for red fox in Mississippi are not available, the unlimited harvest limits allowed by the MDWFP for the species during hunting and trapping seasons and the classification of the species as a "*nuisance animal*" indicates the species is not at risk of overharvesting. The proposed lethal removal of red fox would be a small component of the overall harvest of red fox in the State. The overall removal would be of low magnitude when compared to the actual statewide population and the number of fox harvested during the annual harvest seasons.

Bobcat Population Information and Effects Analysis

The bobcat, also called "*wildcat*," is a medium-sized member of the North American cat family, and may be mistaken for a large bob-tailed domestic cat by some people. Bobcats are actually two to three times larger than most domestic cats and appear more muscular and fuller in body. Bobcats are capable of hunting and killing prey that range from the size of a mouse to that of a deer. Rabbits, tree squirrels, ground squirrels, wood rats, porcupines, pocket gophers, and woodchucks comprise most of their diet. 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 and bobcats are known to scavenge. Bobcats are opportunistic predators, and may feed on livestock and domestic animals such as poultry, sheep, goats, house cats, small dogs, exotic birds and game animals, and rarely, calves (Virchow and Hogeland 1994). Anderson and Lovallo (2003) reported the cottontail rabbit to be the principal prey of bobcats throughout their range.

Ruell et al. (2009) reported bobcat densities ranged from 0.65 to 1.09 bobcats per square mile (0.25 to 0.42 bobcats per km^2) in coastal southern California in both large open habitat and in habitat surrounded by human development. Lawhead (1984) reported bobcat densities of 0.66 per square mile (0.26 bobcats per km^2) in Arizona with a preference for riparian habitat. Bobcats in southern Illinois were reported to have a population density of 0.70 bobcats per square mile (0.27 bobcats per km^2) (Nielsen and Woolf 2001), while Anderson (1987) provided population density estimates of 0.13 to 0.26 bobcats per square mile (0.05 to 0.10 bobcats per km^2). Bobcats reach densities of about one per 0.7 km^2 (1 per ¼ mi^2) on some islands in the Gulf Coast of the southeastern United States. Densities vary from about one per 1.3 square kilometer (1 per ½ mi^2) in coastal plains to about 1 cat per 10.7 square kilometer (1 per 4 mi^2) in portions of the Appalachian foothills. Mid-Atlantic and mid-western states usually have scarce populations of bobcats (Virchow and Hogeland 1994). Populations are stable in many northern states and reviving in other states where intensive trapping formerly decimated the species (National Audubon Society 2000). Rates of natural mortality reported for adult bobcats in protected populations appear to be quite low. Crowe (1975) estimated a 3% mortality rate in a protected population, based on study of bobcats in southeastern Idaho conducted by Bailey (1972). Causes of natural mortality for adult bobcats include starvation (Hamilton 1982), disease and predation (Lembeck 1978), and injuries inflicted by prey (Fuller et al. 1985).

Bobcats are common statewide in Mississippi in suitable habitat. Population estimates for bobcats in Mississippi are not currently available. Since population estimates are not available for bobcats, the best available data will be used to estimate a population size to analyze potential impacts.

Bobcats are classified as furbearers in Mississippi, with regulated annual hunting and trapping seasons. During the annual trapping season, there is no daily or possession limit for bobcats. At the time this document was prepared, harvest limits were in place for a portion of the hunting season for bobcats while no possession limit occurs during other portions of the hunting season. Table 4.10 shows the number of bobcats harvested from 2009 through 2014. As mandated through the Convention on International Trade in Endangered Species, the MDWFP requires that all bobcat pelts to be sold must be tagged. However, bobcats can be found statewide in Mississippi where suitable habitat occurs and are not considered a threatened or endangered species.

Table 4.10 - Cumulative bobcat removal from known sources in Mississippi, 2009-2015

Year	Type of Harvest		WS' Removal[1]	TOTAL	WS % of Total
	Hunting	Trapping			
2009-10	7,959	1,119	3	**9,081**	0.03%
2010-11	8,896	1,714	4	**10,614**	0.04%
2011-12	8,552	1,880	2	**10,434**	0.02%
2012-13	3,881	1,939	0	**5,820**	-
2013-14	4,860	2,484	0	**7,344**	-
2014-15	N/A[†]	N/A	0	-	-
TOTAL	**34,148**	**9,136**	**9**	**43,293**	**0.02%[‡]**

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

[†]N/A=Information is not available

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

Since FY 2009, WS has lethally removed nine bobcats in the State during damage management activities. Of those nine bobcats lethally removed by WS, WS' personnel lethally removed one bobcat unintentionally in FY 2010 during other damage management activities. As shown in Table 4.10, WS' lethal removal as a percentage of the overall lethal removal of bobcats in the State has not exceeded 0.04% between 2009 and 2014. On average, WS' lethal removal of bobcats has represented 0.02% of the annual total harvest of bobcats in the State. Based upon an anticipated increase in damage management activities associated with bobcats in the future, it is possible that WS could kill up to 50 bobcats per year in Mississippi.

The statewide bobcat population is currently unknown and density information for Mississippi is currently not available. Habitat preferred by bobcats is quite diverse in Mississippi ranging from upland forests to coastal wetlands. If only 50% of the land area of Mississippi represents suitable bobcat habitat and using density estimates for the Appalachian foothills of 1 bobcat per 4 square miles, a statewide population could be estimated to be approximately 5,900 bobcats. However, this estimate could be considered low given that where quality habitat and prey are available densities tend to be much higher. A recent study where bobcats were reintroduced to an island off the coast of Georgia, bobcat densities stabilized at 1 bobcat per 1.2 square mile (Diefenbach et al. 2006). A total bobcat population could be estimated at 19,600 bobcats using a density of one bobcat per 1.2 square mile and bobcats inhabiting only 50% of the land area in the State. Given the harvest levels that occurred from 2009 through 2014, the actual population is likely to be much higher. If bobcats occurred at densities of one bobcat per 1.2 square miles across the State, the population could be approximately 39,100 bobcats. No information indicates the densities of bobcats in the State are declining and the continued unlimited harvest allowed during the trapping season and portions of the hunting season provide an indication that overharvest in not likely to occur. In addition, the statewide population of bobcats likely exceeds 39,100 bobcats.

If the average number of bobcats harvested annually by hunters and trappers were representative of future harvest levels, the cumulative removal of bobcats (*i.e.*, WS' removal of 50 bobcats and the harvest of 8,657 bobcats annually) would represent 22.1% of a statewide population estimated at 39,100 bobcats. The highest annual harvest of bobcats in the State occurred during the 2010-2011 season when people harvested 10,610 bobcats. If WS lethally removed 50 bobcats and the annual harvest reached 10,610 bobcats, the cumulative removal would represent 27.3% of a statewide population estimated at 39,100 bobcats.

Since the statewide population of bobcats is likely higher than 39,100 bobcats, WS' removal of bobcats and the cumulative removal of bobcats would represent a lower percentage of the actual statewide population. Like other mammal species addressed in this EA, the unlimited harvest allowed by the MDWFP during the hunting and trapping seasons provides an indication that bobcat populations maintain sufficient densities within the State to sustain unlimited harvest and that overharvest is unlikely. The lethal removal of bobcats by WS would only occur when authorized by the MDWFP and only at levels authorized. Based on the limited removal proposed by WS and the oversight by the MDWFP, WS' removal of bobcats annually would have no effect on the ability of those persons interested to harvest bobcats during the regulated harvest season.

Feral Swine Population Information and Effects Analysis

Feral swine are also known as "*wild pigs*", "*wild boars*", and "*feral hogs*". Feral swine are medium-size hoofed mammals that often can look like domestic pigs. Feral swine usually have coarser and denser coats than their domestic counterparts and exhibit modified canine teeth called "*tusks*" which are usually 7.5 to 12.5 cm (3 to 5 inches) long, but may be up to 23 cm (9 inches) long. Tusks can curl out and up along the sides of the mouth. Lower canines are also prominent but smaller. Young feral hogs have pale longitudinal stripes on the body until they are 6 weeks of age. Adults of the species average 90 cm (3 feet) in height and 1.32 to 1.82 m (4 feet 6 inches to 6 feet). Males may attain a weight of 75 to 200 kg (165 to 440 lb) while females may weigh from 35 to 150 kg (77 to 330 lbs). Feral swine mate any time of year but peak breeding times usually occur from January and February through early summer. Litter sizes are usually three to 12 (National Audubon Society 2000). Feral hogs are the most prolific wild mammal in North America. Given adequate nutrition, a wild pig population can double in just four months. Feral hogs may begin to breed before six months of age and sows can produce two litters per year (Barrett and Birmingham 1994).

Evidence of the presence of feral swine may be rooted up earth, tree rubs at ground level to 900 cm (36 inches) high, with clinging hair or mud, and muddy wallows in wild habitat. In Mississippi, feral swine can be found statewide and often exploit a variety of habitats. Feral swine are considered a "*nuisance animal*" in Mississippi and can be addressed throughout the year, with few exceptions and no limits on the number of feral swine that can be removed.

Damage in areas supporting feral swine populations is sometimes a serious natural resource management concern for land managers. Substantial damage has occurred to natural resources, including destruction of fragile plant communities, killing and destruction of tree seedlings, and erosion of soils (Barrett and Birmingham 1994). Food sources for feral hogs includes acorns, hickory nuts, pecans, beech nuts, and a wide variety of vegetation including roots, tubers, grasses, fruit, and berries, but feral hogs also eat crayfish, frogs, snakes, salamanders, mice, eggs and young of ground -nesting birds, young rabbits, and any other easy prey or carrion encountered. Feral swine have been known to kill and eat fawns (National Audubon Society 2000). Feral swine have also been reported to kill considerable numbers of domestic livestock, especially young animals, in some areas (Barrett and Birmingham 1994). Several diseases are associated with feral swine populations (see Chapter 1).

The population of feral swine in Mississippi is currently unknown and population density information is not currently available to estimate a statewide population. Table 4.11 shows the number of feral swine harvested in the State from 2009 through 2014. In total, people have harvested 467,125 feral swine, which is an average harvest of 93,425 swine from 2009 through 2014. The highest harvest level occurred during the 2011-2012 season when people harvested nearly 156,100 feral swine in the State, which compares to the lowest harvest level estimated at nearly 34,000 swine that occurred during the 2009-2010 season.

Table 4.11 – Cumulative feral swine removal from known sources in Mississippi, 2009-2015

Year	Harvest[a]	WS' Removal[b]	Total Removal	WS % of Total
2009-10	33,789	147	**33,936**	0.4%
2010-11	68,845	161	**69,006**	0.2%
2011-12	155,789	282	**156,071**	0.2%
2012-13	105,368	310	**105,678**	0.3%
2013-14	103,334	207	**103,541**	0.2%
2014-15	N/A[†]	650	-	-
TOTAL	**467,125**	**1,757**	**468,882**[*]	**0.4%**[‡]

[a]Harvest data provided by the MDWFP

[b]WS' removal is reported by FY

[†]N/A=Information is not available

[*]Total includes WS' removal during FY 2014

[‡]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

WS has lethally removed 1,757 feral swine from FY 2009 through FY 2014 in the State to alleviate damage and threats of damage. WS' total removal of feral swine has represented 0.4% of the total number of feral swine harvested in the State. In anticipation of future requests for assistance, WS' personnel could lethally remove up to 5,000 feral swine annually to alleviate damage or threats of damage. Lethal removal of 5,000 swine would represent 5.4% of the average number of feral swine harvested from 2009 through 2014. If WS had lethally removed 5,000 feral swine in FY 2009, the removal would have represented 14.8% of the lowest harvest level of feral swine that occurred during 2009-2010.

In those cases where feral swine are causing damage or where feral swine are a nuisance and complete removal of the local population could be achieved, this could be considered as providing some benefit to the native environment since feral swine are not considered part of the native ecosystem. The National Invasive Species Council specifically lists feral swine as an invasive species pursuant to Executive Order 13112. Executive Order 13112 directs federal agencies to address invasive species to the extent practicable and permitted by law.

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 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).

The authority for management of resident wildlife species, including deer, is the responsibility of the MDWFP. The MDWFP collects and compiles information on white-tailed deer population trends and lethal removal, and uses this information to manage deer populations. The primary tool for the management of deer populations is through adjusting the allowed lethal removal during the deer harvest season in the State that the MDWFP regulates. Where deer damage is severe, the MDWFP also issues depredation permits for the lethal removal of deer outside of the regulated season to reduce damage.

Between the 2009-2010 deer harvest season in Mississippi and the 2013-2014 season, the highest level of harvest occurred during the 2010-2011 season when 322,287 deer were harvested (see Table 4.12). Hunters have harvested over 1.4 million deer between 2009 and 2014 during the regulated harvest season. In addition to harvest occurring during the regulated season, deer populations are also regulated by other factors. Mortality also occurs from vehicle collisions, dogs, illegal lethal removal, tangling in fences, depredation permits, disease, and other causes (Crum 2003). The highest mortality from vehicle collisions occurred in 2010 when an estimated 14,738 deer were killed. Deer mortality associated with other factors is currently unknown in the State.

Since FY 2009, WS has used lethal methods to remove 651 deer in Mississippi with the highest level of removal occurring in FY 2009 when WS' personnel lethally removed 192 deer (see Table 4.12). All lethal removal by WS has occurred after receiving a request for assistance with resolving damage caused by deer and after the MDWFP issued a permit to remove deer. In addition, WS' personnel employed non-lethal methods to disperse 124 deer between FY 2009 and FY 2014. One white-tailed deer was live-captured unintentionally during activities targeting other animals during FY 2014 but WS' personnel released the deer unharmed. WS in Mississippi has also conducted 36 technical assistance projects involving deer damage management since FY 2009 as shown in Table 1.1.

