ENVIRONMENTAL ASSESSMENT

MAMMAL DAMAGE MANAGEMENT IN THE TENNESSEE WILDLIFE SERVICES PROGRAM

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

IN COOPERATION WITH

U.S. TENNESSEE VALLEY AUTHORITY (TVA)

October 2005

TABLE OF CONTENTS

Lists of Tables and Figures .....

List of Tables .....

Table 1.1 Wildlife Diseases That Pose Potential Human Health Risks in the South-Eastern United States ..... 1 - 4

Table 3.1 Summary of Example Cooperative MDM Programs with Derived Grades and Calculated Score from Pooled Results for the Purpose of Determining Success in Meeting Overall MDM Program Objectives ..... 3 - 7

Table 5.1 Number of Animals Killed by WS FY 1998 – 2002 ..... 5 - 2

Table 5.2 Bats Found in Tennessee ..... 5 - 3

Table 5.3 Turtles (Except Box Turtles) Found in Tennessee ..... 5 -47

Table 5.4 Alternative Effects on Issue Compared ..... 5 -64

List of Figures .....

Figure 4.1 APHIS – WS Decision Model ..... 4 -6

ACRONYMS vii

1.0 CHAPTER 1: PURPOSE AND NEED FOR ACTION ..... 1 - 1

1.1 INTRODUCTION ..... 1 - 1

1.1.1 The Tennessee WS Program ..... 1 - 2

1.2 PURPOSE ..... 1 - 3

1.3 NEED FOR ACTION ..... 1 - 3

1.3.1 Summary of Proposed Action 1 - 3

1.3.2 Need for Mammal Damage Management to Protect Human Health and Safety ..... 1 - 3

1.3.3 Need for Mammal Damage at Airports ..... 1 - 7

1.3.4 Need for Mammal Damage Management to Protect Agriculture ..... 1 - 8

1.3.5 Need for Mammal Damage Management to Protect Natural Resources Including Threatened and Endangered Species ..... 1 - 9

1.3.6 Need for Mammal Damage Management to Protect Property ..... 1 - 10

1.4 WS RECORD KEEPING REGARDING REQUESTS FOR MAMAL DAMAGE MANAGEMENT ASSISTANCE ..... 1 - 11

1.5 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS ... 1 - 11

1.5.1 ADC Programmatic Environmental Impact Statement ..... 1 - 11

1.5.2 Environmental Assessment and Finding of No Significant Impact – Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Foxes, and Coyotes in the United States ..... 1 - 11

1.6 DECISION TO BE MADE ..... 1 - 12

1.7 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ..... 1 - 12

1.7.1 Actions Analyzed ..... 1 - 12

1.7.2 Period for Which This EA is Valid ..... 1 - 12

1.7.3 Site Specificity ..... 1 - 12

1.7.4 American Indian Lands and Tribes ..... 1 - 13

1.7.5 Summary of Public Involvement ..... 1 - 13

1.8 AUTHORITY AND COMPLICANCE ..... 1 - 13

1.8.1 Authority of Federal and State Agencies in Mammal Damage Management In Tennessee ..... 1 - 13

1.8.1.1 WS Legislative Authorities ..... 1 - 13

1.8.1.2 Tennessee Wildlife Resources Agency (TWRA) ..... 1 - 13

1.8.1.3 Tennessee Department of Agriculture (TDA) ..... 1 - 14

1.8.1.4 U.S. Fish and Wildlife Service (USFWS) ..... 1 - 14

1.8.1.5 Natural Resource Conservation Service (NRCS) ..... 1 - 14

1.8.1.6 U.S. Army Corps of Engineers (COE) ..... 1 - 14

1.8.1.7 U.S. Environmental Protection Agency (EPA) ..... 1 - 14

1.8.1.8 U.S. Tennessee Valley Authority (TVA)..... 1 - 14

1.8.2 Compliance with Other Federal Laws ..... 1 - 15
1.8.2.1 National Environmental Policy Act (NEPA) ..... 1 - 15
1.8.2.2 Endangered Species Act (ESA) ..... 1 - 15
1.8.2.3 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) ..... 1 - 15
1.8.2.4 National Historic Preservation Act (NHPA) of 1966 as Amended ... 1 - 15
1.8.2.5 The Clean Water Act (33.U.S.C. 1344) ..... 1 - 16
1.8.2.6 Executive Order 13122 On Invasive Species ..... 1 - 16
1.8.2.7 Food Security Act ..... 1 - 16
1.8.2.8 Native American Graves Protection and Repatriation Act ..... 1 - 16
1.8.2.9 Environmental Justice and Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low – Income Populations ..... 1 - 16
1.8.2.10 Protection of Children from Environmental Health and Safety Risks (Executive Order 13045) ..... 1 - 17
1.8.2.11 Federal Food, Drug, and Cosmetic Act (21 U.S.C. 360)..... 1 - 17
1.8.2.12 Controlled Substance Act of 1970 (21 U.S.C. 821 et seq.)..... 1 - 17
1.8.2.13 Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA). 1 - 17
1.8.3 Memorandum Of Understanding (MOU) Between Various Agencies and WS In Tennessee ..... 1 - 18
2.0 CHAPTER 2: ISSUES ..... 2 - 1
2.1 AFFECTED ENVIRONMENT..... 2 - 1
2.2 SUMMARY OF ISSUES ..... 2 - 1
2.3 ISSUES ADDRESSED IN THE ANALYSIS OF ALTERNATIVES ..... 2 - 1
2.3.1 Effects on Wildlife ..... 2 - 1
2.3.1.1 Effects on Target Mammal Species Populations ..... 2 - 1
2.3.1.2 Effects on Nontarget Species Populations, Including T&E Species ..... 2 - 2
2.3.2 Effects on Human Health and Safety ..... 2 - 2
2.3.2.1 Safety and Efficacy of Chemical Control Methods Used in MDM ..... 2 - 2
2.3.2.2 Effects on Human Health and Safety from Non-Chemical MDM Methods ..... 2 - 3
2.3.2.3 Effects on Human Health and Safety from Not Conducting MDM to Reduce Disease Threats or Outbreaks and Mammal Strike Hazards at Airports ..... 2 - 3
2.3.3 Effects on the Socio-cultural Elements and Economics of the Human Environment ..... 2 - 4
2.3.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species ..... 2 - 4
2.3.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals... 2 - 5
2.3.4 Effects on Wetlands ..... 2 - 5
2.3.5 Humaneness and Animal Welfare Concerns of Methods Used by WS ..... 2 - 7
2.3.5.1 Humaneness of Using Drowning Sets for Euthanizing Beavers and Muskrats ..... 2 - 7
2.4 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE ..... 2 - 9
2.4.1 Appropriateness of Preparing an EA (Instead of an EIS) for Such a Large Area ..... 2 - 9
2.4.2 Effects on Public Use of Mammals ..... 2 - 9
2.4.3 WS's Effect on Biodiversity ..... 2 - 10
2.4.4 Wildlife Damage is a Cost of Doing Business – a "Threshold of Loss" Should Be Established Before Allowing Any Lethal Mammal Damage Management ..... 2 - 10
2.4.5 Wildlife Damage Management Should Not Occur at Taxpayer Expense But Should Be Fee-Based ..... 2 - 10
2.4.6 Cost Effectiveness of MDM ..... 2 - 10

3.0 CHAPTER 3: OBJECTIVES ..... 3 - 1
3.1 SUMMARY OF OBJECTIVES ..... 3 - 1
3.2 DESCRIPTION OF OBJECTIVES ..... 3 - 1
3.2.1 Reductions in Damage to Agriculture ..... 3 - 1
3.2.2 Reductions in Mammal-caused Human Health and Safety Incidents ..... 3 - 2
3.2.3 Reductions in Damage to Property Caused by Mammals ..... 3 - 2
3.2.4 Reduction in Damage to Natural Resources Caused by Mammals ..... 3 - 2
3.3 METHODS FOR MEASURING ACCOMPLISHMENTS OF OBJECTIVES IN DIRECT ASSISTANCE PROGRAMS ..... 3 - 3
3.3.1 Qualitative Methods ..... 3 - 4
3.3.1.1 Cooperator Assessment of Work Plan Accomplishments as a Measure of Achieving Objectives ..... 3 - 4
3.3.2 Quantitative Methods ..... 3 - 5
3.3.2.1 Observed/Calculated Damage Reductions as a Measure of Achieving Objectives ..... 3 - 5
3.3.2.2 Observed/Calculated Resources Saved as a Measure of Achieving Objectives ..... 3 - 5
3.4 DETERMINATION OF OVERALL OBJECTIVE GRADE ..... 3 - 6
4.0 CHAPTER 4: ALTERNATIVES INCLUDING THE PROPOSED ACTION ..... 4 - 1
4.1 DESCRIPTION OF ALTERNATIVES ..... 4 - 1
4.1.1 Alternative 1 – Continue the Current Federal MDM Program (No Action/ Proposed Action) ..... 4 - 1
4.1.2 Alternative 2 – Nonlethal Required Before Lethal Control ..... 4 - 2
4.1.3 Alternative 3 – Technical Assistance Only ..... 4 - 2
4.1.4 Alternative 4 – No Federal WS MDM ..... 4 - 2
4.2 MDM STRATEGIES AND METHODOLOGIES AVAILABLE TO WS IN TENNESSEE ..... 4 - 2
4.2.1 Integrated Wildlife Damage Management (IWDM) ..... 4 - 3
4.2.2 The IWDM Strategies Employed by WS ..... 4 - 3
4.2.2.1 Technical Assistance Recommendations ..... 4 - 3
4.2.2.2 Operational Damage Management Assistance ..... 4 - 4
4.2.2.3 Education/Outreach Programs ..... 4 - 4
4.2.2.4 Research and Development ..... 4 - 4
4.2.2.5 Examples of WS Operational and Technical Assistance in MDM in Tennessee ..... 4 - 4
4.2.3 WS Decision Making ..... 4 - 6
4.2.4 Mammal Damage Management Methods Available for Use ..... 4 - 6
4.2.4.1 Nonchemical Methods ..... 4 - 6
4.2.4.2 Chemical Methods ..... 4 - 7
4.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE ..... 4 - 8
4.3.1 Lethal MDM Only by WS ..... 4 - 8
4.3.2 Compensation for Mammal Damage Losses ..... 4 - 9
4.3.3 Short Term Eradication and Long Term Population Suppression ..... 4 - 9
4.3.4 Bounties ..... 4 - 9
4.3.5 Reproduction Control ..... 4 - 10
4.4 MITIGATION AND STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT TECHNIQUES ..... 4 -11
4.4.1 Mitigation in Standard Operating Procedures (SOPs) ..... 4 -11
4.4.2 Additional Mitigation Specific to the Issues ..... 4 -12
4.4.2.1 Effects on Target Species Populations ..... 4 -12
4.4.2.2 Effects on Nontarget Species Populations Including T&E Species ..... 4 -12
4.4.2.3 Effects on Human Health and Safety ..... 4 -13
4.4.2.4 Effects on Socio-cultural Elements of the Human Environment ..... 4 -13
4.4.2.5 Effects of Beaver Dam Removal on Wetland Wildlife Habitat ..... 4 -13