As shown in table 4.12, the highest level of removal by WS occurred in FY 2009 when personnel removed 192 deer using lethal methods, which accounted for 0.01% of the total known mortality of deer in Mississippi. Since FY 2009, WS' personnel have lethally removed 651 deer as targets, which represents 0.04% of the total known mortality of deer in the State. Based on previous requests for assistance, the magnitude of WS' lethal removal of deer to resolve damage or threats has been low in

Mississippi. When lethal removal of deer has occurred by WS, the magnitude of removal compared to the total known mortality has ranged from 0.02% to 0.1% since FY 2009. Based on the limited removal by WS from FY 2009 through FY 2014, WS' activities to resolve or prevent damage have not adversely affected the deer population.

Table 4.12 - Total known deer mortality in Mississippi by year, 2009 - 2015

Year	Deer Harvest[a]	Vehicle Collisions	WS' Removal[b]	Total Mortality	WS' % of Total
2009-10	270,890	14,327	192	**285,409**	0.1%
2010-11	322,287	14,738	170	**337,195**	0.1%
2011-12	272,275	13,489	93	**285,857**	0.03%
2012-13	273,126	14,185[†]	115	**287,426**	0.04%
2013-14	263,705	14,185[†]	57	**277,947**	0.02%
2014-15	N/A[‡]	N/A	24	-	-
TOTAL	**1,402,283**	**70,924**	**651**	**1,473,858[§]**	**0.04%[*]**

[a]Data adapted from Hunt (2010)

[b]Data reported by federal fiscal year

[†]Data for 2012-2013 and 2013-2014 is an average of collisions from 2009-2010 through 202011-2012 since data is currently unavailable for 2012-2013 and 2013-2014

[‡]N/A=Information is not available

[§]Total includes WS' removal during FY 2014

[*]Represents WS' cumulative removal from FY 2009 to FY 2014 as a percentage of the cumulative removal from 2009 to 2014

After review of the number of requests for assistance to resolve and prevent deer damage in Mississippi received by WS since FY 2009 and in consultation with the MDWFP, WS' anticipates the number of requests for assistance to increase in the future. Based on consultation with the MDWFP, a review of previous requests for assistance, and in anticipation of an increasing number of requests for assistance, WS anticipates the use of non-lethal and lethal methods to resolve deer damage and threats to increase.

An increasing number of requests for assistance would likely result in the escalated use of lethal and non-lethal methods to resolve damage and threats associated with deer as permitted by the MDWFP. Non-lethal methods generally have minimal impacts on wildlife populations since no lethal removal occurs and wildlife are only dispersed to other areas. No population reduction is likely from the use of non-lethal methods, except for reproductive inhibitors, which are currently not available for use in Mississippi. Therefore, the increased use of non-lethal methods to resolve and prevent damage would not adversely affect deer populations in the State.

After review of previous activities conducted by WS and in anticipation of a gradual increase in requests for lethal removal, WS anticipates that future lethal removal would not exceed 450 deer annually. In addition, WS may be requested by the MDWFP and/or the MDAC to assist with sampling and managing the spread of diseases found in free-ranging and/or captive deer populations. In the case of a disease outbreak, WS could lethally remove up to 250 additional white-tailed deer for sampling and/or to prevent further spread of diseases. Therefore, WS' total annual removal would not exceed 700 deer annually under the proposed action. The MDWFP must authorize and permit any lethal removal of deer in the State, including any removing occurring by WS.

If requested, WS could also assist with sampling and removing deer from captive facilities where 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 those 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 MDWFP and/or the MDAC. As proposed in this alternative, in those cases where a person requests assistance from WS to assist with the removal of a captive deer herd in Mississippi, the lethal removal would not exceed 250 deer for purposes of disease monitoring or surveillance. Deer confined inside perimeter fences for the purposes of non-traditional farming, including confined for hunting, are not included in statewide deer population management objectives. However, since lethal removal of deer by WS for disease surveillance or monitoring could occur in free-ranging or captive herds, the potential lethal removal of up to 250 deer for disease surveillance and monitoring by WS would be part of the impact analysis on the statewide free-ranging deer population. Therefore, the analyses will evaluate the lethal removal of up to 700 deer annually by WS at the request of cooperators and approved by the MDWFP.

In addition to WS' intentional removal of deer to resolve or prevent damage, WS also conducts other damage management activities that pose a risk of lethally removing deer unintentionally, primarily projects that target coyotes, fox, and feral swine. From FY 2009 through FY 2014, WS' personnel did not lethally remove deer as unintentional non-targets. However, the unintentional removal of deer could occur during other damage management activities. During FY 2014, one deer was live-captured unintentionally but WS' personnel released the deer unharmed. Based on the limited unintentional removal that occurred from FY 2009 through FY 2014 during other program activities in Mississippi and after the review of proposed activities, the unintentional removal of deer by WS during other activities is not likely to increase to any appreciable extent. The unintentional removal of deer by WS would continue to be minimal when compared to the number of deer harvested annually. WS would report all lethal removal, including unintentional removal, to the MDWFP. In addition, WS will evaluate removal, whether intentional or unintentional, cumulatively to ensure activities do not adversely affect deer populations in the State.

Since deer harvest levels and other mortality events fluctuate annually in the State (see Table 4.12), the analysis of impacts of WS' removal on the statewide deer population under this alternative will occur using several scenarios. WS' proposed removal would not exceed 450 deer annually. In the event of a disease threat, the lethal removal of deer by WS for disease monitoring and surveillance would not exceed 250 deer when requested by the MDWFP and/or the MDAC. Under a worst-case scenario, WS' personnel could lethally remove 700 deer annually under this alternative. Since the worst-case scenario would represent the highest level of annual removal, the analyses will evaluate the lethal removal of 700 deer to determine the maximum possible potential impact. However, the removal of 700 deer annually is unlikely and would likely be less than 450 deer.

From 2009 through 2014, the highest deer harvest (322,287) in Mississippi and the highest level of mortality from vehicle collisions (14,738) occurred during 2010-2011 resulting in the lethal removal of 337,025 deer. During the same period, the lowest deer harvest (263,705) in Mississippi occurred during 2013-2014 while the lowest number of deer killed from vehicle strikes occurred during 2011-2012 when vehicle strikes killed 13,489 deer. If WS' lethal removal reached 700 deer during the highest known mortality of deer in the State, WS' lethal removal of 700 deer would have represented 0.2% of the total known mortality in the State. If WS' lethal removal reached 700 deer and the lowest mortality event occurred during the same year, WS' removal of deer would represent 0.3% of the lowest cumulative mortality.

If WS had lethally removed 700 deer each year from FY 2009 through FY 2013, WS' lethal removal would have presented 0.2% of the total harvest of deer in the State during the annual hunting season and the estimated mortality of deer from vehicle strikes. The deer population in Mississippi is currently unknown. However, the MDWFP currently estimates the deer population in the State to be generally expanding (MDWFP 2012).

The lethal removal of deer unintentionally during other WS' damage management activities is not likely to increase greatly; therefore, even under the worst-case scenario, the potential impacts on the deer population in Mississippi is likely to be extremely low. With oversight of the MDWFP, the magnitude of removal by WS annually to resolve damage and threats would be low. WS would continue to report all program removal to the MDWFP to ensure the MDWFP has the opportunity to incorporate WS' activities into deer population objectives for the State. People can also remove deer to alleviate damage after the issuance of permits by the MDWFP. Therefore, in the absence of any involvement by WS, people could lethally remove deer to alleviate damage or threats of damage or seek assistance from other entities to remove deer. WS' damage management activities associated with deer would only occur after the MDWFP authorizes the activities. WS could conduct activities after the MDWFP provides authorization directly to a property owner or property manager where WS was working as an agent of the owner or manager under the authorization or WS could conduct activities pursuant to authorization granted directly to the WS program by the MDWFP. Therefore, in some cases, WS' activities would target deer that the property owner and/or manager could remove themselves under authorizations from the MDWFP but the property owner/manager has chosen to request assistance from WS. Even in the event of a disease threat, those deer that WS' personnel remove other entities would likely remove whether WS was directly involved or not. Therefore, WS' activities under the proposed action would not likely be additive to the mortality that could occur under permits and that could occur during disease threats. The potential impacts to the statewide deer population under the proposed action would likely be similar to the other alternatives given that WS' activities would not substantially increase the removal that could occur in the absence of WS' direct involvement since removal could occur when authorized by the MDWFP. The deer that WS could remove under the proposed action would likely be those deer that other entities would remove in the absence of WS' direct involvement in the activities.

The EPA approved the use of GonaCon™ in 2009 for use in reducing fertility in female white-tailed deer. According to the label, only WS or state wildlife management agency personnel or individuals working under their authority can use the reproductive inhibitor. Additionally, in order for WS or a wildlife management agency to use GonaCon™ in any given state, the appropriate state agency responsible for managing wildlife must also approve the use of the product along with the appropriate state agency responsible for registering pesticides. The reproductive inhibitor Gonacon™ is currently not registered for use in Mississippi. However, if Gonacon™ becomes available to manage deer in the State, WS could consider the use of the reproductive inhibitor under the proposed action. Gonacon™ would be a method that WS could consider as part of an integrated methods approach to managing damage.

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

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

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

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

The magnitude of WS' activities to alleviate damage and threats associated with deer in the State would be low with the oversight and permitting of WS' activities occurring by the MDWFP. If removal by WS had reached 700 deer when the lowest known deer mortality occurred in the State, WS' removal would have represented 0.3% of the total known mortality. Based on those worst-case scenarios, WS' removal of up to 700 deer under the proposed action would be extremely low when compared to the total known mortality. WS would report to the MDWFP and monitor removal to ensure WS' activities do not adversely affect deer. The permitting of all WS' removal by the MDWFP ensures WS' removal would meet the population goals for deer in the State as determined by the MDWFP. Based on the limited removal proposed by WS and the oversight by the MDWFP, WS' removal of deer annually would have no effect on the ability of those persons interested to harvest deer during the regulated harvest season.

Feral Cat Population Information and Effects Analysis

Feral cats are domesticated cats living in the wild. They are small in stature, weighing from 3 to 8 pounds (1.4 to 3.6 kg), standing 8 to 12 inches (20 to 30.5 cm) high at the shoulder, and 14 to 24 inches (35.5 to 61 cm) long. The tail adds another 20 to 30.5 cm (8 to 12 inches) to their length. Colors range from black to white to orange, and a variety of combinations of those colors. Other hair characteristics also vary greatly (Fitzwater 1994).

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

Feral cats produce two to 10 kittens during any month of the year. An adult female may produce three litters per year where food and habitat are sufficient. Cats may be active during the day but typically are more active during twilight or night. House cats have been reported to live up to 27 years, but feral cats probably average only three to five years. They are territorial and move within a home range of roughly 4 square kilometers (1.5 mi^2). After several generations, feral cats can be considered to be completely wild in habits and temperament (Fitzwater 1994).

Where it has been documented, the impact of feral cats on wildlife populations in suburban and rural areas, directly by predation, and indirectly by competition for food, has been enormous (Coleman and Temple 1989). In the United Kingdom, one study determined that house cats might take an annual toll of some 70 million animals and birds (Churcher and Lawton 1987). American birds face an estimated 117 to 157 million exotic predators in the form of free-ranging domestic cats, which are estimated to kill at least one billion birds every year in the United States. Cats have contributed to declines and extinctions of birds worldwide, with feral cats considered one of the most important drivers of global bird extinctions (Dauphine and Cooper 2009).

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

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

WS killed one feral cat in Mississippi from FY 2009 through FY 2014. In addition, WS live-captured and released seven feral cats unintentionally during activities that targeted other animals between FY 2009 and FY 2014. WS could employ live-capture methods to alleviate damage or threats of damage associated with feral or free-ranging cats. Once live-captured, WS could transfer custody of the cats to a local animal control facility. After relinquishing the feral or free-ranging cats to a local animal control facility, the care and the final disposition of the cat would be the responsibility of the animal control facility. However, in some cases, WS may receive requests to remove feral cats lethally to alleviate damage or threats. WS could lethally remove up to 100 feral cats annually to address requests for assistance. WS could also remove feral cats unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of feral cats to exceed 100 cats annually.

Based upon the above information, WS' limited lethal removal of feral cats would have minimal effects on local or statewide populations of this species in Mississippi. Any damage management activities involving the use of lethal or non-lethal methods by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced because of WS' activities aimed at reducing damage at a local site. In those cases where feral cats were causing damage or where feral cats were a nuisance and complete removal of the local population could be achieved, this could be considered as providing some benefit since feral cats are not considered part of the native ecosystem.

Feral Dog Population Information and Effects Analysis

Like domestic dogs, feral dogs (sometimes referred to as wild or free-ranging dogs) manifest themselves in a variety of shapes, sizes, colors, and even breeds. McKnight (1964) noted German shepherds, Doberman pinschers, and collies are the breeds that most often become feral. Most feral dogs today are descendants of domestic dogs that appear similar to dog breeds that are locally common (Green and Gipson 1994). The primary feature that distinguishes feral from domestic dogs is the degree of reliance or dependence on humans, and in some respect, their behavior toward people. Feral dogs survive and reproduce independently of human intervention or assistance. While it is true that some feral dogs use human garbage for food, others acquire their primary subsistence by hunting and scavenging like other wild canids.

Feral and domestic dogs often differ markedly in their behavior toward people. Scott and Causey (1973) based their classification of those two types by observing the behavior of dogs while confined in cage traps. Domestic dogs usually wagged their tails or exhibited a calm disposition when a human approached, whereas most feral dogs showed highly aggressive behavior, growling, barking, and attempting to bite. Some dogs were intermediate in their behavior and could not be classified as either feral or domestic based solely on their reaction to humans. Since people often pursue, shoot at, or trap feral dogs, their aggressive behavior toward people is not surprising. For example, a feral dog caught in Arkansas had numerous lead pellets imbedded under the skin, which Gipson (1983) indicated was likely a testament to the relationship between some people and feral dogs.

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

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

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

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

Like coyotes, feral dogs are best described as opportunistic feeders. They can be efficient predators, preying on small and large animals, including domestic livestock. Many rely on carrion, particularly road-killed animals, crippled waterfowl, green vegetation, berries and other fruits, and refuse at garbage dumps (Green and Gipson 1994).

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

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

Hybridization between feral dogs and other wild canids can occur, but non-synchronous estrus periods and pack behavior (that is, excluding non-resident canids from membership in the pack) may preclude much interbreeding. Dens may be burrows dug in the ground or sheltered spots under abandoned buildings or farm machinery. Feral dogs commonly use former fox or coyote dens (Green and Gipson 1994).

Feral dogs can cause damage by preying on livestock, poultry, house cats, or domestic dogs. They may also feed on fruit crops including melons, berries, grapes, and native fruit. They may also attack people, especially children. This is especially true where they feed at and live around landfills near human dwellings (Green and Gipson 1994). In some locales, they may present a serious threat to deer (Lowry 1978) and other valuable wildlife (Green and Gipson 1994).

When receiving requests for assistance associated with feral and free-ranging dogs, the WS program in Mississippi would follow WS Directive 2.340. WS would primarily provide technical assistance to requesters when those requesters were seeking assistance with dogs. WS would refer most requests for assistance to a local animal control facility since requesters are often unable to determine if a dog was feral or a free-ranging pet. In most cases, WS would employ live-capture methods to alleviate damage or threats of damage associated with dogs. Once live-captured, WS would transfer custody of the dogs to a local animal control facility. After relinquishing the dogs to a local animal control facility, the care and the final disposition of the dog would be the responsibility of the animal control facility.

From FY 2009 through FY 2014, WS lethally removed six feral dogs during damage management activities in Mississippi. WS also live-captured one feral dog unintentionally during activities targeting other animals but released the dog unharmed. In addition, the WS program dispersed 24 feral dogs between FY 2009 and FY 2014 to alleviate damage. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 100 feral dogs per year under the proposed action alternative. WS could also remove feral dogs unintentionally during other damage management activities; however, WS does not anticipate the cumulative lethal removal of feral dogs to exceed 100 dogs annually.

Based upon the above information, WS' limited lethal removal of feral dogs should have no adverse effects on overall populations in Mississippi. Any activities conducted by WS involving lethal control actions by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced because of removal activities aimed at reducing damage at a local site. In those cases where feral dogs were causing damage or posing as a nuisance and complete removal of the local population could be achieved, this would be considered as providing some benefit to the natural environment since feral dogs are not considered part of the native ecosystem.

Additional Target Species

In addition to those mammal species discussed previously, WS has addressed limited numbers of woodchucks, southern flying squirrels, gray squirrels, and fox squirrels previously or WS anticipates addressing a limited number of those species under the proposed action alternative. Requests for assistance associated with those species would often occur infrequently or would involve only a few individuals. Under the proposed action alternative, WS could receive requests for assistance to use lethal methods to remove those species when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision model.

Based on previous requests for assistance and the removal levels necessary to alleviate those requests for assistance, WS would not lethally remove more than 10 individuals of those species annually. WS' personnel could also lethally remove those species unintentionally during activities targeting other animal species; however, the total annual removal by WS would not exceed 10 individuals of each species. WS does not expect the annual removal of those species to occur at any level that would adversely affect populations of those species. Removal would be limited to those individuals deemed causing damage or posing a threat.

Gray squirrels and fox squirrels have annual hunting seasons that allow people to harvest those species in the State. Woodchucks are an unregulated species in the State and removal can occur at any time to alleviate damage or threats of damage. If WS lethally removed up to 10 individuals of each of those species to alleviate damage or threats of damage, the removal would be of low magnitude when compared to the number of those species harvested each year. In addition, the remove of up to 10 individuals of each of those species would be of extremely low magnitude when compared to the statewide population of those species. Those densities of those species in the State are not low. Based on the limited removal proposed by WS and the oversight by the MDWFP, WS' removal of those species annually would have no effect on the ability of those persons interested to harvest those species.

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

Wildlife Disease Surveillance and Monitoring

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

Under disease sampling strategies that could be implemented to detect or monitor diseases in the United States, WS' implementation of those sampling strategies would not adversely affect mammal populations in the State. Sampling strategies that could be employed involve sampling live-captured mammals that could be released on site after sampling occurs. The sampling (*e.g.*, drawing blood, swabbing nasal cavities, collecting fecal samples) and the subsequent release of live-captured mammals would not result in adverse effects since those mammals would be released unharmed on site. In addition, the sampling of mammals that were sick, dying, or harvested by hunters would not result in the additive lethal removal of mammals that would not have already occurred in the absence of disease sampling. Therefore, the sampling of mammals for diseases would not adversely affect the populations of any of the mammals addressed in this EA nor would sampling mammals result in any lethal removal of mammals that would not have already occurred in the absence of disease sampling (*e.g.*, hunter harvest).

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

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

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

With the oversight of the MDWFP, 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 MDWFP, private entities, and/or municipal authorities. If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal removal, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e.g*., see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

Alternative 3 – No Mammal Damage Management Conducted by WS

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

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

Since mammals could still be removed under this alternative, the potential effects on the populations of those mammal species in the State would be similar to the other alternatives for this issue. WS' involvement would not be additive to removal that could occur since the cooperator requesting WS' assistance could conduct mammal damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with mammals could occur by other entities despite WS' lack of involvement under this alternative. In addition, WS would have no impact on the ability to harvest mammals under this alternative. WS would not be involved with any aspect of mammal damage management. The MDWFP would continue to regulate populations through adjustments of the allowed removal during the regulated harvest season and the continued use of permits.

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

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

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

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

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

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

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

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

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

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

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

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

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

The use of firearms would essentially be selective for target species since animals would be identified prior to application; therefore, no adverse effects would be anticipated from use of this method.

Similarly, the use of euthanasia methods would not result in non-target removal since identification would occur prior to euthanizing an animal.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

***Domestic Animals and Small Mammals*:** A number of studies with laboratory animals (*e.g*., rodents [Borg 1978]) and domestic animals (*e.g*., sheep [Ames and Arehart 1972]) have shown that these animals can become habituated to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "*fight or flight*" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 dbA (United States Forest Service 1992).

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

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

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

Between FY 2009 and FY 2014, WS' personnel lethally removed three opossum and one raccoon unintentionally in body-gripping traps during activities targeting mammal species addressed in this EA. The lethal removal of non-targets could result in declines in the number of individuals in a population; however, as was discussed previously, the lethal removal of non-targets by WS during damage management activities would be of low magnitude when compared to the actual statewide population of those species. The previous non-targets lethally removed unintentionally by WS are representative of non-targets that WS could lethally remove under the proposed action alternative. WS could lethally remove additional species of non-targets unintentionally; however, the removal of individuals from any species would not be likely to increase substantially above the number of non-targets removed annually by WS during previous damage management activities.

Those species lethally removed previously during activities targeting mammal species addressed in this EA are also target species in this EA and the level of removal analyzed for each of those species under

Issue 1 included the unintentional removal that could occur by WS. Therefore, the analyses evaluated lethal removal of those species cumulatively under Issue 1, including removal that could occur when a species was a target or non-target. WS would continue to monitor activities, including non-target removal, to ensure the annual removal of non-targets does not result in adverse effects to a species' population. In addition, hunters and/or trappers can harvest those species lethally removed as non-targets previously by WS in the State during annual harvest seasons.

Table 4.13 shows those non-targets live-captured and released unharmed by WS from FY 2009 through FY 2014 during activities targeting mammal species addressed in this EA. The WS program in Mississippi live captured unintentionally but was able to release 10 opossum, seven feral cats, and one raccoon between FY 2009 and FY 2014 during activities targeting mammal species addressed in this EA. Since those animals were live-captured and released unharmed, no adverse effects to a species population occurred. WS' employees would release live-captured non-target if releasing the animal could occur safely (*e.g.*, without harming the employee, the public, or posing a safety hazard) and no serious harm had occurred to the animal.

Table 4.13 – Non-targets live-captured and released by WS in Mississippi, FY 2009 – FY 2013

Species	Method of Live-Capture			Total
	Body Grip†	Cage Trap	Foothold†	
Feral Cat	4	2	1	7
Opossum	0	10	0	10
Raccoons	0	1	0	1

†Animals captured in body grip traps, foothold traps, or neck snares by the tail or other extremity would be released if they are unharmed and can be released safely.

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

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

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

T&E SPECIES EFFECTS

WS would make special efforts to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. Chapter 3 of this EA describes those SOPs that WS' employees would implement to avoid effects to T&E species.

Although an exact estimate of population numbers for each of the target mammal species is not available, target mammal species can occur statewide in Mississippi. Damage or threats of damage caused by mammals could occur statewide in Mississippi wherever they occur. However, WS would only conduct activities to alleviate or prevent damage when a landowner or manager requests such assistance and only on properties where WS and a cooperating entity sign a MOU, work initiation document, or another comparable document. Therefore, WS has defined the action area as the State of Mississippi, which encompasses the known areas occupied by all of the T&E species listed within the State.

The WS program in Mississippi consulted with the USFWS on the potential effects to threatened or endangered species from managing damage associated with mammals in 2012. The USFWS concurred with WS' determinations that activities to manage damage associated with mammals would not adversely affect threatened or endangered species in the State (S. Ricks, USFWS pers. comm. 2012). Since those consultations with the USFWS were completed, no incidental take of threatened or endangered species has occurred by WS during activities targeting target mammal species. Those methods and activities that WS could conduct under the proposed action alternative (Alternative 1) have not changed from those activities described during the previous consultation processes.

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

For several species listed within the State, WS has determined that the proposed activities "*may affect*" those species but those effects would be solely beneficial, insignificant, or discountable, which would warrant a "*not likely to adversely affect*" determination (see Table 4.14). In addition, WS has made a "*no effect*" determination for several species currently listed in the State based on those methods currently available and based on current life history information for those species (see Table 4.14).

Table 4.14 - List of threatened or endangered species in Mississippi and WS' determination

Common Name	**Scientific Name**	**Status**[†]	**Determination**[‡]
Animals			
Invertebrates			
Alabama Heelsplitter	*Potamilus inflatus*	T	NE
Black Clubshell	*Pleurobema curtum*	E	NE
Ovate Clubshell	*Pleurobema perovatum*	E[*]	NE
Southern Clubshell	*Pleurobema decisum*	E	NE
Cumberlandian Combshell	*Epioblasma brevidens*	E[*]	NE
Southern Combshell	*Epioblasma penita*	E[*]	NE
Fat Pocketbook	*Potamilus capax*	E	NE
Rabbitsfoot	*Quadrula cylindrica cylindrica*	T[*]	NE

Alabama Moccasinshell	*Medionidus acutissimus*	T*	NE
Orangenacre Mucket	*Lampsilis perovalis*	T*	NE
Sheepnose Mussel	*Plethobasus cyphyus*	E	NE
Snuffbox Mussel	*Epioblasma triquetra*	E	NE
Flat Pigtoe	*Pleurobema marshalli*	E	NE
Stirrupshell	*Quadrula stapes*	E	NE
Heavy Pigtoe	*Pleurobema taitianum*	E	NE
Slabside Pearlymussel	*Pleuronaia dolabelloides*	E*	NE
Mitchell's Satyr Butterfly	*Neonympha mitchellii mitchellii*	E	NE
American Burying Beetle	*Nicrophorus americanus*	E	NE
Reptiles			
Green Sea Turtle	*Chelonia mydas*	T	MANLAA
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	MANLAA
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	MANLAA
Leatherback Sea Turtle	*Dermochelys coriacea*	E	MANLAA
Loggerhead Sea Turtle	*Caretta caretta*	T*	MANLAA
Gopher Tortoise	*Gopherus polyphemus*	T	MANLAA
Ringed Map Turtle	*Graptemys oculifera*	T	MANLAA
Yellow-blotched Map Turtle	*Graptemys flavimaculata*	T	MANLAA
Eastern Indigo Snake	*Drymarchon corais couperi*	T	MANLAA
Alabama Red-belly Turtle	*Pseudemys alabamensis*	E	MANLAA
Black Pine Snake	*Pituophis melanoleucus lodingi*	C	MANLAA
Amphibian			
Dusky Gopher Frog	*Rana sevosa*	E*	MANLAA
Fish			
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	T*	NE
Pallid Sturgeon	*Scaphirhynchus albus*	E	NE
Alabama Sturgeon	*Scaphirhynchus suttkusi*	E	NE
Pearl Darter	*Percina aurora*	C	MANLAA
Smalltooth Sawfish	*Pristis pectinata*	E	NE
Bayou Darter	*Etheostoma rubrum*	T	MANLAA
Mammals			
Louisiana Black Bear	*Ursus americanus luteolus*	T	MANLAA
West Indian Manatee	*Trichechus manatus*	E	NE
Finback Whale	*Balaenoptera physalus*	E	NE
Humpback Whale	*Megaptera novaeangliae*	E	NE
Gray Bat	*Myotis grisescens*	E	NE
Indiana Bat	*Myotis sodalist*	E	NE
Northern Long-eared Bat	*Myotis septentrionalis*	T	MANLAA
Florida Panther	*Puma concolor coryi*	E	NE
Gray Wolf	*Canis lupis*	E	NE
Birds			
Piping Plover	*Charadrius melodus*	T*	MANLAA
Interior Least Tern	*Sterna antillarum*	E	MANLAA
Red-cockaded Woodpecker	*Picoides borealis*	E	MANLAA
Mississippi Sandhill Crane	*Grus canadensis pulla*	E*	MANLAA
Wood Stork	*Mycteria americana*	E	NE