4.4.2.6 Humaneness of Methods Used by Wildlife Services ..... 4 - 13
5.0 CHAPTER 5: ENVIRONMENTAL CONSEQUENCES ..... 5 - 1
5.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL ..... 5 - 1
5.1.1 Alternative 1 – Continue the Current Federal Mammal Damage Management Program (The Proposed Action/No Action) ..... 5 - 1
5.1.1.1 Effects on Wildlife Including Target and Nontarget Species and T&E Species..... 5 - 1
5.1.1.1.1 Effects on Target Species Mammal Populations ..... 5 - 1
5.1.1.1.1.1 Bat Population Information and Effects Analysis ..... 5 - 2
5.1.1.1.1.2 Beaver Population Information and Effects Analysis. 5 - 5
5.1.1.1.1.3 Black Bear Population Information and Effects Analysis ..... 5 - 6
5.1.1.1.1.4 Bobcat Population Information and Effects Analysis ..... 5 - 7
5.1.1.1.1.5 Coyote Population Information and Effects Analysis ..... 5 - 8
5.1.1.1.1.6 Eastern Cottontail Rabbit Population Information and Effects Analysis ..... 5 - 10
5.1.1.1.1.7 Elk Population Information and Effects Analysis ... 5 - 11
5.1.1.1.1.8 Feral Cat Population Information and Effects Analysis ..... 5 - 13
5.1.1.1.1.9 Feral Dog Population Information and Effects Analysis ..... 5 - 14
5.1.1.1.1.10 Feral Swine Population Information and Effects Analysis ..... 5 - 16
5.1.1.1.1.11 Fox Population Information and Effects Analysis... 5 - 17
5.1.1.1.1.11.1 Gray Fox Population Information and Effects Analysis ..... 5 - 17
5.1.1.1.1.11.2 Red Fox Population Information and Effects Analysis ..... 5 - 19
5.1.1.1.1.12 Groundhog Population Information and Effects Analysis ..... 5 - 21
5.1.1.1.1.13 Mink Population Information and Effects Analysis... 5 - 22
5.1.1.1.1.14 Muskrat Population Information and Effects Analysis ..... 5 - 24
5.1.1.1.1.15 Opossum Population Information and Effects Analysis ..... 5 - 25
5.1.1.1.1.16 Other Rodent and Burrowing Mammal Population Information and Effects Analysis .....5 - 26
5.1.1.1.1.16.1 Rats, Mice, and Voles..... 5 - 26
5.1.1.1.1.16.1.1 White-footed and Deer Mice ..... 5 - 27
5.1.1.1.1.16.1.2 Norway Rats and Roof Rats..... 5 - 28
5.1.1.1.1.16.1.3 Voles ..... 5 - 30
5.1.1.1.1.16.2 Chipmunks ..... 5 - 32
5.1.1.1.1.16.3 Moles ..... 5 - 33
5.1.1.1.1.17 Raccoon Population Information and Effects Analysis ..... 5 - 35
5.1.1.1.1.18 River Otter Population Information and Effects Analysis ..... 5 - 37
5.1.1.1.1.19 Skunk Population Information and Effects Analysis... 5 - 38
5.1.1.1.1.19.1 Spotted Skunk Population Information and Effects Analysis... 5 - 38

5.1.1.1.1.19.2 Striped Skunk Population Information and Effects Analysis... 5 - 39
5.1.1.1.1.20 Tree Squirrel Population Information and Effects Analysis ..... 5 - 41
5.1.1.1.1.21 White-tailed Deer Population Information and Effects Analysis ..... 5 - 42
5.1.1.1.1.22 Emerging Non-Native Species..... 5 - 44
5.1.1.1.1.22.1 Nine Banded Armadillo Population Information and Effects Analysis...5 - 44
5.1.1.1.1.22.2 Nutria Population and Information Effects Analysis.....5 - 45
5.1.1.2 Effects on Non-target Species Population, Including T&E Species .....5 - 46
5.1.1.2.1 Turtle Populations Information and Effects Analysis. ..... 5 - 47
5.1.1.2.2 Threatened and Endangered Species .....5 - 48
5.1.1.2.2.1 Critical Habitat Designations for Aquatic Animal Species..... 5 - 48
5.1.1.2.2.2 Beaver Damage Management Impacts on Federally Listed Aquatic Animal Species..... 5 - 49
5.1.1.2.2.2.1 Bog Turtle Information and Effects Analysis.....5 - 49
5.1.1.2.2.2.2 Slackwater Darter Population Information and Effects Analysis.... 5 - 50
5.1.1.2.2.2.3 Mussel Populations Information and Effects Analysis..... 5 - 51
5.1.1.2.2.3 Beaver Damage Management Methods Information and Effects Analysis..... 5 - 51
5.1.1.2.2.3.1 Beaver Removal Methods and SOP Effects Analysis ..... 5 - 51
5.1.1.2.2.3.2 Beaver Dam Removal Methods and SOP Effects Analysis ..... 5 - 52
5.1.1.2.2.4 Conclusions Pertaining to the Protection of Federally Listed T&E Species..... 5 - 54
5.1.1.2.2.5 State Listed Species..... 5 - 54
5.1.1.3 Effects on Human Health and Safety ..... 5 - 54
5.1.1.4 Effects on Socio-cultural Elements and Economics of the Human Environment ..... 5 - 56
5.1.1.4.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species ..... 5 - 56
5.1.1.4.2 Effects on Aesthetics and Value of Property Damaged by Mammals ..... 5 - 57
5.1.1.5 Effects on Wetlands ..... 5 - 57
5.1.1.6 Humaneness of Methods Used by WS ..... 5 - 58
5.1.2 Alternative 2 – Nonlethal Required Before Lethal Control ..... 5 - 58
5.1.2.1 Effects on Wildlife..... ..... 5 - 58
5.1.2.2 Effects of MDM Methods on Human Health and Safety ..... 5 - 59
5.1.2.3 Effects on the Socio-cultural Elements and Economics of the Human Environment ..... 5 - 59
5.1.2.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species ..... 5 - 59
5.1.2.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals ..... 5 - 59
5.1.2.4 Effects on Wetlands ..... 5 - 60

5.1.2.5 Humaneness of Methods Used by WS ..... 5 - 60
5.1.3 Alternative 3 – Technical Assistance Only ..... 5 - 60
5.1.3.1 Effects on Wildlife..... 5 - 60
5.1.3.2 Effects of MDM Methods on Human Health and Safety ..... 5 - 60
5.1.3.3 Effects on the Socio-cultural Elements and Economics of the Human Environment ..... 5 - 61
5.1.3.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species ..... 5 - 61
5.1.3.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals ..... 5 - 61
5.1.3.4 Effects on Wetlands ..... 5 - 61
5.1.3.5 Humaneness of Methods Used by WS ..... 5 - 61
5.1.4 Alternative 4 – No Federal WS MDM ..... 5 - 62
5.1.4.1 Effects on Wildlife ..... 5 - 62
5.1.4.2 Effects of MDM Methods on Human Health and Safety ..... 5 - 62
5.1.4.3 Effects on the Socio-cultural Elements and Economics of the Human Environment ..... 5 - 63
5.1.4.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species ..... 5 - 63
5.1.4.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals .....5 - 63
5.1.4.4 Effects on Wetlands ..... 5 - 63
5.1.4.5 Humaneness of Methods Used by WS ..... 5 - 64
5.2 SUMMARY OF POTENTIAL IMPACTS ..... 5 - 64
5.3 CUMULATIVE IMPACTS OF THE PROPOSED ALTERNATIVE BY ISSUE ..... 5 - 65
5.3.1 Cumulative Impacts on Wildlife Including Target and Non-target, and T&E Species ..... 5 - 66
5.3.2 Cumulative Impacts on Human Health and Safety ..... 5 - 67
5.3.3 Cumulative Impacts on Socio-cultural Elements and Economics of the Human Environment ..... 5 - 68
5.3.3.1 Cumulative Impacts on Human Affectionate-Bonds ..... 5 - 68
5.3.3.2 Cumulative Impacts on Aesthetic Enjoyment of Wildlife ..... 5 - 69
5.3.3.3 Cumulative Impacts on Economic Loss Resulting from Overabundant Wildlife ..... 5 - 69
5.3.4 Cumulative Impacts on Wetlands..... ..... 5 - 70
5.3.5 Cumulative Impacts on Concerns about Humaneness of MDM Methods ..... 5 - 70
5.4 SUMMARY OF CUMULATIVE IMPACTS..... 5 - 70
6.0 CHAPTER 6: LIST OF PREPARERS AND PERSONS CONSULTED ..... 6 - 1
APPENDIX A – LITERATURE CITED ..... A - 1
APPENDIX B – MAMMAL DAMAGE MANAGEMENT (MDM) METHODS AVAILABLE FOR USE OR RECOMMENDED BY THE TENNESSEE WILDLIFE SERVICES PROGRAM .... B - 1
APPENDIX C – MEMORANDUM OF UNDERSTANDING AMONG ENTITIES COLLABORATING WITH WILDLIFE SERVICES IN THE MDM PROGRAM IN TENNESSEE ..... C - 1
APPENDIX D – MATERIAL SAFETY DATA SHEETS AND PESTICIDE LABELS FOR PESTICIDES USED IN THE TENNESSEE WILDLIFE SERVICES MDM PROGRAM ..... D - 1
APPENDIX E – FEDERAL AND STATE THREATENED AND ENDANGERED SPECIES WHICH OCCUR IN TENNESSEE ..... E - 1
APPENDIX F – SUMMARY INFORMATION REGARDING T&E MUSSEL SPECIES FOUND IN TENNESSEE ..... F - 1
APPENDIX G – LETTER FROM USFWS REGARDING WS PROGRAM EFFECTS ON FEDERALLY LISTED T/E SPECIES..... G – 1
APPENDIX H – LETTER FROM TWRA REGARDING WS PROGRAM EFFECTS ON STATE LISTED T/E SPECIES..... H - 1

APPENDIX I – LETTER SENT TO INTERESTED PARTIES REGARDING NOTIFICATION OF AVAILABILITY OF DRAFT EA ..... I - 1

ACRONYMS

ADC	Animal Damage Control
APHIS	Animal and Plant Health Inspection Service
ATF	Bureau of Alcohol, Tobacco, and Firearms
AVMA	American Veterinary Medical Association
BMP	Best Management Practice
CDC	Centers for Disease Control and Prevention
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COE	U.S. Corps of Engineers
EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ERO	Eastern Regional Office
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	Fiscal Year
GPRA	Government Performance Results Act of 1993
IWDM	Integrated Wildlife Damage Management
MDM	Mammal Damage Management
MIS	Management Information System
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOA	Notice Of Availability
NRCS	Natural Resources Conservation Service
NWRC	National Wildlife Research Center
OSHA	Occupational Safety and Health Administration
PEP	Post - Exposure Prophylaxis
SOP	Standard Operating Procedure
TCA	Tennessee Code Annotated
TDA	Tennessee Department of Agriculture
T&E	Threatened and Endangered
TWRA	Tennessee Wildlife Resources Agency
USC	United States Code
USDA	U.S. Department of Agriculture
USDC	U.S. Department of Commerce
USDI	U.S. Department of Interior
USGS	U. S. Geological Survey
USFWS	U.S. Fish and Wildlife Services
WDM	Wildlife Damage Management
WS	Wildlife Services

1.0 CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Across the United States, wildlife habitat has substantially changed as human populations have expanded and land has been transformed to meet varying human needs. These changes often compete with wildlife and have inherently increased the potential for conflicts between wildlife and people. Some species of wildlife have adapted to, and thrive in, the presence of humans and the changes that have been made. These species, in particular, are often responsible for the majority of conflicts between humans and wildlife. The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control (ADC) Final Environmental Impact Statement (FEIS) summarizes the relationship in American culture of wildlife values and wildlife damage in this way (USDA 1997):

> *"Wildlife has either positive or negative values, depending on varying human perspectives and circumstances . . . Wildlife generally is regarded as providing economic, recreational and aesthetic benefits . . . , and the mere knowledge that wildlife exists is a positive benefit to many people. However, the activities of some wildlife may result in economic losses to agriculture and damage to property . . . Sensitivity to varying perspectives and values is required to manage the balance between human and wildlife needs. In addressing conflicts, wildlife managers must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well."*

The United States Department of Agriculture is authorized to protect American agriculture and other resources from damage associated with wildlife. This function is carried out by the USDA, APHIS, Wildlife Services[1] (WS) program. The primary authorities for the WS program come from the Act of March 2, 1931, as amended (46 Stat. 1468; 7 U.S.C. 426-426b and 426c), the Rural Development, Agriculture and Related Agencies Appropriations Act of 1988 (Public Law 100-202), and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act of 2001, Public Law 106-387, October 28, 2000 Stat. 1549 (Sec 767). WS activities are conducted in cooperation with other Federal, State, and Local agencies, as well as private organizations and individuals. This Environmental Assessment (EA) evaluates a portion of this responsibility, specifically, management of damage caused by mammals in Tennessee.