Sprague's Pipit	*Anthus spragueii*	C	MANLAA
Red Knot	*Calidris canutus rufa*	T	NE
Plants			
American Chaffseed	*Schwalbea americana*	E	NE
Price's Potato-bean	*Apios priceana*	T	NE
Louisiana Quillwort	*Isoetes louisianensis*	E	NE
Pondberry	*Lindera melissifolia*	E	NE
White Fringeless Orchid	*Platanthera integrilabia*	C	NE

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

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

*Species with critical habitat designated within Mississippi

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

Alabama heelsplitter mussel - In Mississippi, this species historically occurred in the Pearl River located in Hancock, Itawamba, Lowndes, Monroe, Noxubee, and Pearl River Counties; however, the heelsplitter likely no longer occurs in the Pearl River. The species normally occurs on the protected side of bars and can be found living at depths of over 20 feet. Siltation may adversely affect juveniles, while adults may survive limited amounts of siltation (USFWS 1992). George et al. (1996) recently found evidence of this species occurring in the West Pearl River drainage in Louisiana. WS concludes the proposed action alternative (Alternative 1) would have no effect on the status of this mussel based on the historic occurrence of the species in only the Pearl River in Mississippi and the likely absence of the species in the State. In addition, WS based this determination on the use patterns of methods, and activities not occurring directly in large river systems of the State where the mussel is likely to occur, if present.

Black clubshell – At the time of listing, only a single population of the black clubshell was known to exist, which occurred in the East Fork Tombigbee River located in Itawamba and Monroe Counties of Mississippi. However, documentation of this species occurring in that location has not occurred since 1997, despite numerous surveys of historical habitat (USFWS 2009*a*). Based on the known locations of this species, the use patterns of the methods, and the locations where damage management activities occur, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of this species.

Ovate clubshell – The ovate clubshell is known to occur in localized areas of the Buttahatchee River in Lowndes and Monroe Counties, and Luxapalila Creek and its tributary Yellow Creek in Lowndes County, Mississippi. Ovate clubshells generally occur in the sand/gravel shoals and runs of small rivers and large streams. Sedimentation and water quality continue to affect this species, along with other events, such as spills, drought, and land use runoff (USFWS 2008*a*). Based on the known locations of this species, the use patterns of the methods, and the locations where damage management activities occur, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of this species. In addition, proposed activities would have no effect any designated critical habitat for this species of clubshell in the State.

Southern clubshell – The southern clubshell is known to occur in small, fragmented populations in the East Fork Tombigbee River in Itawamba and Monroe Counties, Luxapalila Creek in Lowndes County, and Buttahatchee River in Monroe and Lowndes Counties, Mississippi. Southern clubshell occurs in sand/gravel/cobble substrate in shoals and runs of small rivers and large streams. Sedimentation and water quality continue to affect this species, along with other events, such as spills, drought, and land use runoff. Several species of shiners were identified as fish hosts for this species (USFWS 2008*a*). Based on the known locations of this species, the use patterns of the methods, and the locations where damage management activities occur, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of this species.

Cumberlandian combshell – This species of combshell is known to occur in Bear Creek that runs through Tishimingo County, Mississippi. The Cumberlandian combshell occurs in medium-sized streams and large rivers on shoals and riffles with sand, gravel, cobble, and boulders (USFWS 2004). Given the limited distribution of this species of combshell in the State, the proposed activities would have no effect on the status of the Cumberlandian combshell in Mississippi or any designated critical habitat.

Southern combshell – This species of combshell continues to occur along a short reach of the Buttahatchee River in Lowndes and Monroe Counties, Mississippi. No evidence of the southern combshell occurring in the Tombigbee and East Fork Tombigbee Rivers has been found since 1980 (USFWS 2009*a*). Given the limited distribution of this species of combshell in the State, the proposed activities would have no effect on the status of the southern combshell in Mississippi or any designated critical habitat.

Fat pocketbook pearly mussel - This mussel prefers the sand, mud, and fine gravel bottoms of large rivers. It is found in depths that range from a few inches to 8 feet. The general distribution of the fat pocketbook pearly mussel in Mississippi is along the Mississippi River in Adams, Bolivar, Claiborne, Coahoma, DeSoto, Issaquena, Jefferson, Tunica, Warren, Washington, and Wilkinson Counties. Activities that WS could conduct as part of Alternative 1 do not occur in large rivers and streams. Based on the presence of this mussel species in large rivers where activities do not occur, WS has determined the proposed action (Alternative 1) would have no effect on the status of this species.

Rabbitsfoot mussel – The rabbitsfoot is a freshwater mussel found in small streams and some large rivers. In Mississippi, the rabbitsfoot is known to occur along stretches of the Tennessee River, Bear Creek, Yazoo River, Big Sunflower River, and Big Black River in Claiborne, Hinds, Madison, Sunflower, Tishomingo, Warren, and Yazoo Counties. Based on the use patterns of the methods available and the locations where damage management activities could occur, the proposed action (Alternative 1) would have no effect on the status of the rabbitsfoot in the State or any designated critical habitat.

Alabama moccasinshell – This mussel species inhabits sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers. The species is known to occur in small, localized areas of the Luxapalila Creek in Lowndes County, Bull Mountain Creek in Itawamba County, Buttahatchee River in Lowndes and Monroe Counties, and the Sipsey Creek in Monroe County. The moccasinshell is very sensitive to sedimentation and erosion, along with chemical runoff, surface mine drainage, water impoundment, and sewage discharge, and channel degradation. Based on the locations where the moccasinshell could occur in the State, damage management activities associated with target mammal species would have no effect on the status of this mussel species. In addition, the proposed action (Alternative 1) would have no effect on any designated critical habitat for the species in the State.

Orangenacre mucket – The orangenacre mucket is known to occur in the Buttahatchee River in Lowndes and Monroe Counties, the Luxapalila Creek in Monroe County, and the East Fork Tombigbee River in Itawamba and Monroe Counties, Mississippi. The mucket occurs in high quality stream and small river habitat on stable sand/gravel/cobble substrate in moderate to swift currents. Based on the known locations of this species, the use patterns of the methods, and the locations where damage management activities occur, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of this species. In addition, the proposed action alternative (Alternative 1) would have no effect on any designated critical habitat in Mississippi.

Sheepnose mussel - The sheepnose mussel can be found in shallow areas of larger rivers and streams with moderate to swift currents flowing over coarse sand and gravel. In Mississippi, populations of sheepnose mussel are known to occur in the Big Sunflower River along a 12 to 15 mile section upstream of Indianola, Mississippi in Sunflower County (see 77 FR 14914-14949). Based on the known locations of extant populations in the State, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of the sheepnose mussel in the State, including any designated critical habitat.

Snuffbox mussel - The snuffbox mussel is a freshwater invertebrate that can be found in small- to medium-sized creeks to larger rivers and in lakes. No extant populations are currently known to occur in Mississippi; however, snuffbox mussels are known to occur in the Tennessee River (see 77 FR 8632-8665), which lies within Tishomingo County, Mississippi. However, that portion of the Tennessee River in Mississippi has been dammed forming Pickwick Lake. Based on the known locations of extant populations in the State, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of the snuffbox mussel in the State, including any designated critical habitat.

Flat pigtoe - The flat pigtoe was a freshwater mussel unique to the Tombigdee River system that is now believed to be extinct (USFWS 2009*a*). Based on the current known status of the flat pigtoe, WS' mammal damage management activities conducted pursuant to the proposed action (Alternative 1) would have no effect on the pigtoe given the likely extinction of the species.

Stirrupshell – Similar to the flat pigtoe, the stirrupshell was a freshwater mussel unique to the Tombigdee River system that is now believed to be extinct (USFWS 2009*a*). Based on the current known status of the stirrupshell, WS' mammal damage management activities conducted pursuant to the proposed action (Alternative 1) would have no effect on the stirrupshell given the likely extinction of the species.

Heavy pigtoe – Historically, the heavy pigtoe was found in the Tombigbee River in Itawamba County and the Buttahatchee River in Lowndes County, Mississippi. However, no heavy pigtoes have been found in those locations since 1980 despite extensive searches. The pigtoe is likely extirpated from the State with the only known population occurring in the Alabama River in Alabama. Based on the likely extirpation of the species from the State and the locations where individuals could occur, WS has determined the proposed action alternative (Alternative 1) would have no effect on the heavy pigtoe.

Slabside Pearlymussel - The slabside pearlymussel is only known to occur in Mississippi along a stretch of Bear Creek in Tishomingo County (see 78 FR 59269-59287). Given the limited distribution of the pearlymussel in the State, WS' mammal damage management activities would have no effect on the status of the pearlymussel in Mississippi or any designated critical habitat.

Mitchell's Satyr Butterfly - The Mitchell's satyr butterfly is thought to occur in Itawamba, Prentiss, and Tishomingo Counties in Mississippi. The butterfly appears to be a habitat specialist being found only in fens habitat that are characterized by low-nutrient levels and alkaline water discharged from groundwater seeps, which are dominated by sedges. The loss of wetland fens appears to be the primary factor in the decline of the butterfly. Based on the isolated populations and the habitats where butterflies could be found, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of the butterfly in the State, including any designated critical habitat.

American Burying Beetle - The American burying beetle is not currently known to occur in the State. Based on the absence of the species from the State using current information, the proposed action alternative (Alternative 1) would have no effect on the status of the beetle and any critical habitat.

Green sea turtle (Nesting) – Like the other sea turtles, the green sea turtle is a marine species that could be found along the coastal waters of the State. Based on the use patterns of methods, the proposed activities would have no direct effect on the status of the green sea turtle. Nesting is not known to occur on coastal beaches of the continental United States; however, if nesting were to occur along the beaches in the State, removing mammalian predators near nesting areas could provide some benefit by reducing predation on eggs and young turtles.

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

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

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

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

Gopher tortoise - The gopher tortoise is an inhabitant of the southeastern portion of the State, including Clarke, Covington, Forrest, George, Greene, Hancock, Harrison, Jackson, Jasper, Jefferson Davis, Jones, Lamar, Marion, Pearl River, Perry, Smith, Stone, Walthall, and Wayne Counties. It inhabits well-drained sandy soils associated with an open pine overstory and grassy groundcover. The proposed activities would not directly affect the gopher tortoise; however, the removal of mammalian predators by WS could reduce predation on young and nests, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

Ringed map turtle – The ringed map turtle generally inhabits clean rivers having a moderate current, an open canopy and numerous beaches and basking logs. Preferred nesting beaches consist of clean, fine-grained sand with a minimum of vegetative cover. This turtle is endemic to the Pearl and Bogue Chitto River drainages in Louisiana and Mississippi. The species is known to occur or is believed to occur in

Copiah, Hancock, Hinds, Lawrence, Leake, Madison, Marion, Neshoba, Pearly River, Rankin, Scott, and Simpson Counties. Damage management activities normally do not occur on large rivers and streams. Similar to other turtle species, the proposed activities would not directly affect ringed map turtles; however, the removal of mammalian predators by WS could reduce predation on adults, young, and nests, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

Yellow-blotched map turtle – The yellow-blotched map turtle occurs in the Pascagoula River and its larger tributaries, the Escatawpa River, the Leaf River, and the Chickasawhay River. It occasionally occurs in smaller tributaries of the Pascagoula River. The yellow-blotched map turtle occurs or is thought to occur in Clarke, Forrest, George, Greene, Jackson, Jones, Perry, Stone, and Wayne Counties of the State. This species requires rivers with good current and large sandbars for nesting. Damage management activities normally do not occur on large rivers and streams. Similar to other turtle species, the proposed activities would not directly affect yellow-blotched map turtles; however, the removal of mammalian predators by WS could reduce predation on adults, young, and nests, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

Alabama red-belly turtle - The Alabama red-belly turtle is only known to occur in Mississippi from the lower portions of the coastal streams between the Escatawpa River and the Biloxi River in waters under tidal influence (Mississippi Museum of Natural Science 2001). The proposed activities would not directly affect Alabama red-belly turtles; however, the removal of mammalian predators by WS could reduce predation on adults, young, and nests, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

Eastern indigo snake – This large snake is currently found along the southern coastal areas of Alabama, Georgia, and throughout most of Florida. No populations are currently known to occur in Mississippi. The indigo snake relies on a variety of habitats to complete its annual cycle. Eastern indigo snakes depend heavily on gopher tortoise burrows for shelter to escape the winter cold; thus, are commonly found near healthy longleaf pine (*Pinus palustris*) forest ecosystems. The proposed activities would not directly affect eastern indigo snakes; however, the removal of mammalian predators by WS could reduce predation on adults, young, and eggs, which could benefit the species if the species occurred in the State. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

Black pine snake - The black pine snake has been listed as a candidate for listing in Mississippi and is now being proposed as a threatened species. The pine snake is known to occur or thought to occur in Covington, Forrest, George, Greene, Harrison, Jackson, Jones, Lamar, Marion, Perry, Stone, and Wayne Counties. Pine snakes can be found in upland longleaf pine forests with sandy, well-drained soils with dense ground cover (USFWS 2013). The proposed activities would not directly affect black pine snakes; however, the removal of mammalian predators by WS could reduce predation on adults, young, and eggs, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

Dusky gopher frog – The dusky gopher frog is only known to occur at one location in Harrison County, Mississippi (see 77 FR 35118-35161). Gopher frogs are found breeding in wetland habitats characterized by ponds that are small (less than 10 acres), ephemeral, and acidic that are located in longleaf pine communities. During the non-breeding season, frogs can be found adjacent to breeding ponds in the longleaf pine forest and prefer areas that are maintained by fires that create open canopy and abundant herbaceous ground cover. The proposed activities would not directly affect dusky gopher frogs; however, the removal of mammalian predators by WS could reduce predation risks, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination. Based on the use patterns of methods available to manage damage caused by mammals, the proposed action would have no effect on any designated critical habitat in the State.