Wildlife damage management (WDM), or control, is defined as the alleviation of damage or other problems caused by wildlife (Leopold 1933, The Wildlife Society 1990, Berryman 1991). WS uses an Integrated WDM (IWDM) approach (sometimes referred to as "Integrated Pest Management") and is described in Volume 4, Chapter 1, pages 1-7 of the WS FEIS (USDA 1997). This includes nonlethal strategies such as the modification of habitat or the behavior of the offending animal(s), and lethal control of the offending animal(s) or local populations of the offending species. IWDM is not based on punishing animals, but provides a means of reducing future losses or damage.

This EA documents the analysis of the potential environmental effects of a proposed mammal damage management (MDM) program. This analysis relies on data contained in published documents (Appendix A), including the *Animal Damage Control Program Final Environmental Impact Statement* (USDA 1997). The FEIS contains detailed discussions of potential environmental impacts from methods that are used for MDM in Tennessee. The FEIS may be obtained by contacting the USDA, APHIS, WS Operational Support Staff at 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

Wildlife Services' mission, developed through a strategic planning process, is to *"provide leadership in wildlife damage management for the protection of America's agricultural, industrial and natural resources, and to safeguard public health and safety"* (USDA 1989). This is accomplished through:

- training of wildlife damage management professionals;

[1] Wildlife Services was previously known as the Animal Damage Control program. The name change became effective in 1997. Throughout this document, the acronyms "ADC" and "WS" refer to the same federally authorized program.

- development and improvement of strategies to reduce economic losses and threats to humans from wildlife;
- the collection, evaluation, and dissemination of management information;
- cooperative wildlife damage management programs;
- informing and educating the public on how to reduce wildlife damage; and
- providing technical advice and a source for limited-use management materials and equipment such as pesticides, cage traps, and pyrotechnics.

Wildlife Services' Policy Manual[2] reflects this mission and provides guidance for engaging in WDM activities. Before WDM is conducted, *Agreements for Control* or *WS Annual Work Plans* must be signed by WS and the land owner / administrator / agency representative. WS cooperates with land managers and wildlife management agencies when appropriate and as requested, to combine efforts to effectively and efficiently resolve wildlife damage problems in compliance with all applicable Federal, State, and Local laws and Memoranda of Understanding (MOUs) between WS and other agencies.

1.1.1 The Tennessee WS Program

Wildlife Services national program activities consist of both operations and research pursuits. The majority of the program's research is conducted by the WS National Wildlife Research Center (NWRC) through its central location in Fort Collins, CO and its research stations around the country. WS's operational work is conducted through its two Regional offices (Ft. Collins, CO and Raleigh, NC) and State/District offices in the fifty states. For Tennessee, the WS program is administered through the State Office in Nashville; District offices are located in Jackson, Knoxville, and Nashville. The work of WS consists primarily of technical and operational assistance to reduce migratory bird damage caused by such species as blackbirds (Family Icteridae), Canada geese (*Branta canadensis*), mallard ducks (*Anas platyrhynchos*), black and turkey vultures (*Coragyps atratus, Cathartes aura*), European starlings (*Sturnis vulgaris*), and feral pigeons (*Columba livia*). Assistance is also provided for mammal damage management pursuant to funded agreements, authorizations, and requests from State wildlife management and other agencies and affected individuals, and organizations.

Wildlife Services responds to damage threats from several mammalian species with both technical assistance and direct damage management programs in Tennessee. WS currently has more than 213,000 acres of properties under agreement to conduct direct damage management programs related at least in part to mammal damage in Tennessee (USDA-WS MIS Database 2002). WS addresses damage related to the activities of a number of mammal species including, but not limited to, beaver (*Castor canadensis*), red foxes (*Vulpes vulpes*), muskrats (*Ondatra zibethicus*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), groundhogs (*Marmota monax*), and small rodents including voles (*Microtus* spp.), rats (*Rattus* spp.) and mice (*Mus musculus*, *Peromyscus* spp.).

Wildlife Services is a cooperatively funded, service-oriented program that conducts WDM in cooperation with various governmental agencies, industries, businesses, and private individuals in the State. A Memorandum of Understanding among several Tennessee State agencies including the University of Tennessee Agricultural Extension Service, Tennessee Department of Agriculture, Tennessee Department of Health, Tennessee Wildlife Resources Agency, Tennessee Department of Environment and Conservation and WS (Appendix C). This MOU outlines protocol for WDM activities and partnering among concerned agencies and departments in the State.

---

[2]**WS Policy Manual** - Provides guidance for WS personnel to conduct wildlife damage management activities through Directives. WS Directives referenced in this EA can be found in the manual but will not be referenced in the Literature Cited Section.

1.2 PURPOSE

This EA analyzes effects of a mammal damage management program (MDM) in Tennessee as it relates to the protection of agriculture, property, natural resources, and human health and safety. These problems are resolved on a case-by-case basis. Normally, according to the APHIS procedures for implementing NEPA, individual wildlife damage management actions may be categorically excluded (7 CFR 372.5(c), 60 Fed. Reg. 6,000-6,003, 1995). We have decided to prepare this EA to facilitate planning, interagency coordination, and the streamlining of program management, and to clearly communicate with the public the analysis of cumulative effects.

Mammal species addressed in this EA include: beaver (*Castor canadensis*), red and gray foxes (*Vulpes vulpes* and *Urocyon cinereoargentius*), muskrat (*Ondatra zibethicus*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), groundhogs (*Marmota monax*), Virginia opossums (*Didelphis virginianus*), cottontail rabbits (*Sylvilagus floridanus mearnsii*), feral house cats (*Felis domesticus*)and dogs (*Canis familiaris*), river otter (*Lutra canadensis*), tree squirrels (*Sciurus* spp.), black bear (*Ursus americanus*), bobcat (*Lynx rufus*), feral swine (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), mink (*Mustela vison*), chipmunk (*Tamia striatus*), mole (*Scalopus aquaticus* and *Condylura cristata*), spotted skunk (*Spilogale putoris*), various bat species (See Table 5-1), nine banded armadillo (*Dasypus novemcinctus*), nutria (*Myocastor coypus*), and small rodents including voles (*Microtus* spp.), rats (*Rattus spp.*) and mice (*Mus musculus*, *Peromyscus* spp.).

1.3 NEED FOR ACTION

1.3.1 Summary of Proposed Action

The proposed action is to continue the current portion of the WS program in Tennessee that responds to requests for MDM to protect agriculture, human health and safety, natural resources, and property in Tennessee. One component of MDM in the Tennessee WS program has the goal of minimizing human health and safety threats and property damage in urban and rural environments. Primary species of concern related to damage in these environments are raccoons, coyotes, groundhogs, skunks, and beavers. Damage by these or other mammal species also may be addressed by WS in MDM programs aimed at reducing losses or the risk of loss to agricultural crops, livestock, timber, and any other agriculture-related resource. In addition, damage caused by any mammal species to natural resources, including threatened and endangered species, wildlife, natural flora, parklands, recreation areas, peculiar habitats, etc. may be addressed through programs conducted by WS. Elimination or alleviation of damage to property such as residential and non-residential buildings, water resources, dikes, dams, impoundments, drainages, landscape plantings, golf courses, grasses and turf, pets, zoo animals, trees, or any other properties would be an objective of WS MDM programs contemplated under this EA.

To meet the goals previously described, WS's objective would be to attempt to respond to all requests for assistance with, at a minimum, technical assistance or self-help advice, or, where appropriate and when cooperative or congressional funding is available, direct damage management assistance in which professional WS Wildlife Biologists or Specialists conduct damage management actions. An Integrated Wildlife Damage Management approach would be implemented which would allow use of any legal technique or method, used singly or in combination, to meet requester needs for resolving conflicts with mammals. Lethal methods used by WS could include shooting, trapping, snaring, and FDA or EPA approved chemicals. Nonlethal methods used by WS could include fencing, netting, deterrents/repellents, exclusion, harassment, habitat alteration, or live-capture and translocation for some individuals of some species. Definitive objectives of the WS MDM program in Tennessee are discussed in Chapter 3 of this document. Appendix B provides a more detailed description of the methods that could be used under the proposed action.

1.3.2 Need for Mammal Damage Management to Protect Human Health and Safety

A considerable threat to human health is sometimes presented by disease organisms or parasites carried by some mammals which are transmissible or infectious to humans. These include viral, bacterial, mycotic (fungal), protozoal and rickettsial diseases. Several of these diseases are transmittable to humans. Table1.1 shows the

more typical diseases affecting humans that can be transmitted by mammals in addition to diseases which affect other animals, including domestic species.

Table 1.1. Wildlife Diseases That Pose Potential Human Health Risks in the Southeastern United States (Davidson and Nettles 1997)

Disease	Causative Agent	Hosts
Anthrax	bacterium (*Bacillus antracis*)	cattle, sheep, horses, swine, white-tailed deer, dogs, cats
Dermatophilosis	bacterium (*Dermatophilus congolensis*)	mammals (wild and domestic)
Demodectic mange	mange mite (*Demodex odocoilei*)	White-tailed deer
Sarcoptic mange	mite *(Sarcoptes scabiei)*	red foxes, coyotes, domestic dogs
Swine brucellosis	bacterium (*Brucella suis)*	swine
Trichinosis	nematode *(Trichinella spiralis)*	swine, bears, raccoons, foxes, rats
Rabies	virus (Rhabidovirus)	all mammals (high risk wildlife: raccoons, foxes, skunks, bats)
Visceral larval migrans	nematode (*Baylisascaris procyonis)*	raccoons, skunks
Leptospirosis	bacteria (*Leptospira interrogans*) over 180 different serovars	All mammals
Echinococcus infection	tapeworm (*Echinococcus multilocularis)*	foxes, coyotes
Bovine Brucellosis	bacterium (*Brucela abortus)*	cattle (evidence from Texas that organism has infected coyotes that scavenged aborted fetuses and placentas of infected cattle)
Toxoplasmosis	protozoan parasite (*Toxoplasma ondii)*	cats are definitive hosts, mammals and birds are intermediate hosts
Spirometra infection	tapeworm, (*Spirometra mansonoides)*	bobcats, raccoons, foxes, dogs, cats
Murine typhus	bacteria (*Rickettsia mooseri = R. typhi*)	rats, mice, as hosts for primary flea, louse or mite host
Giardiasis	protozoan parasite (*Giardia lamblia, G. Duodenalis*, and other Giardia sp.- taxonomy controversial)	beavers, coyotes, dogs, cats

Individuals or property owners that request assistance with mammals frequently are concerned about potential disease risks but are unaware of the types of diseases that can be associated with them. In most such situations, MDM is requested because of a perceived risk to human health or safety associated with wild animals living in close association with humans, or from animals acting out of character by roving in human-inhabited areas during daylight, or showing no fear when humans are present. Under the proposed action, WS could agree to assist in resolving these types of problems.

In the majority of cases in which human health concerns are a major reason for requesting MDM, there may have been no actual cases of transmission of disease to humans by mammals to prompt the request. Thus, it is the risk of disease transmission that is the primary reason for requesting and conducting MDM. Situations in Tennessee where the threat of disease associated with wild or feral mammal populations might occur could be:

- Exposure by residents to the threat of raccoon rabies due to high populations of raccoons in urban settings or from companion animals coming in contact with infected raccoons in any environment.
- Concern about the threat of histoplasmosis from the disturbance of a large deposit of guano in an attic where a colony of bats routinely roosts or raises young.
- Accumulated droppings from denning or foraging raccoons and subsequent exposure to raccoon roundworm in fecal deposits in a suburban community or at an industrial site where humans must work or live in areas of accumulation.
- Exposure of humans to threats of rabies posed by skunks denning and foraging in a residential community.
- Threats of parasitic infections to humans from *Giardia* spp. resulting from high beaver populations in a park or recreation area where swimming is allowed.

In Tennessee, raccoons are abundant in urban environments. They have been associated with the spread of rabies in other states throughout the East, including states adjacent to Tennessee (USDA 2001, B. Dunlap, WS, pers. comm., 2003). Rabies poses a direct threat to humans. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal. The disease can be effectively prevented in humans and many domestic animals species, but abundant and widely distributed reservoirs among wild mammals complicate 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*) (USDA 2001).

Over the last 100 years, rabies in the United States has changed dramatically. About 90% or greater of all animal cases reported annually to CDC now occur in wildlife (Krebs et al. 2000; CDC 2001a.). Before 1960 the majority of cases were reported in domestic animals. The principal rabies hosts today are wild carnivores and bats. The number of rabies-related human deaths in the U.S. has declined from more than 100 annually at the turn of the century to an average of one or two people per year in the 1990's. 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 2001a). In the U.S., 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. These 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 2001a).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the U.S. each year is unknown, it is estimated to be about 40,000. When rabies becomes epizootic 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 immune globulin and five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2001a) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in wildlife populations, the risk of "mass" human exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increase. One case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for a total of 71 persons (CDC 2001b). 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 U.S. occurred in 1994 when a kitten from a pet store in Concord, NH tested positive for rabies after a brief illness. As a result of potential exposure to this 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).

Rabies in raccoons was virtually unknown prior to the 1950's. It was first described in Florida and spread slowly during the next three decades into Georgia, Alabama, and South Carolina. It was unintentionally introduced into the Mid-Atlantic States, probably by translocation of infected animals (Krebs et al.1998). The first cases appeared in West Virginia and Virginia in 1977 and 1978. Since then raccoon rabies in the area expanded to form the most intensive rabies outbreak in the U.S. The strain 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). In the past 21 years, all of the mid-Atlantic and New England states have experienced at least one outbreak. The raccoon rabies epizootic front reached Maine in 1994, reflecting a movement rate of about 30-35 miles per year.

Raccoon rabies presents a human health threat through potential direct exposure to rabid raccoons, or indirectly through the exposure of pets that had an encounter with rabid raccoons. In March, 2003, a 25-year old Virginia man died from rabies infection, representing the first confirmed human death from the raccoon rabies variant. Additionally, the number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested, and the number of post exposure treatments are all greater when raccoon rabies is present in the 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.

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 U.S. If the "immune barrier" is breached by raccoon rabies, research suggests that raccoon populations are sufficient (Sanderson and Huber 1982, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999) for rabies to spread westward along a front at a rate similar to or greater than the rate at which this rabies strain has spread in the eastern U.S.

In Tennessee no cases of raccoon rabies had been reported until 2003. Five cases have been identified in the easternmost tip of Tennessee in Carter and Johnson counties. Four of the cases involved raccoons in the vicinity of Roan Mountain State Park in Carter County. The remaining case was a human exposure involving a bite from a feral cat near Mountain City in Johnson County.

Burrowing mammals, such as groundhogs, muskrats, voles, field rats, and moles (Family Talpidae) may sometimes threaten earthen dams as they form networks of burrows which can weaken such structures, causing erosion and failure. Such incidents can threaten the safety and lives of humans living downstream from the dam. For that reason, managers of such sites are concerned with preventing excessive burrowing by these animals at dam sites. WS performs burrowing mammal damage management activities for owners and managers of earthen dams in Tennessee, and could be requested to provide services at such a site, for any requester anywhere in the State. Much of the damage caused by muskrats is primarily through their burrowing activity (Miller 1994, Linzey 1998, Perry 1982) in dikes, dams, ditches, ponds, and shorelines. Muskrats dig burrows into banks, levees, and where higher ground is available, for dens (Linzey 1998, Perry 1982). Muskrats dig burrows with underwater entrances along shorelines and burrowing may not be readily evident until serious damage has occurred. When water levels drop, the muskrat holes are expanded to keep pace with the retreating water level. Additionally, when water levels rise muskrats expand the burrows upward. These burrows can collapse when walked upon by people or animals and crossed over with heavy equipment (i.e., mowers, tractors).

Beaver activity in certain situations can become a threat to public health and safety (e.g., burrowing into or flooding of roadways and railroad beds can result in serious accidents) (Miller 1983, Woodward 1983). Increased water levels in urban areas resulting from beaver activity can lead to unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities (DeAlmeida 1987, Loeb 1994). Beaver damming activity also creates conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of these insects (Wade and Ramsey 1986). While the presence of these insects is largely a nuisance, mosquitoes can transmit diseases, such as encephalitis (Mallis 1982) and West Nile Virus (CDC 2000). In addition, beaver are carriers of the intestinal parasite *Giardia lamblia,* which can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). The CDC has recorded at least 41 outbreaks of waterborne Giardiasis, affecting more than 15,000 people. Beaver are also known carriers of tularemia, a bacterial disease that is transmittable to humans through bites by insect vectors or infected animals or by handling animals or carcasses which are infected (Wade and Ramsey 1986). Skinner et al. (1984) found that in cattle-ranching sections of Wyoming the fecal bacterial count was much higher in beaver ponds than in other ponds, something that can be a concern to ranchers and recreationists. On rare

occasions, beaver may contract the rabies virus and attack humans. In February 1999, a beaver attacked and wounded a dog and chased some children that were playing near a stream in Vienna, Virginia. Approximately a week later, a beaver was found dead at the site and tested positive for rabies (T. Meinke, WS, pers. comm., 2003). Furthermore, damming of streams may increase the number of aquatic snakes, including the poisonous cottonmouth (*Agkistrodon piscivorus*) (Wade and Ramsey 1986).

Norway (*Rattus norvegicus*) and black, or roof rats (*Rattus rattus*) present disease threats to humans. They live in close association to human habitations and provide a potential source of disease transmission. Many of these diseases are transmitted to humans and animals through primary hosts such as fleas, lice, and mites which live on rats (Schmidt and Roberts 1989). Among the diseases rats may transmit to humans or livestock are murine typhus, leptospirosis, trichinosis, salmonellosis (food poisoning), and ratbite fever (Timm 1994). Plague is a disease that can be carried by a variety of rodents, but it is more commonly associated with roof rats than with Norway rats (Timm 1994). Some diseases associated with rats are listed in Table 1.1.

Black bears (*Ursus americanus*) occasionally threaten human health and safety. Herrero (1985) documented 500 injuries to humans resulting from encounters with black bears from 1960 to 1980. Of these, 90% were minor injuries (minor bites, scratches, and bruises). Only 23 fatalities were recorded from 1900 to 1980 due to black bear attacks. These are remarkably low numbers, considering the geographic overlap of human and black bear populations. Ninety percent of all incidents were likely associated with habituated, food-conditioned bears. Fatalities to humans caused by black bears have been rare in Tennessee.

A study in France determined that stray cats (*Felis catus*) serve as major reservoirs for the bacterium Bartonella spp. Consequently, stray cats and their fleas (*Ctenocephalides felis*) are the only known vectors for infecting house bound cats and humans with this bacterium. Humans are not infected via the flea, but pet cats often are infected by flea bites. 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 most significant animal transmitting rabies to humans (Eng and Fishbein 1990; Krebs et al. 1996; Vaughn 1976).

WS could provide operational MDM, upon request, involving virtually any mammal species that poses a threat to human health and safety to any requester experiencing such damage anywhere in Tennessee.

1.3.3 Need for Mammal Damage Management at Airports

The risk that mammals pose to aircraft is well documented (USDOT 1997), and data kept by the Federal Aviation Administration shows that civil aircraft incurred 983 strikes with mammals between 1990 and 2001. The number of mammal strikes actually occurring is likely to be much greater, since an estimated 80% of civil wildlife strikes go unreported (Cleary et al. 2000). Civil and military aircraft have collided with a diversity of mammal species, including, white-tailed deer, coyotes, raccoons, and a number of other species. Costs of these collisions vary, but FAA data reveals that mammal strikes in the U. S. cost the civil aviation industry approximately 121,272 hours of down time, and $23,276,153 in direct monetary losses between 1990 and 2001. In addition to damages caused by mammal strikes to aircraft, these incidents sometimes pose serious threats to human safety. One human death resulting from aircraft striking mammals was reported for 1990 - 2001 in the U. S. Data indicates a much higher percentage of mammal strikes resulted in aircraft damage than did bird strikes. About 68% of mammal strikes resulted in damage compared to 19% for birds (USDOT 2000). In Tennessee, eleven mammal strikes were reported between January 1, 1993 and December 31, 2003.

WS receives several requests annually for assistance regarding mammal damage management at airports in Tennessee. These requests are considered serious because of the potential for loss of human life and because damage to aircraft can be extremely expensive. WS could provide operational MDM involving virtually any mammal species that poses a strike hazard at the request of any aviation facility in the State.

1.3.4 Need for Mammal Damage Management to Protect Agriculture

A number of mammal species cause damage to a variety of agricultural resources in Tennessee. Losses related to aquaculture, field crops, orchards, nurseries, truck gardens, commercial timber, and livestock are reported yearly to TWRA (E. Warr, TWRA, pers. comm., 2003) and WS (USDA-WS MIS Database 2002).