Gulf sturgeon –This anadromous fish is restricted to the Gulf of Mexico, the Mississippi River, and other large drainages. WS would not conduct activities under the proposed action alternative (Alternative 1) in this type of habitat; therefore, WS believes its activities will have no effect on this species, including any designated critical habitat in the State.

Pallid sturgeon - Pallid sturgeons require large, turbid, free-flowing riverine habitat and are usually found near the bottom of those rivers. This species has been found in the Mississippi River and large tributaries of the Mississippi River. WS would not conduct activities under the proposed action alternative (Alternative 1) in this type of habitat; therefore, WS believes its activities will have no effect on this species.

Alabama Sturgeon – The Alabama sturgeon was once found in the Tombigbee River in Mississippi; however, the species is not currently known to occur in the State. Based on the likely absence of the species from the State and the riverine habitats the species is known to occur in, WS has determined the proposed action (Alternative 1) would have no effect on the status of this species.

Pearl Darter - The pearl darter is also listed as a candidate species for listing in Mississippi. Historically, the pearl darter was only known from localized sites in the drainages of the Pearl River and the Pascagoula River in Mississippi and Louisiana. However, no darters have been collected from the Pearl River drainage since 1973, despite sampling efforts and they are considered extirpated from the Pearl River drainage (USFWS 2014). Currently, the pearl darter is believed to occur only in the Pascagoula River drainage, including the Pascagoula, Chickasawhay, Chunky, Leaf, and Bouie Rivers and Okatoma and Black Creeks in Mississippi (USFWS 2014). River habitat where darters have been collected has varied but the species is thought to inhabit rivers and large creeks in areas of moderate current, usually over sandy or gravel substrates at the edges of riffles or deep channels (USFWS 2014). Based on the use pattern of the methods and the locations where WS' personnel could use those methods, WS has determined Alternative 1 would have no direct effects on the status of the pearl darter; however, the removal of mammal predators could reduce predation risks. Therefore, Alternative 1 could benefit the pearl darter, which would warrant a may affect, not likely to adversely affect determination.

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

Bayou darter - The Bayou darter normally prefers swift, shallow water flowing over course gravel. They prefer larger streams and are not found in small tributaries. They occur only in Bayou Pierre and its larger tributaries (White Oak, Foster, and Turkey creeks) in Copiah, Claiborne, and Hinds Counties. Based on the use pattern of the methods and the locations where WS' personnel could use those methods, WS has determined Alternative 1 would have no direct effects on the status of the pearl darter; however, the removal of mammal predators could reduce predation risks. Therefore, Alternative 1 could benefit the pearl darter, which would warrant a may affect, not likely to adversely affect determination.

Louisiana black bear – The Louisiana black bear once occupied forestlands in Louisiana, Mississippi, and eastern Texas, with hardwood forests being the preferred habitat of bears. However, bears can also occur in other forested habitats where sufficient food, water, cover, and denning locations are available in large remote forested areas. Over 80% of the suitable habitat for black bears in Louisiana, Mississippi, and eastern Texas had been cleared for agricultural purposes by the time the bear was listed. With the clearing of suitable habitat, the quality of remaining habitat due to fragmentation and other human activities has been severely reduced (USFWS 2009*b*).

The Louisiana black bear is currently known to occur in southern Mississippi. Although reproduction has been documented to occur in Mississippi recently, critical habitat for Louisiana black bears has only been designated in Louisiana (see 74 FR 10349-10409). WS and many other entities (nuisance wildlife control operators, fur trappers, private landowners and managers) currently conduct management activities in areas where bears could be present. Although a very remote possibility of capturing a bear exists, it has never occurred in Mississippi while reducing damage caused by the target mammal species. Based on the use patterns of those methods available to address mammal damage, and the history of WS and all other entities resulting in no captures of bears, WS does not believe any of its mammal damage management activities would adversely affect Louisiana black bears. WS' activities may result in beneficial effects to the bear population by reducing competition for food sources if predators were removed. In addition, although bears are opportunistic foragers, none of the target mammal species appears to be major food sources for bears (Benson and Chamberlain 2006). Therefore, the removal of those target mammal species to alleviate damage would not reduce the availability of a major food source preferred by bears.

West Indian manatee – In Mississippi, manatees occur or thought to occur in Hancock, Harrison, and Jackson Counties along the coast. Manatees are an aquatic species occasionally found in larger drainages that empty into large saltwater bays and lakes or the Gulf of Mexico. WS does not conduct damage management activities in those types of environments; therefore, WS has determined that activities under the proposed action alternative (Alternative 1) would have no effect on this species, including any designated critical habitat.

Finback whale – The finback whale is a marine species that can occur along the coastal waters of Mississippi. WS would not conduct activities to manage damage caused by target mammal species in marine environments; therefore, activities will have no effect on this species.

Humpback whale - The humpback whale is a marine species that can occur along the coastal waters of Mississippi. WS would not conduct activities to manage damage caused by target mammal species in marine environments; therefore, activities will have no effect on this species.

Gray bat - The gray bat is currently known to occur in Tishomingo County, Mississippi in the extreme northeast corner of the State. Gray bats are found in caves throughout the year, with hibernation occurring in deep, vertical caves. During the summer, bats roost in caves along rivers in limestone karst areas of the southeastern United States. Based on the known locations of extant populations in the State, WS has determined the proposed action alternative (Alternative 1) would have no effect on the status of the gray bat in the State, including any designated critical habitat.

Indiana bat –The Indiana bat is known in Mississippi from one record that occurred in Tishomingo County and a recent record in Benton County. During 2013, a single radio tagged female Indiana bat spent multiple days in a roost tree in Benton County, Mississippi. Because the female bat spent multiple days in the roost tree, is was likely the site represented a maternity roost (K. Shelton, MDWFP pers.

comm. 2015). However, the current presence and range of the species in the State is unknown. The Indiana bat hibernates in caves; however, during warmer months, this bat species roosts within hollow trees and under bark where colonies of up to 100 females can be found. The proposed activities would not result in modifications to any caves and would not disturb any snags or other large trees the bats would utilize. Therefore, WS has concluded that the proposed activities would have no effect on the status of the Indiana bat.

Northern long-eared bat – The USFWS has listed the northern long-eared bat as a threatened species in Mississippi. The northern long-eared bat is a medium-sized bat found throughout much of the eastern United States. In general, the long-eared bat has been more common in the northern portion of their range than the southern and western portion. During the winter, long-eared bats are found in hibernacula that include caves and abandoned mines, where they are found most commonly roosting in small crevices and cracks, but have been observed in abandoned railroad tunnels, storm sewers, hydro-electric dam facilities, and wells. Where found, long-eared bats often occur in low numbers; however, their inconspicuous nature and preference for roosting in cracks and crevices can make surveying difficult. During the summer, long-eared bats are most commonly found roosting individually or in small colonies underneath bark or in cavities or crevices of live trees and snags. However, bats have also been observed roosting in caves, mines, and man-made structures, such as buildings, barns, park pavilions, sheds, cabins, and under the eaves of buildings, behind window shutters, and bat houses, during the summer. There are no summer records of long-eared bats in Mississippi (see 78 FR 61046-61080). The primary factor influencing the listing of the long-eared bat is the presence of white-nose syndrome, which has caused severe population declines.

The USFWS is currently proposing a species-specific rule under authority of section 4(d) of the ESA that outline the prohibitions, and exceptions to those prohibitions, necessary to provide for the conservation of the long-eared bat should the species warrant listing as an threatened species (see 80 FR 2371-2378). Under the current proposed rule, purposeful take of long-eared bats throughout its range would be prohibited except when removing northern long-eared bats from human dwellings and when authorized capture and handling of long-eared bats by individuals permitted to conduct those activities for other listed bats. In addition, in areas not affected by white nose syndrome[14], all incidental take resulting from any otherwise lawful activity would be exempt from prohibition.

The distribution and status of the long-eared bat in Mississippi is not well known. Although long-eared bats could be present in human dwellings, the likelihood of the species being present in a dwelling that requests assistance from WS would likely be minimal. No lethal take of bats has occurred previously by WS in Mississippi and WS receives relatively few requests for assistance associated with bats in the State. WS' personnel address most requests for assistance with technical assistance only and in limited cases, WS' personnel may install exclusion devices that allow bats to exit a structure but prevent re-entry or conduct structural repairs. When providing direct operational assistance to cooperators, WS would attempt to survey the bats to identify the species involved. If WS' personnel identified long-eared bats associated with a request for assistance, WS would recommend the property owner or manager contact the USFWS or WS' personnel would contact the USFWS directly to determine the appropriate action. Depending on the appropriate action, WS would conduct further consultation with the USFWS or obtain the appropriate permits when required. Therefore, the involvement of WS could benefit the species since WS' personnel would attempt to identify the species of bats before providing direct assistance. If WS anticipated take when providing assistance, further consultation with the USFWS would occur.

[14]The USFWS defined the portion of the long-eared bat range considered to be affected by white nose syndrome as that area within 150 miles of the boundary of counties within the United States or Canadian districts where the fungus *Pseudogymnoascus destructans* or white nose syndrome has been detected (see80 FR 2371-2378).

Florida panther – The Florida panther does not currently occur in the State. Based on the absence of the species from the State using current information, the proposed action alternative (Alternative 1) would have no effect on the status of the panther and any critical habitat.

Gray wolf - The gray wolf does not currently occur in the State. Based on the absence of the species from the State using current information, the proposed action alternative (Alternative 1) would have no effect on the status of the wolf and any critical habitat.

Piping plover – This bird winters along the coast and prefers tidal flats for feeding and sandy beaches for roosting. Plovers occur or thought to occur in Hancock, Harrison, and Jackson Counties along the coastal areas of the State. The removal of mammalian predators by WS could reduce predation risks on adults, young, and eggs of piping plovers, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination. Based on the use patterns of methods available to manage damage, the proposed action alternative would have no effect on any designated critical habitat in the State.

Interior least tern – This species has been found on sand bars along the Mississippi River and its tributaries. The removal of mammalian predators by WS could reduce predation risks on adults, young, and eggs of least terns, which could benefit the species. Therefore, WS has concluded the proposed activities could benefit the species by reducing predation risks, which would warrant a not likely to adversely affect determination.

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

Mississippi sandhill crane – The Mississippi sandhill crane can only be found on and adjacent to the Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, Mississippi. Mississippi sandhill cranes are non-migratory and many home ranges are no more than a few miles in size. Any activities that WS could conduct in and around the Mississippi Sandhill Crane National Wildlife Refuge would be limited to projects that are being conducted in coordination with and at the request of Refuge personnel. As such, all activities that WS conducts would occur in accordance with intraservice Section 7 consultations completed by the Refuge. Activities to alleviate mammal damage in Jackson County, Mississippi could provide some benefit to cranes by reducing mammal predators that may prey up adults, young, or eggs, which would reduce predation risks. Therefore, WS has determined Alternative 1 (proposed action) would not adversely affect the status of the Mississippi sandhill crane and any designated critical habitat.

Wood stork - Storks utilize freshwater and estuarine wetlands, primarily nesting in cypress or mangrove swamps. They feed in freshwater marshes, tidal creeks, and tidal pools. In Mississippi, wood stork occur or are thought to occur in Clarke, Jasper, Jones, Kemper, Lowndes, Monroe, Noxubee, Oktibbeha, Smith, and Wayne Counties. The proposed activities do not result in habitat destruction or modifications of habitat. Based on the habitat preferences of wood storks and the activities where damage management activities could occur, WS has determined the proposed activities would have no effect on the status of wood storks in the State, including any designated critical habitat.

Sprague’s pipit – The Sprague’s pipit is considered a candidate species for listing across their range. Their breeding range includes the native prairie regions of Upper Great Plains with their wintering range along the southern edge of the United States from southern Arizona across to southern Louisiana and northern Mexico to northwest Mississippi (see 78 FR 70104-70162). The pipit uses a wider range of grassland habitats on their winter ranges but appear to be strongly associated with native prairie habitats. The primary threats to the Sprague's pipit are habitat conversion (*e.g.*, land conversion, grazing, fire suppression, mowing, fragmentation) and energy development (*e.g.*, oil, gas, wind, roads). The proposed activities would not result in destruction or modification of native prairie habitats or result in direct take of pipits; however, removing predators in areas where pipits occur could reduce predation risks. Based on the potential beneficial effects associated with removing mammalian predators, WS has determined the proposed action alternative (Alternative 1) could provide some benefit to the pipit but would not likely adversely affect the status of the species.

Red Knot - The USFWS has listed the red knot as a threatened species. During the breeding season, red knots occur in the extreme northern artic region. Red knots winter primarily in intertidal marine habitats, especially near coastal inlets, estuaries, and bays. In Mississippi, red knots occur in marine habitats along the coast (Baker et al. 2013). Primary food sources include invertebrates, especially bivalves and crustaceans. Based on the use patterns of the methods available to alleviate damage and the areas where damage management activities could occur in relationship to areas where red knots are likely to occur, WS has concluded the proposed action (Alternative 1) would have no effect on the status of the red knot.

American chaffseed – This plant grows on pimple mounds with well-drained sandy soil imbedded in flat, poorly drained longleaf pine flatwoods savannah and may possibly occur in hilly upland long leaf pine country as well. Historically, two occurrences of American chaffseed were known in Mississippi; however, those locations no longer contain chaffseed. No current locations containing chaffseed exist in Mississippi and the species is likely extirpated from the State. Therefore, WS has determined the proposed activities would have no effect on the status of the American chaffseed in the State.

Price's potato-bean – In Mississippi, the price's potato-bean exists in four populations, two in Oktibbeha County, and one each in Clay and Lee Counties. The species occurs in well-drained loam soils on old alluvium or over limestone. Based on the use patterns of the methods available and the current known locations of potato-bean in the State, WS has concluded the proposed action alternative would have no effect on the status of this plant species. Methods do not cause major ground disturbance or cause habitat destruction.

Louisiana quillwort – This species inhabits gravel and sand bars on small and medium size streams. Currently, it is known only from two small populations in the Bogue Chitto drainage of Washington and St. Tammany Parishes. Based on the use patterns of the methods available and the current known locations of Louisiana quillwort in the State, WS has concluded the proposed action alternative would have no effect on the status of this plant species. Methods do not cause major ground disturbance or cause habitat destruction.

Pondberry – This plant prefers seasonally wet low areas among bottomland hardwoods, edges of cypress ponds, and shallow depression ponds of sandhills. In Mississippi, pondberry occurs in or is thought to occur in Bolivar, Sharkey, Sunflower, and Tallahatchie Counties. Based on the use patterns of the methods available and the current known locations of pondberry in the State, WS has concluded the proposed action alternative would have no effect on the status of this plant species. Methods do not cause major ground disturbance or cause habitat destruction.

White fringeless orchid - The white fringeless orchid has been designated as a candidate for listing in Mississippi by the USFWS. In Mississippi, the orchid is known from two records that were taken in Alcorn County in 1863 and another from Tishomingo County in 1974 (USFWS 2008*b*). The population in Alcorn County is thought to be extirpated. In Tishomingo County, the population where the first county record was described is believed to still be extant with an additional population located in the County since the first record was noted (USFWS 2008*b*). The fringeless orchid can be found in boggy areas at the head of streams and on slopes with water seepage (USFWS 2008*b*). Based on the use patterns of the methods available and the current known locations of the orchid in the State, WS has concluded the proposed action alternative would have no effect on the status of this plant species. Methods do not cause major ground disturbance or cause habitat destruction.

The WS' program in Mississippi would also consider the following recommendations made by the USFWS when conducting activities to alleviate the damage that mammals cause in the State:

- Avoid working in ponds where dusky gopher frogs are known to occur, avoid working in streams with listed mussels, fish, or turtles, avoid Mississippi sandhill crane nesting areas, avoid sea turtle and piping plover nesting areas (unless conducting activities to protect those species)
- When conducting ground-disturbing activities, the project site should be surveyed for potential roosting locations of T&E bat species, such as culverts, underpasses, caves, abandoned mines and buildings, wells, and snags. Because methods can disturb roosting bats offsite and result in abandonment of an area, activities should be conducted 500 yards away from any identified or potential roosting areas. Before using exclusion devices to manage damage associated with bats and depending on the time of year, WS' personnel will attempt to visually survey bats to insure there are no immature bats that could be separated from adults.
- In vegetated wetland areas, surveys for Mitchell's satyr butterflies, Price's potato bean, pondberry, and Louisiana quillwort should be conducted, if suitable habitat were present
- Forested areas with suitable habitat for red-cockaded woodpeckers should be surveyed
- Areas with suitable soils and vegetation should be surveyed for gopher tortoises
- Louisiana black bear breeding areas have been documented along the Mississippi River and no activities should take place during the breeding season in those locations
- Areas with suitable nesting/roosting trees within 0.5 miles of large water bodies, such as lakes, reservoirs, or rivers should be surveyed for wood storks and bald eagle activity.
- Chemical repellents should not be used in locations with protected species or their habitats.

Pursuant to Section 7 of the ESA, WS consulted with the USFWS on those effects analysis and determinations. The USFWS concurred with those effects determination made by WS for those species listed in Table 4.14 (K. Lunceford, USFWS pers. comm. 2015). Personnel from WS would have the experience and training to identify wildlife correctly and to select the most appropriate methods for capturing or removing targeted animals and excluding non-target species. Non-target animals would be individuals that WS captures or kills unintentionally because of mammal damage management. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that are as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. WS' personnel have not captured, killed, or otherwise adversely affected any T&E species during activities conducted previously within the State.

As described previously, methods available to resolve mammal damage in Mississippi involve resource management methods, physical exclusion methods, and population management methods. The actual methods applied to resolve requests for assistance would be based on the use of WS' Decision Model (Slate et al. 1992), which allows for an adaptive approach to managing damage or threats of damage. The Decision Model allows WS' personnel to apply site-specific factors into determining the appropriate methods for addressing damage or threats of damage while considering other known factors, such as the likely presence of T&E species in the area where methods would be employed.

State Listed Species – The current list of State listed species designated as endangered or threatened as determined by the Mississippi Museum of Natural Science 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. The MDWFP has concurred with WS' determination for State listed species (P. Sanderson, Mississippi Museum of Natural Science pers. comm. 2015).

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

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

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

The potential impacts of harassment and exclusion methods on non-target species would be similar to those described under the proposed action. Harassment and exclusion methods would be easily obtainable and simple to employ. Since identification of targets would occur when employing shooting as a method, the potential impacts to non-target species would likely be low under this alternative but would be based on the knowledge and experience of the person to identify the target species correctly.

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

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

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

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

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be directly involved with damage management activities in the State. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. Mammals would continue to be lethally removed when authorized by the MDWFP, removal would continue to occur during the regulated harvest seasons, and some mammal species could continue to be removed without the need for authorization from the MDWFP. Risks to non-targets and T&E species would continue to occur from those people who implement damage management activities on their own or through recommendations by other federal, state, and private entities. Although some risks could occur from those people that implement mammal damage management in the absence of any involvement by WS, those risks would likely be low, and would be similar to those risks under the other alternatives.

The ability to reduce negative effects caused by mammals to other wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative.

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

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

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

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

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

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

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

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

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

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

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

WS' employees would only administer immobilizing drugs to mammals that have been live-captured using other methods or administered through injection using a projectile (*e.g.*, dart gun). WS' employees could use immobilizing drugs to sedate animals that require handling (*e.g.*, during disease sampling) and/or animals being transported (*e.g.*, placed in an animal crate and transported to a release site). Sedating the animal could lessen the distress of the animal during the handling and/or transportation process. Drug delivery would likely occur on site with close monitoring of the animal to ensure proper care of the animal. Immobilizing drugs would be reversible with a full recovery of sedated animals occurring. Drugs used in capturing and handling wildlife that would be available include ketamine, a mixture of ketamine/Xylazine, and Telazol. A list and description of immobilizing drugs available for use under the identified alternatives can be found in Appendix B.

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

- All immobilizing drugs used in capturing and handling wildlife would be under the direction and authority of veterinary authorities, either directly or through procedures agreed upon between those authorities and WS.
- As determined on a state-level basis by those veterinary authorities (as allowed by AMDUCA), wildlife hazard management programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to the hunting or trapping season for the target species. This practice would avoid release of animals that may be consumed by hunters and/or trappers prior to the end of established withdrawal periods for the particular drugs used. Ear tagging or other marking of animals drugged and released to alert hunters and trappers that they should contact state officials before consuming the animal.

- Most animals administered immobilizing drugs would be released well before hunting/trapping seasons, which would give the drug time to metabolize completely out of the animals' systems before they might be harvested and consumed by people. In some instances, animals collected for control purposes would be euthanized when they were captured within a certain specified time period prior to the legal hunting or trapping season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems.

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

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

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

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

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 MDAC for the purchase and application of restricted-use pesticides. Risks to human safety would be limited primarily to the actual applicator due to the necessity to capture and inject GonaCon™ into each animal to be vaccinated. During the development of this EA, GonaCon™ was not registered for use in Mississippi; therefore, GonaCon™ would not be available for use within the State. However, this product could be registered for use in Mississippi and could be administered by MDWFP or their agents under any of the alternatives.

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

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

The recommendation by WS that mammals be harvested during the regulated hunting and/or trapping season that are established by the MDWFP 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 MDWFP for the regulated hunting and trapping season would further minimize risks associated with hunting and trapping. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized populations of mammals would not increase those risks.

CONSEQUENCES OF AERIAL WILDLIFE OPERATIONS ACCIDENTS

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

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

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

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

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

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

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

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

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

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

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

The use of chemical methods that are considered non-lethal could be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage damage caused by mammals in the State. Most repellents require ingestion of the chemical to achieve the desired effects on target species. Repellents that require ingestion are intended to discourage foraging on vulnerable resources and to disperse mammals from areas where the repellents were applied. Repellents, when used according to label directions, are generally regarded as safe especially when the ingredients are considered naturally occurring. Some risk of exposure to the chemical would occur to the applicator, as well as others, as the product was applied due to the potential for drift. Some repellents also have restrictions on whether application can occur on edible plants with some restricting harvest for a designated period after application. All restrictions on harvest and required personal protective equipment would be included on the label and if followed, would minimize risks to human safety associated with the use of those products.

The recommendation by WS that mammals be harvested during the regulated hunting and/or trapping season, which would be established by the MDWFP 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 MDWFP for the regulated hunting and trapping season would further minimize risks associated with those activities. Although hunting and trapping accidents do occur, the recommendation of allowing hunting or trapping to reduce localized mammal populations would not increase those risks.

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

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

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

Alternative 3 – No Mammal Damage Management Conducted by WS

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

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

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

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

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

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

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

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

All activities would be conducted where a request for assistance was received and only after the cooperator and WS had signed a MOU, work initiation document, or similar document. Some aesthetic value would be gained by the removal of some mammal species and the return of a more natural environment, including the return of native wildlife and plant species that may be suppressed or displaced by high mammal densities.

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

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

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

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

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

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

Alternative 3 – No Mammal Damage Management Conducted by WS

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

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

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

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

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

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

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

Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. With the multitude of attitudes on the meaning of humaneness and the varying perspectives on the most effective way to address damage and threats in a humane manner, agencies are challenged with conducting activities and employing methods that are perceived to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of WS would be to use methods as humanely as possible to resolve requests for assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

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

Therefore, the goal would be to address requests for assistance effectively using methods in the most humane way possible that minimizes the stress and pain to the animal. Overall, the use of resource management methods, harassment methods, and exclusion devices would be regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

Although some issues of humaneness could occur from the use of cage traps, foothold traps, reproductive inhibitors, translocation, immobilizing drugs, nets, and repellents, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of wildlife. Concerns from the use of those non-lethal methods would be from injuries to animals restrained in traps and from the stress of the animal while being restrained or during the application of the method. Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when people do not take action to alleviate conditions that cause pain or distress in animals.

WS' personnel would check methods in accordance with WS Directive 2.210 and WS Directive 2.450. Personnel would directly monitor some live-capture methods (*e.g*., drops nets, cannon nets, immobilizing drugs administered through a dart gun), which ensures that personnel could release non-target species quickly, if captured. In most cases, WS' personnel would check other live-traps (*e.g*., cage traps, foothold traps, restraining cables), which do not require direct monitoring, at least once every 24 hours or in accordance with Mississippi laws and regulations. Checking traps frequently would help ensure that personnel could release live-captured non-target species in a timely manner. Although stress could occur to animals restrained in a trap, timely attention to live-captured animals would alleviate suffering. Stress would likely be temporary.

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

The euthanasia methods that WS is considering for use under the proposed action for animal live-captured are carbon dioxide, carbon monoxide, gunshot, and barbiturates or potassium chloride in conjunction with general anesthesia. The AVMA considers those methods as acceptable for euthanasia and the use of those methods would meet the definition of euthanasia (AVMA 2013). The use of carbon dioxide, carbon monoxide, barbiturates, and potassium chloride for euthanasia would occur after the animal had been live-captured and would occur away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2013). WS' personnel that employ firearms to address mammal damage or threats to human safety would be aware of the proper placement of shots to ensure a timely and quick death.

Research and development by WS has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products were found practical, a certain amount of animal suffering could occur when some methods were used in situations where non-lethal damage management methods were not practical or effective. As stated previously, research suggests that some methods, such as restraint in foothold traps or changes in the blood chemistry of trapped animals, indicate "*stress*" (Kreeger et al. 1990). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011).