Beavers are reported to damage field crops, commercially grown standing timber and seedling trees. Populations of this species are abundant in Tennessee. Beaver are present in all 95 Tennessee counties where appropriate habitat occurs (E. Warr, TWRA, pers. comm., 2003). Beaver activities cause flooding of prime bottom land crop fields, costing farmers considerable dollar losses because of late planting dates or flooding of growing crops. Similar flooding and subsequent killing of trees occurs in some commercial forest tracts, killing harvestable trees or seedlings. In addition, feeding by beaver on bark, and felling of some trees results in the loss of stands of all age classes (D. Allsbrooks, TVA, pers. comm., 2003). From Fiscal Year 1998 through Fiscal Year 2002, $5,074,200 in losses/damage to timber was reported to Wildlife Services (USDA-WS MIS Database 2002).

Cottontail rabbits (*Sylvilagus floridanus*) and voles are reported to damage orchard trees by gnawing. Trees are badly damaged or the bark is girdled and trees die when feeding by rabbits and voles is severe. Similar damage occurs in nurseries which grow landscape ornamentals and shrubs (USDA-WS MIS Database 2002).

Bears, red foxes, gray foxes (*Urocyon cinereoargenteus*), coyotes, and feral dogs (*Canis familiaris*) can cause predation losses or injury to livestock (e.g. sheep, goats, cattle, pigs, horses) and poultry (e.g. chickens, turkeys, geese ducks). Sheep and lamb losses from predators in the U.S. totaled 273,000 head and $16.5 million during 1999 (NASS 2000). Coyotes and dogs accounted for 60.7% and 15.1% of these predator losses, respectively. In 2000, cattle and calf losses from predators in the U.S. totaled 147,000 head and $51.6 million (NASS 2001). NASS (2001) reported 4,500 cattle and calves lost to predation in Tennessee during 2000 with the value of these cattle and calves losses totaling approximately $1.4 million. Coyotes and dogs accounted for 64.6% and 17.7% of these predator losses, respectively. Coyotes were also the most commonly reported predator of goats in the U.S., accounting for 35.6% of predator losses (NASS 2000). The value of goats lost from all predators in the U.S. in 1999 was $3.4 million. Cattle and calves are most vulnerable to predation at calving time and less vulnerable as they get older and larger (Horstman and Gunson 1982). Calves remain vulnerable to black bear predation during the spring through autumn if they are grazed in areas that typically represent suitable habitats for bears.

Rats (Rattus spp.) cause damage to stored grain through feeding and contamination with droppings. They may damage crops in fields and containers and packaging materials in stored food. They cause structural damage to commodity storage structures and foundations, etc. by burrowing and gnawing.

The domestic cat has been found to transmit *Toxoplasma gondii* to both domestic and wild animal species. Fitzgerald et al. (1984) documented that feral and free-ranging cats transmitted *T. gondii* to sheep in New Zealand, resulting in abortion in ewes. The authors also found *Sarcocystis* spp. contamination in the musculature of sheep. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *Toxoplasma 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. Cats were believed to be the cause of disease transmission (*T. gondii*) and the death of kangaroos, wallabies, and potaroos at the Knoxville Zoological Park in Tennessee (Patton et al. 1986). 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, *Toxoplasmosis gondii* (Dubey 1973; Teutsch et al. 1979). Both stray and domiciled cats may be infected by this protozoan, but this infection is more common in stray cats. Diseases that may be communicable from free-ranging or feral cats to pet cats include feline panleukopenia (FPL) infection, feline calicivirus (FCV) infection, feline reovirus (FRV) infection, and feline syncytium-forming virus (FSV) infection (Gillespie and Scott 1973). Of the four feline diseases, feline panleukopenia is considered to be the most serious. Reif (1976) found that during the acute stages of feline panleukopenia, fleas were vectors of this disease to other cats. FPL infection is cyclic in nature, being more prevalent in the July to September time period.

1.3.5 Need for Mammal Damage Management to Protect Natural Resources Including Threatened and Endangered Species

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

Sometimes the activities of mammals cause damage to natural resources. This most frequently occurs in relation to plants or other animals, including but not limited to, trees, natural vegetation of other types, other mammals, and birds. Mammals causing damage are usually locally overabundant at the damage site, and threaten the welfare of a species population identified as a natural resource. Examples of this might be vegetation at a park which is being damaged by excessive browsing by overabundant white-tailed deer populations, or ground-nesting game bird populations which are being decimated by the presence of mammalian carnivores, such as raccoons, coyotes, or foxes.

Massey (1971) and Massey and Atwood (1981) found that predators can prevent least terns (*Sterna antillarum*) from nesting or cause them to abandon previously occupied sites. In another study, mammalian predators were found to have significantly impacted the nesting success of least terns on sandbars and sandpits (Kirsch 1996). Skunks (Massey and Atwood 1979), red foxes (Minsky 1980), coyotes (Grover and Knopf 1982), and raccoons (Gore and Kinnison 1991) are common predators of least terns. During one 2-year study, coyotes destroyed 25.0-38.5% of all interior least tern nests (Grover 1979). Raccoons are considered a major predator of ground-nesting upland bird nests and poults (Johnson 1970, Speake 1980, Speake et al. 1985, Speake et al. 1969). In Massachusetts, predators destroyed 52-81% of all active piping plover (*Charadrius melodus*) nests from 1985-1987 (MacIvor et al. 1990). Red foxes accounted for 71-100% of the nests destroyed by predators at the site. During FY95-98, Nebraska personnel were asked to remove coyotes, striped skunks, opossums *(Didelphis virginiana),* and mink (*Mustela vison*) from nesting sites along the Platte River in central Nebraska to protect threatened piping plovers and endangered least terns. As expected, the removal of predators increased plover and tern nesting success and chick survival rates (Wildlife Services 1999). Balser et al. (1968) recommended that predator damage management programs target the entire predator complex or compensatory predation may occur by a species not under control, a phenomena also observed by Greenwood (1986). Trautman et al. (1974) concluded that a single species predator damage management program showed some promise for enhancing ring-necked pheasant (*Phasianus colchicus)* populations. Clearly, predator damage management can be an important tool for achieving and maintaining game, nongame, and T&E species production and management objectives.

Some of the species listed as threatened or endangered under the Endangered Species Act of 1973 are preyed upon or otherwise adversely affected by certain mammal species. In FY 2001, the WS program nationwide actively protected 144 Federal and State listed threatened and endangered species. More than 95 percent of these projects resulted in the increase or maintenance of local threatened and endangered species populations. In 2001, Alaska's Aleutian Canada goose (*Branta canadensis leucopareia*) was officially removed from the list of federally threatened species, due in part to WS' efforts to prevent predation by the artic fox (*Alopex lagopus*). In Florida alone, WS protects 14 threatened and endangered species, including five species of sea turtles from raccoon, coyote, and skunk predation (B. Constantin, WS, pers. comm., 2003). Other instances where WS was requested to assist in developing programs to safeguard the survival of endangered species include protection of adult and young least terns and snowy plovers (*Charadrius alexandrinus*) in California from predation by raccoons, coyotes, and skunks (J. Turman, M. Jensen WS, pers. comm., 2003), protection of juvenile salmonoids (steelhead and salmon) in Washington from river otters (*Lutra canadensis*) (B. Dunlap, K. Gruver, WS, pers. comm., 2003), protection of Sierra Nevada Bighorn sheep (*Ovis canadensis*) from mountain lion (*Felis concolor*) predation in California (B. Dunlap, WS, pers. comm., 2003). Endangered species could be jeopardized by mammals in Tennessee. WS could provide operational MDM involving virtually any mammal species that poses a threat to wildlife, including T&E species to any requester experiencing such damage anywhere in Tennessee.

Feral hogs (*Sus scrofa*) cause damage to natural areas such as parks and wildlife management areas in Tennessee. These sites suffer erosion and local loss of critical ground plants and roots as well as destruction of seedlings as a result of their feeding and other activity (Barrett and Birmingham 1994). Many state and federal natural resource managers are now in the process of controlling hog numbers because of their known impact to endangered plants and animals (Thompson 1977). Feral hogs are not native to North America and many native species have not evolved to deal with hog competition or predation. Feral hogs are known to feed on many of the smaller animals (some threatened or endangered), disrupt ecosystems via rooting, and feeding on rare and endangered plants. Many experts in the fields of botany and herpetology have observed marked declines in some rare species of plants, reptiles, amphibians, and soil invertebrates (Singer et al. 1982) in areas inhabited by feral hogs. It has been well documented that feral hogs disturb large areas of vegetation and soils through rooting, and it is documented that hogs inhabiting coastal, upland, and wetland ecosystems are uprooting, damaging, and feeding on rare native species of plants and animals (Means 1999). It has been documented that hogs can disrupt natural vegetative communities, eliminate rare plants and animals, alter species composition within a forest including both canopy and low growing species (Frost 1993, Lipscomb 1989), increase water turbidity in streams and wetlands (reducing water quality and impacting native fishes), and increase soil erosion and alter nutrient cycling (DeBenedetti 1986, Singer et al. 1982).

Beavers cause extensive damage to timber, seedling trees, and other vegetation in natural areas, park and recreation areas, and wetland mitigation sites in Tennessee. From FY 1998 through FY 2002, $311,025 in losses/damage to hardwood timber and reclamation/restoration sites was reported to Wildlife Services (USDA-WS MIS Database 2002). Beaver activities also destroy critical habitat types (e.g. free-flowing water, riparian areas, and bird roosting and nesting areas) which are important to many wildlife species, including certain species of fish and mussels. Patterson (1951) and Avery (1992) reported the presence of beaver dams can negatively affect fisheries. Beaver dams may adversely affect stream ecosystems by increasing sedimentation in streams, and thereby negatively affect wildlife that depend on clear water.

Groundhogs often cause damage to the grounds of historic sites. They can damage the earthworks of historic battlefields by their burrowing activity. The burrows create large tunnels that accelerate erosion and may lead to the collapse of these features. They allow rainwater to enter which further undermines the structures. The burrows themselves are also a trip hazard to visitors at these sites (T. Hogan, NPS, pers. comm., 2003).

Muskrats are largely vegetarians; however, they also eat other animals as part of their diet (Perry 1982). Schwartz and Schwartz (1959), Neves and Odom (1989) and Miller (1994) reported muskrats also ate animal matter including mussels, clams, snails, crustaceans (i.e., crawfish), and young birds. Some mussels consumed by muskrats may be listed as federal T&E species under the ESA. Neves and Odom (1989) reported that muskrats appeared to be inhibiting the recovery of endangered mussels and are likely placing pigtoe mussels in further jeopardy in the Clinch and Holston Rivers in Virginia. Muskrats can negatively impact native vegetation. When muskrats become over-populated an "eat-out" may occur. An "eat-out" occurs when vegetation, including soil binding roots, is consumed. These "eat-out" events may result in the feeding area being ruined for a number of years (O'Neil 1949). The loss of vegetation removes food and cover for muskrats and other wildlife. Marsh damage from muskrats is inevitable when areas heavily populated by muskrats are under-trapped (Lynch et al. 1947). While eat-outs are beneficial to some bird species, they also result in stagnant water which predisposes the same birds to diseases (Lynch et al. 1947).