Personnel from WS would be experienced and professional in their use of management methods. Consequently, management methods would be implemented in the most humane manner possible. Many of the methods discussed in Appendix B to alleviate mammal damage and/or threats in the State could be used under any of the alternatives by those persons experiencing damage regardless of WS' direct involvement. The only methods that would have limited availability to those people experiencing damage associated with mammals would be reproductive inhibitors, immobilizing drugs, euthanasia chemicals, and the use of aircraft. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives since those methods could be employed by other entities in the absence of WS' involvement. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. SOPs that would be incorporated into WS' activities to ensure methods were used by WS as humanely as possible are listed in Chapter 3.

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

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

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

Alternative 3 – No Mammal Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of mammal damage management in Mississippi. 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.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

Cumulative impacts, as defined by the CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

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

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

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

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

The issue of the effects on target mammal species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats. As part of an integrated methods approach to managing damage and threats, WS could apply both lethal and non-lethal methods when requested by those persons experiencing damage.

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

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

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

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

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on mammal populations when targeting those species responsible for damage at the levels addressed in this EA. WS' actions would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but would not be limited to:

- Natural mortality of mammals
- Mortality through vehicle strikes, aircraft strikes, and illegal harvest
- Human-induced mortality of mammals through private damage management activities
- Human-induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

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

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

The populations of several wildlife species are sufficient to allow for annual harvest seasons that typically occur during the fall. The MDWFP establishes hunting and trapping seasons in the State for wildlife. With oversight of activities to alleviate damage associated with wildlife, the MDWFP maintains the ability to regulate removal by WS to meet management objectives for wildlife in the State. Therefore, the MDWFP would have the opportunity to consider the cumulative removal of wildlife as part of their objectives for wildlife populations in the State. WS' removal of mammals in Mississippi from FY 2009 through FY 2014 was of a low magnitude when compared to the total known removal of those species and the populations of those species. The anticipated annual removal of target wildlife species would also be of low magnitude when compared to estimated populations and the annual harvest of those species. Therefore, the proposed activities would not limit the ability of people to harvest target wildlife species in the State.

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

Historical outcomes of WS' damage management activities on mammals

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

SOPs built into the WS program

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

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

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

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

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

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according with WS' Directives and relevant federal, state, and local regulations. Chemical methods available for use under the proposed action would include repellents, reproductive inhibitors, fumigants, immobilizing drugs, and euthanasia chemicals, which are described in Appendix B. Except for repellents that would be applied directly to the affected resource and reproductive inhibitors that would be applied directly to target animals, those chemical methods available for use would be employed using baits that were highly attractive to target species, used in known burrow/den sites, and/or used in areas where exposure to non-targets would be minimal. The use of those methods often requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to product labels, which would ensure that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals would also ensure non-target hazards would be minimal.

Repellents may be used or recommended by the WS program in Mississippi 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 Mississippi when used according to label requirements.

The amount of chemicals used or stored by WS would be minimal to ensure human safety. All label requirements of repellents and toxicants would be followed to minimize non-target hazards. Based on this information, WS' use of chemical methods, as part of the proposed action, would not have cumulative impacts on non-targets. The methods described in Appendix B have a high level of selectivity and could be employed using SOPs to ensure minimal impacts to non-target species. The unintentional removal of wildlife would likely be limited and would not reach a magnitude where adverse effects would occur.

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

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

Non-chemical methods described in Appendix B would be used within a limited period, would not be residual, and do not possess properties capable of inducing cumulative effects on human health and safety. Non-chemical methods would be used after careful consideration of the safety of those persons employing methods and to the public. When possible, capture methods would be employed where human activity was minimal to ensure the safety of the public. Capture methods also require direct contact to trigger ensuring that those methods, when left undisturbed, would have no effect on human safety. All methods would be agreed upon by the requesting entities, which would be made aware of the safety issues of those methods when entering into a MOU, work initiation document, or another comparable document between WS and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or remove wildlife. Firearms used to alleviate or prevent damage, though hazards do exist, would be employed to ensure the safety of employees and the public.

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

Repellents to disperse mammals from areas of application would be available. Repellents must be registered with the EPA according to the FIFRA and registered with the MDAC. 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 must also be registered for use with the EPA and the MDAC. Given the use patterns of repellents, and fumigants, no cumulative effects would occur to human safety.

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

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

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

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

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

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

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

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

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

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

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS

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APPENDIX A
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APPENDIX B
METHODS AVAILABLE FOR RESOLVING OR PREVENTING MAMMAL DAMAGE IN MISSISSIPPI

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

In selecting damage management techniques for specific damage situations, consideration would be given to the responsible species and the magnitude, geographic extent, duration and frequency, and likelihood of wildlife damage. Consideration would also be given to the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. Those factors would be evaluated in formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to the WS program in Mississippi 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 Mississippi. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

Non-chemical Wildlife Damage Management Methods

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

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing of small critical areas can sometimes prevent animals that cannot climb from entering areas of protected resources. Fencing installed with an underground skirt, can prevent access to areas for many mammal species that dig, including fox, feral cats, and striped skunks. Areas such as airports, yards, or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and gnawing of valuable trees and to prevent the entry of mammals into buildings through existing holes or gaps. Riprap can also be used on dams and levees to deter woodchuck burrowing. Exclusion and one-way devices such as netting or nylon window screening can be used to exclude bats from a building or an enclosed structure (Greenhall and Frantz 1994). Electric fences of various constructions have been used effectively to reduce damage to various crops by deer, raccoons, and other species (Boggess 1994, Craven and Hygnstrom 1994).

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

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

Supplemental feeding is sometimes used to reduce damage by wildlife, such as lure crops. Food is provided so that the animal causing damage would consume it rather than the resource being protected. In feeding programs, target wildlife would be offered an alternative food source with a higher appeal with the intention of luring them from feeding on affected resources.

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. Those techniques are usually aimed at causing target animals to respond by fleeing from the site or remaining at a distance. They usually employ extreme noise or visual stimuli. Unfortunately, many of these techniques are only effective for a short time before wildlife habituate to them (Conover 1982). Devices used to modify behavior in mammals include electronic guards (siren strobe-light devices), propane exploders, pyrotechnics, laser lights, human effigies, effigies of predators, and the noise associated with the discharge of a firearm.

Live Capture and Translocation can be accomplished using hand capture, hand nets, catch poles, cage traps, suitcase type traps, cable restraints, or with foothold traps to capture some mammal species for the purpose of translocating them for release in other areas. WS could employ those methods in Mississippi when the target animal(s) can legally be translocated or can be captured and handled with relative safety by WS' personnel. Live capture and handling of mammals poses an additional level of human health and safety threat if target animals are aggressive, large, or extremely sensitive to the close proximity of people. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. The AVMA, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission, particularly for small mammals, such as raccoons or skunks (CDC 1990). Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise in Mississippi 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 MDWFP.

Trapping can utilize a number of devices, including nets, foothold traps, cage-type traps, body-gripping traps, foot snares, and neck/body snares. Those techniques would be implemented by WS' personnel because of the technical training required to use such devices.

Drop nets are nylon or cloth nets that would be suspended above an area actively used by an animal or group of animals where target individuals have been conditioned to feed (Ramsey 1968). The area would be baited and once feeding occurs under the net, the net would be released. Drop nets require constant supervision by personnel to drop the net when target individuals were present and when animals were underneath the net. This method has limited use due to the time and effort required to condition animals to feed in a location and the required monitoring of the site to drop the net when target wildlife were present. Nets are used to live-capture target individuals and if any non-targets are present, they can be released on site unharmed. Drop nets allow for the capture of several animals during a single application. Injuries to animals do occur from the use of nets. Injuries to deer occurred when using drop nets with the rate of injury being correlated with the number of deer captured during a single application of the net (Haulton et al. 2001). Nets are not generally available to the public.

Cannon nets use nylon or cloth nets to capture wildlife that have been conditioned to feed in a given area through baiting (Hawkins et al. 1968). When using cannon nets, the net is fully deployed to determine the capture area when fired. Once the capture zone has been established, the net is rolled up upon itself and bait is placed inside the zone to ensure feeding wildlife are captured. When target animals are feeding at the site and within the capture zone of the net, the launcher is activated by personnel near the site, which launches the net over the target wildlife. The net is launched using small explosive charges and weights or compressed air. Only personnel trained in the safe handling of explosive charges would be allowed to employ rocket nets when explosive charges were used. Pneumatic cannon nets could also be used, which propels the net using compressed air instead of small explosive charges. Cannon nets require personnel to be present at the site continually to monitor for feeding. Similar to drop nets, cannon nets can be used to capture multiple animals during a single application. Similar to drop nets, injury rates for cannons nets appear to be correlated with the number of animals captured during a single application of the net (Haulton et al. 2001). Non-targets incidentally captured can be released on site unharmed. Cannon nets would generally not be available for use by the public and would not be available for use by the public under Alternative 2 and Alternative 3 except by the MDWFP or other natural resource agencies. An entity may be required to obtain authorization from the MDWFP to use cannon nets.

Foothold Traps can be effectively used to capture a variety of mammals. Foothold traps can be placed beside or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target animals. Effective trap placement and adjustment and the use and placement of appropriate baits and lures by trained WS' personnel also contribute to the selectivity of foothold traps. An additional advantage is that foothold traps can allow for the on-site release of non-target animals since animals are captured alive. The use of foothold traps requires more skill than some methods. Foothold traps would generally be available for use by the public and other state or federal agencies.

Cable Restraints are typically made of wire or cable, and can be set to capture an animal by the neck, body, or foot. Cable restraints may be used as either lethal or live-capture devices depending on how or where they are set. Cable restraints set to capture an animal by the neck are usually lethal but stops can be attached to the cable to increase the probability of a live capture depending on the trap check interval. Snares positioned to capture the animal around the body can be a useful live-capture device, but are more often used as a lethal control technique. Snares can incorporate a breakaway feature to release non-target wildlife and livestock where the target animal is smaller than potential non-targets (Phillips 1996). Snares can be effectively used wherever a target animal moves through a restricted travel lane (*e.g.*, under fences or trails through vegetation). When an animal moves forward into the loop formed by the cable, the noose tightens and the animal is held. Snares must be set in locations where the likelihood of capturing non-target animals would be minimized.

The foot or leg snare can be set as a spring-powered non-lethal device, activated when an animal places its foot on the trigger or pan. In some situations, using snares to capture wildlife is impractical due to the behavior or morphology of the animal, or the location of many wildlife conflicts. In general, cable restraints would be available to all entities to alleviate damage.

Cage traps come in a variety of styles to live-capture animals. The most commonly known cage traps are box traps and corral traps. Box traps are usually rectangular and are made from various materials, including metal, wire mesh, plastic, and wood. These traps are well suited for use in residential areas and work best when baited with foods attractive to the target animal. Box traps are generally portable and easy to set-up. Cage traps would be available to all entities to alleviate damage.

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

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

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

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

Body-grip Traps are designed to cause the quick death of the animal that activates the trap, such as conibear traps. The conibear trap consists of a pair of rectangular wire frames that close like scissors when triggered, killing the captured animal with a quick body blow. For conibear traps, the traps should be placed to ensure the rotating jaws close on either side of the neck of the animal to ensure a quick death. Conibear traps are lightweight and easily set. Snap traps are common household rat or mouse traps. These traps are often used to collect and identify rodent species that cause damage so that species-specific control tools can be applied, such as identifying the prey base at airports. Spring-powered harpoon traps are used to control damage caused by surface-tunneling moles. Soil is pressed down in an active tunnel and the trap is placed at that point. When the mole reopens the tunnel, it triggers the trap. Two variations of scissor like traps are also used in tunnels for moles. Safety hazards and risks to people are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to non-target animals. Selectivity of body-grip traps can be enhanced by placement, trap size, trigger configurations, and baits. When using body-grip traps, risks of non-target capture can be minimized by using recessed sets (placing trap inside a cubby, cage, or burrow), restricting openings, or by elevating traps. Choosing appropriately sized traps for the target species can also exclude non-targets by preventing larger non-targets from entering and triggering the trap. The trigger configurations of traps can be modified to minimize non-target capture. For example, offsetting the trigger can allow non-targets to pass through conibear traps without capture. Body-grip traps would be available for use by all entities.

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

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

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

Denning is the practice of locating coyote or fox dens and killing the young, adults or both to stop an ongoing predation problem or prevent future depredation of livestock. Coyote and red fox depredations on livestock often increase in the spring and early summer due to the increased food requirements associated with feeding and rearing litters of pups. Removal of pups will often stop depredations even if the adults are not taken (Till 1992). Pups are typically euthanized in the den using a registered gas fumigant cartridge or by digging out the den and euthanizing the pups with sodium pentobarbital (see discussion of gas cartridges and sodium pentobarbital under *Chemical Wildlife Damage Management Methods*).

Hunting/Trapping is sometimes recommended by WS to resource owners. WS could recommend 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 urban-suburban areas, it can be used to reduce some populations of mammals.

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

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

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

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

Aerial Surveying is a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of wildlife. WS uses aerial surveying throughout the United States to monitor damages and/or populations of coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, mountain lions, white-tailed deer, pronghorn antelope, elk, big-horn sheep, and wild horses but any wildlife species big enough to see from a moving aircraft could be surveyed using this method. As with aerial shooting, the WS program aircraft-use policy helps ensure that aerial surveys are conducted in a safe and environmentally sound manner, in accordance with federal and state laws. Pilots and aircraft must also be certified under established WS program procedures and policies.