WS has received requests in the past for assistance in resolving damage caused to natural resources by mammals, and could be requested to provide services for management of damage to natural resources caused by any mammal at any location in Tennessee.

1.3.6 Need for Mammal Damage Management to Protect Property

Mammals cause damage to a variety of property types in Tennessee each year. During FY 1998-2002 complainants who contacted WS reported $216,262 in damage by all mammal species to all types of property in Tennessee. Considerable among these was $161,475 in damages to structures, which includes residential and non-residential buildings, water control structures, and other human constructed property. Damage was caused

by a variety of mammals, including beavers, groundhogs, opossums, raccoons, bats, squirrels, muskrats, Norway rats, and others.

Most of the damage caused by beaver is a result of dam building, bank burrowing, tree cutting, obstructing overflow structures and spillways, or flooding. Some cases of beaver damage include roads being flooded, reservoir dams being destroyed by bank den burrows, and train derailments being caused by continued flooding and burrowing (Miller and Yarrow 1994). Housing developments have been threatened by beaver dam flooding. Some small bridges also have been destroyed because of beaver dam-building activity. Miller (1983) estimated that the annual damage by beavers in the United States was $75-$100 million. The estimated value of beaver damage is perhaps greater than that of any other single wildlife species in the U.S. with economic damage estimated to have exceeded $4 billion in the southeastern U.S. over a 40-year period (Arner and Dubose 1980). In certain southeastern states, losses from beaver damage have been estimated at $3 million to $5 million dollars annually (Miller and Yarrow 1994), with timber losses as the most common type of damage (Hill 1982). Tracts of bottomland hardwood timber up to several thousand acres in size may be lost to beaver activity (Miller and Yarrow 1994). Surveys in North Carolina and Alabama indicate that the majority of landowners with beaver damage on their property desire damage management via beaver removal (Hill 1976, Lewis 1979, Woodward et al. 1985). Loker et al. (1999) found that suburban residents also may desire lethal management methods to resolve beaver damage conflicts. Such conflicts, which are viewed as *"damage,"* result in adverse impacts that often outweigh benefits (Miller and Yarrow 1994). Beaver often inhabit sites in or adjacent to urban/suburban areas and cut or girdle trees and shrubs in yards, undermine yards and walkways by burrowing, flood homes and other structures, destroy pond and reservoir dams by burrowing into levees, gnaw on boat houses and docks, and cause other damage to private and public property (Wade and Ramsey 1986). Additionally, roads and railroads may be damaged by saturation of the roadbed from beaver flooding or by beaver burrowing into the banks that comprise roadbeds and railroad beds.

1.4 WS RECORD KEEPING REGARDING REQUESTS FOR MAMMAL DAMAGE MANAGEMENT ASSISTANCE

WS maintains a Management Information System (MIS) database to document assistance that the agency provides in addressing wildlife damage conflicts. MIS data is limited to information that is collected from people who have requested services or information from Wildlife Services. It does not include requests received or responded to by local, State or other Federal agencies, and it is not a complete database for all wildlife damage occurrences. The number of requests for assistance does not necessarily reflect the extent of need for action, but this data does provide an indication that needs exist. The database includes, but is not limited to, the following information: species of wildlife involved, the number of individuals involved in a damage situation; tools and methods used or recommended to alleviate the conflict; and the resource that is in need of protection. A description and summary of the types of damage requests received by WS by specific mammal species are described in Section 5.1.1 of this EA.

1.5 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

1.5.1 ADC Programmatic Environmental Impact Statement

WS has issued a Final Environmental Impact Statement (FEIS) on the national APHIS/WS program (USDA 1997). Pertinent information available in the FEIS has been incorporated by reference into this EA.

1.5.2 Environmental Assessment and Finding of No Significant Impact – Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Foxes, and Coyotes in the United States

This EA (USDA 2001) and its Finding of No Significant Impacts dated July 30, 2001 and August 5, 2002 analyzed the environmental effects of APHIS/WS involvement in the funding of and participation in Oral Rabies Vaccination programs to eliminate or stop the spread of raccoon rabies in a number of eastern states (including Tennessee) and gray fox and coyote rabies in Texas. APHIS/WS determined the action would not have any significant impact on the quality of the human environment. Pertinent information from this document has been incorporated by reference into this EA.

1.6 DECISION TO BE MADE

Based on the scope of this EA, the decisions to be made are:

- Should MDM as currently implemented by the WS program be continued in the State?
- If not, how should mammal damage in the State be managed and what role should WS play in this management?
- Might the continuing of WS's current program of MDM have significant effects requiring preparation of an EIS?

1.7 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

1.7.1 Actions Analyzed

This EA evaluates mammal damage management by WS to protect agriculture; human health and safety; natural resources, including threatened and endangered species and other wildlife; and property on private land or public facilities within the State wherever such management is requested from the WS program.

1.7.2 Period for Which This EA is Valid

This EA will remain valid until WS determines that new needs for action or new alternatives having different environmental effects must be analyzed. At that time, this analysis and document will be reviewed and revised as necessary. This process insures the EA is complete and still appropriate to the scope of the State MDM activities. Review of the EA would be conducted each year to ensure that the EA is sufficient.

1.7.3 Site Specificity

This EA analyzes potential effects of WS's MDM activities that will occur or could occur at private property sites or at public facilities within any of the 95 Tennessee counties. Because the proposed action is to continue the current program, and because the current program's goal and responsibility are to provide service when requested within the constraints of available funding and personnel, it is conceivable that MDM activity by WS could occur anywhere in the State.

Planning for the management of mammal damage must be viewed as being conceptually similar to the actions of federal or other agencies whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, insurance companies, etc. Although some of the sites where mammal damage will occur can be predicted, all specific locations or times where such damage will occur in any given year cannot be predicted. Thus, this EA analyzes the potential effects of such efforts wherever and whenever they might occur as part of the current program. The EA emphasizes important issues as they relate to specific areas whenever possible. However, the issues that pertain to the various types of mammal damage and resulting management are the same, for the most part, wherever they occur, and are treated as such. The standard WS Decision Model (Slate et al. 1992) and WS Directive 2.105 is the routine thought process that is the site-specific procedure for determining methods and strategies to use or recommend for individual actions conducted by WS in the State (See USDA 1997, Chapter 2 and Appendix N for a more complete description of the WS Decision Model and examples of its application). Decisions made using this undocumented thought process will be in accordance with any mitigation measures and standard operating procedures described herein and adopted or established as part of the decision.

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

1.7.4 American Indian Lands and Tribes

Currently, Tennessee WS has no MOUs with any American Indian tribe. If WS enters into an agreement with a tribe for MDM, this EA would be reviewed and supplemented if appropriate to insure compliance with NEPA. MOUs, agreements and NEPA compliance would be conducted as appropriate before conducting MDM on tribal lands.

1.7. 5 Summary of Public Involvement.

Issues related to the proposed action were initially developed by WS. Issues were defined and preliminary alternatives were identified. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS-NEPA implementing regulations, this document and its Decision are being made available to the public through "Notices of Availability" (NOA) published in local media and through direct mailings of NOA to parties that have specifically requested to be notified. New issues or alternatives raised after publication of public notices will be fully considered to determine whether the EA and its Decision should be revisited and, if appropriate, revised.

1.8 AUTHORITY AND COMPLIANCE

1.8.1 Authority of Federal and State Agencies in Mammal Damage Management in Tennessee[3]

1.8.1.1 WS Legislative Authorities

The primary statutory authority for the Wildlife Services program is the Act of March 2, 1931 (7 U.S.C. 426-426c; 46 Stat. 1468), as amended in the Fiscal Year 2001 Agriculture Appropriations Bill, which provides that:

> *"The Secretary of Agriculture may conduct a program of wildlife services with respect to injurious animal species and take any action the Secretary considers necessary in conducting the program. The Secretary shall administer the program in a manner consistent with all of the wildlife services authorities in effect on the day before the date of the enactment of the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2001"*

Since 1931, with the changes in societal values, WS policies and programs place greater emphasis on the part of the Act discussing "*bringing (damage) under control*," rather than "*eradication*" and "*suppression*" of wildlife populations. In 1988, Congress strengthened the legislative mandate of WS with the Rural Development, Agriculture, and Related Agencies Appropriations Act. This Act states, in part:

> *"That hereafter, the Secretary of Agriculture is authorized., except for urban rodent control, to conduct activities and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions in the control of nuisance mammals and birds and those mammal and bird species that are reservoirs for zoonotic diseases, and to deposit any money collected under any such agreement into the appropriation accounts that incur the costs to be available immediately and to remain available until expended for Animal Damage Control activities."*

1.8.1.2 Tennessee Wildlife Resources Agency (TWRA)

The TWRA is responsible under Tennessee Code Title 70 Wildlife Resources for managing most wildlife species in the State under the direction of the Tennessee Wildlife Resources Commission. Tennessee Code Annotated (TCA) 70-2-101 prohibits the taking of any wildlife without the requisite license. In Tennessee,

[3]See Chapter 1 of USDA (1994) for a complete discussion of Federal laws pertaining to WS.

pursuant to the authority granted by TCA, Sections 70-4-107 and 70-5-108, the Tennessee Wildlife Resources Commission sets dates for the taking of wildlife. In addition, the TWRA participates with WS and a number of State agencies in a Memorandum of Understanding whereby participating agencies have agreed to collaborate in resolving wildlife damage issues (Appendix C).

1.8.1.3 Tennessee Department of Agriculture (TDA)

The Tennessee Department of Agriculture pesticide division regulates the sale, distribution, storage, and application of pesticides in Tennessee. The division strives to educate the pest control industry and the consumer about the proper use of pesticides through education and training programs conducted across the state.

Tennessee's law that governs the custom application of pesticides is "The Tennessee Application of Pesticides Act" (TAPA), and there are published rules that coincide with the law. In addition, the "Tennessee Insecticide, Fungicide, and Rodenticide Act" (TIFRA) governs certain pesticide issues.

WS consults with the TDA in Tennessee to register new pesticides or formulations which are intended for use in the state, and to keep all pesticide registrations current. Only pesticides with current registrations are used by WS personnel in Tennessee. WS obtains certification for all its employees who apply pesticides in Tennessee.

1.8.1.4 U.S. Fish and Wildlife Service (USFWS)

The USFWS is responsible for managing and regulating take of bird species that are listed as migratory under the MBTA and those species, subspecies, and populations that are listed as threatened or endangered under the Endangered Species Act. Section 1.8.2.2 below describes WS's interactions with the USFWS under this law.

1.8.1.5 Natural Resource Conservation Service (NRCS)

The NRCS is responsible for certifying wetlands under the Wetland Conservation provisions of the Food Security Act (16 U.S.C. 3821 and 3822). Topographic maps are available through their offices that identify the presence of wetlands.

1.8.1.6 U.S. Army Corps of Engineers (COE)

The COE regulates and permits activities regarding waters of the United States including protection and utilization under Section 404 of the Clean Water Act.

1.8.1.7 U.S. 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. The EPA is also responsible for administering and enforcing the Section 404 program of the Clean Water Act with the Corps; this established a permit program for the review and approval of water quality standards that directly impact wetlands.

1.8.1.8 U.S. Tennessee Valley Authority (TVA)

Tennessee Valley Authority, a federal corporation created by an Act of Congress in May 18, 1933 [48 Stat. 58-59, 16 U.S.C. Sec. 831, as amended], provides electrical power to 8.3 million people, businesses, and industries and manages 293,000 acres of public land and 11,000 miles of reservoir shoreline in the 7-state Tennessee Valley region. Largely in Tennessee, TVA's plants and facilities include 11 coal-burning and 6 combustion-turbine plants, 3 nuclear plants, 29 dams and 1 pump-storage plant, as well as 15 solar and other renewable energy production sites. The electricity TVA generates is transmitted over 17,000 miles of

transmission line rights-of-way easements cross the Valley. TVA conducts and contracts with WS to provide nuisance wildlife damage management on its land and at its facilities. TVA also makes its lands available for use for continuation of the WS Oral Rabies Vaccination program in Alabama, Tennessee and Virginia.

1.8.2 Compliance with Other Federal Laws

Several other Federal laws authorize, regulate, or otherwise affect WS wildlife damage management. WS complies with these laws, and consults and cooperates with other agencies as appropriate.

1.8.2.1 National Environmental Policy Act (NEPA)

WS prepares analyses of the environmental effects of program activities to meet procedural requirements of this law. This EA meets the NEPA requirement for the proposed action in Tennessee. When WS operational assistance is requested by another Federal agency, NEPA compliance is the responsibility of the other Federal agency. However, WS could agree to complete NEPA documentation at the request of the other Federal agency.

1.8.2.2 Endangered Species Act (ESA)

It is Federal policy, under the ESA, that all Federal agencies will seek to conserve threatened and endangered (T&E) species, and will utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS conducts Section 7 consultations with the USFWS to use the expertise of the USFWS to ensure that "*any action authorized., funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . . Each agency will use the best scientific and commercial data available*" (Sec.7 (a) (2)). WS obtained a Biological Opinion (B.O.) from USFWS in 1992 describing potential effects on T&E species, and prescribing reasonable and prudent measures for avoiding jeopardy (USDA 1997, Appendix F). In addition, WS is in the process of initiating formal consultation at the programmatic level to reevaluate the 1992 B.O. and to fully evaluate potential effects on T&E species listed or proposed for listing since the 1992 FWS B.O.

1.8.2.3 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing FIFRA. All chemical methods used or recommended by the WS program in Tennessee are registered with and regulated by the EPA and TDA and are used by WS in compliance with labeling procedures and requirements.

1.8.2.4 National Historic Preservation Act (NHPA) of 1966 As Amended

The NHPA of 1966, and its implementing regulations (36 CFR 800), requires federal agencies to: 1) determine whether activities they propose constitute "undertakings" that has the potential to cause effects on historic properties and, 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the Advisory Council on Historic Preservation (i.e. State Historic Preservation Office, Tribal Historic Preservation Officers), as appropriate. WS actions on tribal lands are only conducted at the tribe's request and under signed agreement; thus, the tribes have control over any potential conflict with cultural resources on tribal properties.

Each of the MDM methods described in this EA that might be used operationally by WS do not cause major ground disturbance, do not cause any physical destruction or damage to property, do not cause any alterations of property, wildlife habitat, or landscapes, and do not involve the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS under the proposed action are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a

result of a decision on this EA, then site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

There is potential for audible effects on the use and enjoyment of a historic property when methods such as propane exploders, pyrotechnics, firearms, or other noise-making methods are used at or in close proximity to such sites for purposes of hazing or removing animals. However, such methods would only be used at a historic site at the request of the owner or manager of the site to resolve a damage or nuisance problem, which means such use would be to benefit the historic property. A built-in mitigating factor for this issue is that virtually all of the methods involved would only have temporary effects on the audible nature of a site and can be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary in those types of situations.

1.8.2.5 The Clean Water Act (33 U.S.C. 1344)

The Clean Water Act provides regulatory authority and guidelines for the EPA and the U.S. Army Corps of Engineers related to wetlands. Several Sections of the Clean Water Act pertain to regulating effects on wetlands. Section 101 specifies the objectives of this Act, which are implemented largely through Subchapter III (Standards and Enforcement), Section 301 (Prohibitions). The discharge of dredged or fill material into waters of the United States is subject to permitting specified under Subchapter IV (Permits and Licenses) of this Act. Section 401 (Certification) specifies additional requirements for permit review particularly at the State level. WS consults with appropriate regulatory authorities when wetlands exist in proximity to proposed activities or when such activities might impact wetland areas. Such consultations are designed to determine if any wetlands will be affected by proposed actions.

1.8.2.6 Executive Order 13112 on Invasive Species

Executive Order 13112 - Invasive Species directs Federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm, or harm to human health. To comply with Executive Order 13112, WS may cooperate with other Federal, State, or Local government agencies, or with industry or private individuals to reduce damage to the environment or threats to human health and safety.

1.8.2.7 Food Security Act

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

1.8.2.8 Native American Graves Protection and Repatriation Act

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

1.8.2.9 Environmental Justice and Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Environmental Justice has been defined as the pursuit of equal justice and equal 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. A critical goal of Executive Order 12898 is to improve the scientific basis for decision-making by conducting assessments that identify and prioritize environmental health risks and procedures for risk reduction. Environmental Justice is a priority both within USDA/APHIS and WS. APHIS implements Executive Order 12898 principally through its compliance with the provisions of NEPA.

WS activities are evaluated for their effect on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice. WS personnel use wildlife damage management methods as selectively and environmentally conscientiously as possible. All chemicals used by APHIS-WS are regulated by the EPA through the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), TDA, by MOUs with Federal land managing agencies, and by WS Directives. Based on a thorough Risk Assessment, APHIS concluded that when WS program chemicals are used following label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the environment (USDA 1997, Appendix P). The WS operational program properly disposes of any excess solid or hazardous waste. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental effects to minority and low-income persons or populations.

1.8.2.10 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. Because WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children, WS has considered the impacts that this proposal might have on children. The proposed mammal damage management program would occur by using only legally available and approved methods where it is highly unlikely that children would be adversely affected. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing this proposed action. Additionally, since the proposed mammal damage management program is directed at reducing human health and safety risks at locations where children are sometimes present, it is expected that health and safety risks to children would be reduced.

1.8.2.11 Federal Food, Drug, and Cosmetic Act (21 U.S.C. 360)

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

1.8.2.12 Controlled Substances Act of 1970 (21 U.S.C. 821 et seq.)

This law requires an individual or agency to have a special registration number from the federal Drug Enforcement Administration (DEA) to possess controlled substances, including those that are used in wildlife capture and handling.

1.8.2.13 Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA)

The AMDUCA and its implementing regulations (21 CFR Part 530) establish several requirements for the use of animal drugs, including those used to capture and handle wildlife in rabies 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 the proposed action. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (i.e., a period of time after a drug is

administered that must lapse before an animal may be used for food) for specific drugs. Animals that might be consumed by a human within the withdrawal period must be identified; the Western Wildlife Health Committee of the Western Association of Fish and Wildlife Agencies has recommended that suitable identification markers include durable ear tags, neck collars, or other external markers that provide unique identification (WWHC *undated*). APHIS-WS establishes procedures in each state for administering drugs used in wildlife capture and handling that must be approved by state veterinary authorities in order to comply with this law.

1.8.3 Memorandum Of Understanding (MOU) Between Various Agencies And WS In Tennessee

A MOU (Appendix C) among the University of Tennessee Agricultural Extension Service (UTAES), Tennessee Department of Agriculture (TDA), Tennessee Department of Health and Environment (TDHE), Tennessee Wildlife Resources Agency (TWRA), Tennessee Department of Environment and Conservation (TDEC), and WS was developed in 1988. The objectives of the MOU were to 1) establish a collaborative relationship among the named participants for planning, coordinating, and implementing of animal damage control policies developed to prevent or minimize damage caused by wild animal species, including threatened and endangered species, to agriculture, horticulture, animal husbandry, forestry, wildlife, and human health, safety or other property, and 2) facilitate exchange of information. This MOU allows Tennessee agencies concerned with protection of resources and public health to collaborate with WS in programs in Tennessee to achieve mutual objectives. WS consults with these various agencies from time to time in the process of assisting Tennessee residents in resolving wildlife damage conflicts, and these agencies refer appropriate wildlife damage complaints to WS.

2.0 CHAPTER 2: ISSUES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental effects analysis in Chapter 5 (Environmental Consequences), issues that have driven the development of mitigation measures and/or standard operating procedures, and issues that will not be considered in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues used to develop mitigation measures. Additional description of affected environments will be incorporated into the discussion of the environmental effects in Chapter 5.

Issues are concerns of the public and/or of professional communities about potential environmental problems that might occur from a proposed federal action. Such issues must be considered in the NEPA decision process. Issues relating to the management of wildlife damage were raised during the scoping process in preparing the programmatic ADC FEIS (USDA 1997) and were considered in the preparation of this EA. These issues are fully evaluated within the FEIS, which analyzed data specific to the Tennessee WS Program.

2.1 AFFECTED ENVIRONMENT

Upon request for assistance, mammal damage management could be conducted on private, federal, state, tribal, county, and municipal lands in Tennessee to protect agricultural and natural resources, property, and public health and safety. Areas of the proposed action could include, but are not limited to, state, county, municipal and federal natural resource areas, park lands, and historic sites; state and interstate highways and roads; railroads and their right-of-ways; property in or adjacent to subdivisions, businesses, and industrial parks; timberlands, croplands, and pastures; private and public property where burrowing mammals cause damage to structures, dikes, ditches, ponds, and levees; public and private properties in rural/urban/suburban areas where mammals cause damage to landscaping and natural resources, property, and are a threat to human safety through vehicle collisions and the spread of disease. The area of the proposed action would also include airports and military airbases where mammals are a threat to human safety and to property; areas where mammals negatively impacts wildlife, including T&E species; and public property where mammals are negatively impacting historic structures, cultural landscapes and natural resources.

2.2 SUMMARY OF ISSUES

The following issues have been identified as areas of concern requiring consideration in this EA. These will be analyzed in detail in Chapter 5:

- Effects on Wildlife Including Target and Nontarget Species and T&E Species
- Effects on Human Health and Safety
- Effects on Socio-cultural Elements and Economics of The Human Environment
- Effects on Wetlands
- Humaneness of Methods Used by Wildlife Services

2.3 ISSUES ADDRESSED IN THE ANALYSIS OF ALTERNATIVES

2.3.1 Effects on Wildlife

2.3.1.1 Effects on Target Mammal Species Populations

A common concern among members of the public is whether wildlife damage management actions adversely affect the viability of target species populations. The target species selected for analysis in this EA are the primary species which may be affected by WS's MDM activities in Tennessee. Mammal species addressed in this EA include: beaver (*Castor canadensis*), red and gray foxes (*Vulpes vulpes* and *Urocyon cinereoargentius*), muskrat (*Ondatra zibethicus*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), groundhogs (*Marmota monax*), Virginia opossums (*Didelphis virginianus*), cottontail rabbits (*Sylvilagus floridanus mearnsii*), feral house cats (*Felis domesticus*)and dogs (*Canis familiaris*), river otter (*Lutra canadensis*), tree squirrels (*Sciurus* spp.), black bear (*Ursus*

americanus), bobcat (*Lynx rufus*), feral swine (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), mink (*Mustela vison*), chipmunk (*Tamia striatus*), mole (*Scalopus aquaticus* and *Condylura cristata*), spotted skunk (*Spilogale putoris*), various bat species (See Table 5-1), nine banded armadillo (*Dasypus novemcinctus*), nutria (*Myocastor coypus*), and small rodents including voles (*Microtus* spp.), rats (*Rattus spp.*) and mice (*Mus musculus, Peromyscus* spp.).