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

Chemical Wildlife Damage Management Methods

All pesticides used by WS would be registered under the FIFRA and administered by the EPA and the MDAC. All WS personnel in Mississippi who apply restricted-use pesticides would be certified pesticide applicators by MDAC and have specific training by WS for pesticide application. The EPA and the MDAC require pesticide applicators to adhere to all certification requirements set forth in the FIFRA. Pharmaceutical drugs, including those used in wildlife capture and handling, are administrated by the United States Food and Drug Administration and/or the United States Drug Enforcement Administration.

Chemicals would not be used by WS on public or private lands without authorization from the land management agency or property owner or manager. The following chemical methods have been proven to be selective and effective in reducing damage by mammals.

GonaCon™ was developed by scientists with the NWRC as a reproductive inhibitor. GonaCon™ is a new single dose immunocontraceptive vaccine. Recent studies have demonstrated the efficacy of this single-shot GnRH vaccine on California ground squirrels, Norway rats, feral cats and dogs, feral swine, wild horses, and white-tailed deer. Infertility among treated female swine and white-tailed deer has been documented for up to two years without requiring a booster vaccination (Miller et al. 2000). This vaccine overcomes one of the major obstacles of previous two dose vaccines since target wildlife need to be captured only once for vaccination instead of twice. A single-injection vaccine would be much more practical as a field delivery system for use on free-ranging animals.

GonaCon™ was officially registered by the EPA in 2009 for use in reducing fertility in female white-tailed deer under EPA registration number 56228-40. GonaCon™ is registered as a restricted-use pesticide available for use by WS' personnel and personnel of a state wildlife management agency or persons under their authority. Additionally, in order for GonaCon™ to be used in any given state, the product must also be registered with the state and approved for use by the appropriate state agency responsible for managing wildlife. GonaCon™, when injected into the body, elicits an immune response that neutralizes the GnRH hormone being produced naturally by deer. The GnRH hormone in deer stimulates the production of other sexual hormones, which leads to the body reaching a reproductive state. The vaccine neutralizes the GnRH hormone being produced, which then prevents the production of other sexual hormones in the deer vaccinated; thereby, preventing the body of the deer from entering into a reproductive state (USDA 2010*b*).

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

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

Xylazine is a sedative (analgesic) that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia. It can also be used alone to facilitate physical restraint. Because xylazine is not an anesthetic, sedated animals are usually responsive to stimuli. Therefore, personnel should be even more attentive to minimizing sight, sound, and touch. When using ketamine/xylazine combinations, xylazine will usually overcome the tension produced by ketamine, resulting in a relaxed, anesthetized animal (Johnson et al. 2001). This reduces heat production from muscle tension, but can lead to lower body temperatures when working in cold conditions.

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (AVMA 2013). Sodium pentobarbital would only be administered after target animals were live-captured and properly immobilized to allow for direct injection. There are United States Drug Enforcement Administration restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified WS' personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with United States Drug Enforcement Administration and state regulations. All animals euthanized using sodium pentobarbital and all of its dilutions (*e.g.* Beuthanasia-D, Fatal-Plus) are disposed of immediately through incineration or deep burial to prevent secondary poisoning of scavenging animals and introduction of these chemicals to non-target animals.

Potassium Chloride used in conjunction with prior general anesthesia is used as a euthanasia agent for animals, and is considered acceptable and humane by the AVMA (2013). Animals that have been euthanized with this chemical experience cardiac arrest followed by death, and are not toxic to predators or scavengers.

Beuthanasia®-D combines pentobarbital with another substance to hasten cardiac arrest. Intravenous (IV) and intracardiac (IC) are the only acceptable routes of injection. As with pure sodium pentobarbital, IC injections with Beuthanasia®-D are only acceptable for animals that are unconscious or deeply anesthetized. With other injection routes, there are concerns that the cardiotoxic properties may cause cardiac arrest before the animal is unconscious. It is a Schedule III drug, which means it can be obtained directly from the manufacturer by anyone with a United States Drug Enforcement Administration registration. However, Schedule III drugs are subject to the same security and record-keeping requirements as Schedule II drugs.

Fatal-Plus® combines pentobarbital with other substances to hasten cardiac arrest. IV is the preferred route of injection; however, IC is acceptable as part of the two-step procedure used by WS. Animals are first anesthetized and sedated using a combination of ketamine/Xylazine and once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered. Like Beuthanasia®-D, it is a Schedule III drug requiring a United States Drug Enforcement Administration registration for purchase and is subject to the security and record-keeping requirements of Schedule II drugs.

Carbon dioxide is sometimes used to euthanize mammals that are captured in live traps and when relocation is not a feasible option. Live mammals are placed in a sealed chamber. Carbon dioxide gas is released into the chamber and the animal quickly dies after inhaling the gas. This method is approved as a euthanizing agent by the AVMA. Carbon dioxide gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is the gas released by dry ice. The use of carbon dioxide by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

Repellents are usually naturally occurring substances or chemicals formulated to be distasteful or to elicit pain or discomfort for target animals when they are smelled, tasted, or contacted. Only a few repellents are commercially available for mammals, and are registered for only a few species. Repellents would not be available for many species that may present damage problems, such as some predators or furbearing species. Repellents are variably effective and depend largely on the resource to be protected, time and length of application, and sensitivity of the species causing damage. Again, acceptable levels of damage control would usually not be realized unless repellents were used in conjunction with other techniques.

Gas cartridges (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are registered by WS with the MDAC 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, Wallace 1987). The gas along with other components of the cartridge, are likely to form oxides of nitrogen, carbon, phosphorus, and sulfur. Those products are environmentally non-persistent because they are likely to be metabolized by soil microorganisms or they enter their respective elemental cycles. In rodent cartridges, sodium nitrate is combined with seven additional ingredients: sulfur, charcoal, red phosphorus, mineral oil, sawdust, and two inert ingredients. None of the additional ingredients in this formulation is likely to accumulate in soil, based on their degradation into simpler elements by burning the gas cartridge. Sodium nitrate is not expected to accumulate in soils between applications, nor does it accumulate in the tissues of target animals (EPA 1991). The EPA stated sodium nitrates "*...as currently registered for use as pesticides, do not present any unreasonable adverse effects to humans*" (EPA 1991).

APPENDIX C
STATE LISTED THREATENED AND ENDANGERED SPECIES

MISSISSIPPI NATURAL HERITAGE PROGRAM

Listed Species of Mississippi

- 2015 -

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
BIVALVIA					
Actinonaias ligamentina	Mucket	G5	S1		LE
Cyclonaias tuberculata	Purple Wartyback	G5	S1		LE
Elliptio arctata	Delicate Spike	G3G4	S1		LE
Elliptio dilatata	Spike	G5	S1		LE
Epioblasma brevidens	Cumberlandian Combshell	G1	S1	(LE,XN)	LE
Epioblasma penita	Southern Combshell	G1	S1	LE	LE
Epioblasma triquetra	Snuffbox	G3	S1	LE	LE
Hamiota perovalis	Orange-Nacre Mucket	G2	S1	LT	LE
Medionidus acutissimus	Alabama Moccasinshell	G2	S1	LT	LE
Plethobasus cyphyus	Sheepnose	G3	S1	LE	LE
Pleurobema curtum	Black Clubshell	G1	SX	LE	LE
Pleurobema decisum	Southern Clubshell	G2	S1	LE	LE
Pleurobema marshalli	Flat Pigtoe	GH	SX	LE	LE
Pleurobema perovatum	Ovate Clubshell	G1	S1	LE	LE
Pleurobema rubrum	Pyramid Pigtoe	G2	S1		LE
Pleurobema taitianum	Heavy Pigtoe	G1	SX	LE	LE
Pleuronaia dolabelloides	Slabside Pearlymussel	G2	S1	LE	LE
Potamilus capax	Fat Pocketbook	G1	S1	LE	LE
Potamilus inflatus	Inflated Heelsplitter	G1G2Q	SH	LT	LE
Ptychobranchus fasciolaris	Kidneyshell	G4G5	S1		LE
Quadrula cylindrica cylindrica	Rabbitsfoot	G3T3	S1	LT	LE
Quadrula metanevra	Monkeyface	G4	SX		LE
Quadrula stapes	Stirrupshell	GH	SX	LE	LE
MALACOSTRACA					
Fallicambarus gordoni	Camp Shelby Burrowing Crawfish	G1	S1	C	LE
INSECTA					
Nicrophorus americanus	American Burying Beetle	G2G3	SX	LE	LE
Neonympha mitchellii mitchelli	Mitchell's Satyr	G2T2	S1	LE	LE
OSTEICHTHYES					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	G3T2	S1	LT	LE
Scaphirhynchus albus	Pallid Sturgeon	G1	S1	LE	LE
Scaphirhynchus suttkusi	Alabama Sturgeon	G1	SH	LE	LE
Notropis boops	Bigeye Shiner	G5	S1		LE
Notropis chalybaeus	Ironcolor Shiner	G4	S1		LE
Phenacobius mirabilis	Suckermouth Minnow	G5	S1		LE
Phoxinus erythrogaster	Southern Redbelly Dace[1]	G5	S2		LE
Crystallaria asprella	Crystal Darter	G3	S1		LE
Etheostoma blennioides	Greenside Darter	G5	S1		LE
Etheostoma rubrum	Bayou Darter	G1	S1	LT	LE

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
Percina aurora	Pearl Darter	G1	S1	C	LE
Percina phoxocephala	Slenderhead Darter	G5	S1		LE
Noturus exilis	Slender Madtom	G5	S1		LE
Noturus munitus	Frecklebelly Madtom	G3	S2		LE
Noturus gladiator	Piebald Madtom	G3	S1		LE
AMPHIBIA					
Rana sevosa	Dusky Gopher Frog	G1	S1	LE	LE
Amphiuma pholeter	One-Toed Amphiuma	G3	S1		LE
Cryptobranchus alleganiensis	Hellbender	G3G4	S1	(PS)	LE
Aneides aeneus	Green Salamander	G3G4	S1		LE
Eurycea lucifuga	Cave Salamander	G5	S1		LE
Gyrinophilus porphyriticus	Spring Salamander	G5	S1		LE
REPTILIA					
Drymarchon corais couperi	Eastern Indigo Snake	G3	SX	LT	LE
Farancia erytrogramma	Rainbow Snake	G5	S2		LE
Heterodon simus	Southern Hognose Snake	G2	SX		LE
Pituophis melanoleucus lodingi	Black Pine Snake	G4T3	S2	C	LE
Caretta caretta	Loggerhead; Cabezon	G3	S1B,SNA	LT	LE
Chelonia mydas	Green Turtle	G3	SNA	(LE,LT)	LE
Eretmochelys imbricata	Hawksbill; Carey	G3	SNA	LE	LE
Lepidochelys kempii	Kemp's Or Atlantic Ridley	G1	S1N	LE	LE
Dermochelys coriacea	Leatherback; Tinglar	G2	SNA	LE	LE
Graptemys flavimaculata	Yellow-Blotched Map Turtle	G2	S2	LT	LE
Graptemys nigrinoda	Black-Knobbed Map Turtle	G3	S2		LE
Graptemys oculifera	Ringed Map Turtle	G2	S2	LT	LE
Pseudemys alabamensis	Alabama Redbelly Turtle	G1	S1	LE	LE
Gopherus polyphemus	Gopher Tortoise	G3	S2	(PS:LT)	LE
AVES					
Charadrius nivosus	Southeastern Snowy Plover	G4T3Q	S2		LE
Charadrius melodus	Piping Plover	G3	S2N	(LE,LT)	LE
Sternula antillarum athalassos	Interior Least Tern[3]	G4T2Q	S2B	(PS:LE)	LE
Calidris canutus	Red Knot	G5	S2N	LT	
Mycteria americana	Wood Stork	G4	S2N	(PS:LT)	LE
Falco peregrinus	Peregrine Falcon	G4	S1N		LE
Grus canadensis pulla	Mississippi Sandhill Crane	G5T1	S1	LE	LE
Vermivora bachmanii	Bachman's Warbler	GH	SXB	LE	LE
Thryomanes bewickii	Bewick's Wren	G5	S2B,S3N		LE
Pelecanus occidentalis	Brown Pelican	G4	S1N		LE
Campephilus principalis	Ivory-Billed Woodpecker	GH	SX	LE	LE
Picoides borealis	Red-Cockaded Woodpecker	G3	S1	LE	LE

MISSISSIPPI NATURAL HERITAGE PROGRAM

Listed Species of Mississippi

- 2015 –

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
MAMMALIA					
Puma concolor coryi	Florida Panther	G5T1	SX	LE	LE
Ursus americanus	Black Bear	G5	S1	(PS)	LE
Ursus americanus luteolus	Louisiana Black Bear	G5T2	S1	LT	LE
Myotis grisescens	Gray Myotis	G3	S1	LE	LE
Myotis sodalis	Indiana Or Social Myotis	G2	S1B	LE	LE
Trichechus manatus	Manatee	G2	SZ	LE	LE
PLANTS [3]					
DICOTYLEDONEAE					
Apios priceana	Price's Potato Bean	G2	S1	LE	
Lindera melissifolia	Pondberry	G2	S2	LE	
Schwalbea americana	Chaffseed	G3	SH	LE	
ISOETOPSIDA					
Isoetes louisianensis	Louisiana Quillwort	G3	S2	LE	

[1] *West Mississippi disjunct populations only.*

[2] *Interior populations nesting along the Mississippi River only.*

[3] *Mississippi has no status concerning endangered plants.*

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