2.3.1.2 Effects on Nontarget Species Populations, Including T&E Species

A common concern among members of the public and wildlife professionals, including WS personnel, is the impact of damage management methods and activities on nontarget species, particularly T&E Species. Wildlife Services' standard operating procedures include measures intended to mitigate or reduce the effects on nontarget species populations and are presented in Chapter 4.

Special efforts are made to avoid jeopardizing Threatened and Endangered Species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. WS has consulted with the USFWS under Section 7 of the Endangered Species Act (ESA) concerning potential effects of MDM methods on T&E species and has obtained a Biological Opinion (B.O.). For the full context of the B.O., see Appendix F of the ADC FEIS (USDA 1997). WS is also in the process of reinitiating Section 7 consultation at the program level to assure that potential effects on T&E species have been adequately addressed. As stated is Section 1.3.5 WS activities often help to enhance or maintain populations of Threatened and Endangered species that are adversely affected by mammalian predators.

2.3.2 Effects on Human Health and Safety

2.3.2.1 Safety and Efficacy of Chemical Control Methods Used in MDM.

The public is sometimes concerned about chemicals used in mammal damage management programs because of potential adverse effects on people from being exposed either to the chemicals directly or to mammals that have died as a result of the chemical use. Under the alternatives proposed in this EA, chemical use is regulated by the EPA through FIFRA, by Tennessee State Pesticide Control Laws, by DEA, by FDA and by WS Directives. Based on a thorough Risk Assessment, APHIS concluded that when WS program chemicals are used according to label directions, they are selective to target individuals or populations, and such use has negligible impacts on the environment (USDA 1997, Appendix P). One specific method not addressed in the assessment was the use of explosives to remove beaver dams.

The use of explosives for beaver dam removal can be a sensitive issue with the inexperienced public. WS personnel that use explosives are required to take and pass in-depth training, and must be able to demonstrate competence and safety in their use of explosives. WS personnel adhere to WS policies, as well as regulations from the Bureau of Alcohol, Tobacco and Firearms (ATF), the Occupational Safety and Health Administration (OSHA), and the U.S. Department of Transportation (USDOT) with regards to explosives use, storage, and transportation. WS uses binary explosives which require two components to be mixed before they can be actuated, which virtually eliminates the hazard of accidental detonation during storage and transportation. Storage and transportation of mixed binary explosives is illegal. When explosives are used, signs are placed to stop public entry and other safety measures are taken to avoid public exposure to explosives. Therefore, no adverse effects to public safety are expected from the use of explosives by WS under any alternative.

Other individuals may have concerns that there is a potential for drugs used in animal capture, handling, and euthanasia to cause adverse health effects in humans that hunt and eat the species involved. Among the species to be captured and handled under the proposed action, this issue is expected to only be of concern for wildlife which are hunted and sometimes consumed by people as food.

2.3.2.2 Effects on Human Health and Safety from Non-Chemical MDM Methods

Some people may be concerned that WS's use of firearms, traps, snares, and pyrotechnic scaring devices could cause injuries to people. WS personnel occasionally use traps, snares and firearms to remove mammals that are associated with damage. There is some potential fire hazard to agricultural sites and private property from pyrotechnic use. could cause injuries to people. A formal risk assessment of WS operational management methods found that risks to human safety were low (USDA 1997, Appendix P).

Firearm use in wildlife damage management can be a public sensitivity issue. Safety issues related to the misuse of firearms and the potential human hazards associated with firearms use are concerns both to the public and WS. To ensure safe use and awareness, WS employees who use firearms to conduct official duties are required to attend an approved firearm safety and use training program, and repeat safety training biannually (WS Directive 2.615,05/03/02). WS employees who carry and use firearms as a condition of employment, are required to sign a form certifying that they meet the criteria as stated in the *Lautenberg Amendment*, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence. Additionally, USDA runs thorough background checks on all new employees entering the agency. In Tennessee, during FY 1998-2002, WS conducted 545 events using firearms or air guns which involved the discharge of thousands of projectiles to remove problem mammals and birds without any injuries occurring.

The use of restraining devices such as foothold or body-grip traps or snares is a sensitive issue because of the lack of understanding and experience by the public in using these devices. Some people believe they could be captured and restrained by these traps. Some believe these traps indiscriminately and automatically capture people who may unknowingly approach locations where these traps or snares are placed. When conducting activities that require using such devices, WS personnel provide information about the techniques used to the appropriate landowners or land management personnel. WS is also assisting with the development of Best Management Practices (BMP's) for improving traps and trapping programs in the United States. These BMP's evaluate the animal welfare and efficiency of various traps for species which can be legally harvested in North America.

2.3.2.3 Effects on Human Health and Safety from not Conducting MDM to Reduce Disease Threats or Outbreaks and Mammal Strike Hazards at Airports

The concern stated here is that the absence of adequate MDM would result in adverse effects on human health and safety associated with the transmission of mammal-borne diseases, and mammal strikes on aircraft would not be reduced to acceptable levels. The potential impacts of not conducting such work could lead to increased incidence of injuries, illness, or loss of human lives.

As discussed in Subsection 1.3.2, in Tennessee raccoons are abundant in urban environments. They have been associated with the spread of rabies in other states throughout the east, including states adjacent to Tennessee (USDA 2001, B. Dunlap, WS, pers. comm., 2003). Rabies poses a direct threat to humans. In Tennessee no cases of raccoon rabies had been reported until 2003. Five cases have been identified in the easternmost tip of Tennessee in Carter and Johnson counties. Four of the cases involved raccoons in the vicinity of Roan Mountain State Park in Carter County. The remaining case was a human exposure involving a bite from a feral cat near Mountain City in Johnson County. This exposure was the first confirmed case involving a human. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal. The disease can be effectively prevented in humans and many domestic animals species, but abundant and widely distributed reservoirs among wild mammals complicate rabies control. The vast majority of rabies cases reported to the CDC each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order *Chiroptera*). However, the number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested, and the number of post exposure treatments are all greater when raccoon rabies is present in the area.

Increased populations of raccoons have been implicated in the outbreak of distemper in certain areas. However, distemper has not been identified as transmissible to humans, but urban residents who observe sick raccoons on their property feel threatened. Further, people could be bitten by these affected animals, which lose their fear of humans, and can act aggressively at times.

Beaver activity in certain situations can become a threat to public health and safety. In urban areas, beaver activity can cause increased water levels in urban areas resulting in unsanitary conditions and potential health problems by flooding septic systems and sewage treatment facilities (DeAlmeida 1987, R. Parish, CWD pers. comm., 2002). Beaver damming activity also creates conditions favorable to mosquitoes and can hinder mosquito control efforts or result in population increases of these insects (Wade and Ramsey 1986). In the past two years the West Nile Virus, a disease transmitted by mosquitoes, has increased dramatically in Tennessee (L. Lacey, MSCHD, pers. comm., 2002). In addition, beavers are carriers of the intestinal parasite *Giardia lamblia*, which can contaminate human water supplies and cause outbreaks of the disease Giardiasis in humans (Woodward 1983, Beach and McCulloch 1985, Wade and Ramsey 1986, Miller and Yarrow 1994). The CDC has recorded at least 41 outbreaks of waterborne Giardiasis, affecting more than 15,000 people. Beaver are also known carriers of tularemia, a bacterial disease that is transmittable to humans through bites by insect vectors or infected animals, or by handling animals or carcasses which are infected (Wade and Ramsey 1986). On rare occasions, beaver may contract the rabies virus and attack humans (Todd Menke, WS, pers. comm., 2002).

As discussed in Subsection 1.3.3, WS frequently assists airports in Tennessee that seek to resolve wildlife hazards to air passengers. Airport managers and air safety officials are concerned that the absence of a WS MDM could lead to failure to adequately address the complex wildlife hazard problems faced by these facilities. Hence, potential effects of not conducting such work could lead to an increased incidence of injuries or loss of human lives from mammal strikes to aircraft.

2.3.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

2.3.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species

Aesthetics is a philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is subjective in nature and is dependent on what an observer regards as beautiful.
The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public is no exception, and today a large percentage of households have pets.

Some individual members or groups of wild and feral domestic mammal species habituate and learn to live in close proximity to humans. Some people in these situations feed such mammals and/or otherwise develop emotional attitudes toward such animals that result in aesthetic enjoyment. In addition, some people consider individual wild mammals as "pets," or exhibit affection toward these animals. Examples would be people who visit state or national parks to feed deer, or visit a city park to feed squirrels or raccoons, or homeowners who have wildlife feeders or bat houses. Many people do not develop emotional bonds with individual wild animals, but experience aesthetic enjoyment from observing them. Therefore, the public reaction is variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to reduce conflicts/problems between humans and wildlife. There may be some concern that the proposed action or alternatives would result in the loss of aesthetic benefits to the public, resource owners, or neighboring residents. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people.

Wildlife populations provide a range of social and economic benefits (Decker and Goff 1987). These include direct benefits related to consumptive and non-consumptive use (e.g., wildlife-related recreation, observation, harvest, sale), indirect benefits derived from vicarious wildlife related experiences (e.g., reading, television viewing), and the personal enjoyment of knowing wildlife exists and contributes to the

natural ecosystems (e.g., ecological, existence, bequest values) (Bishop 1987). Direct benefits are derived from a user's personal relationship to animals and may take the form of direct consumptive use (using the animal or intending to) or non-consumptive use (viewing the animal in nature or in a zoo, photography) (Decker and Goff 1987). Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as their use in research (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

Public reaction to damage management actions is variable because individual members of the public can have widely different attitudes toward wildlife. Some individuals who are negatively affected by wildlife support removal or relocation of damaging wildlife, while other individuals affected by the same wildlife may oppose removal or relocation. Individuals unaffected by wildlife damage may be supportive, neutral, or opposed to wildlife removal depending on their individual personal views and attitudes.

Some people do not believe that some mammals should even be harassed to stop or reduce damage problems. Some of them are concerned that their ability to view mammals is lessened by WS nonlethal harassment efforts. Those totally opposed to mammal damage management want WS to teach tolerance for damage and threats to public health or safety, and that wildlife should never be killed. Some people would strongly oppose removal of mammals regardless of the amount and type of damage. Some members of the public who oppose removal of wildlife do so because of human-affectionate bonds with individual animals. These human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Some individuals are offended by the presence of overabundant mammal species, such as rats, mice, and even raccoons, opossums, deer, or feral species, such as house cats, nutria and feral hogs. To such people these species represent pests which are nuisances and which upset the natural order in ecosystems, and that are sowers of diseases transmissible to humans or other wildlife. Their overall enjoyment of other mammals is diminished by what they view as a destructive presence of such species. They are offended because they feel that these mammal species proliferate in such numbers and appear to remain unchecked.

2.3.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Property owners that have deer browsing and killing landscape vegetation and natural plants on their holdings, or have beavers damming, flooding and destroying their trees, or voles or rabbits killing expensive ornamentals and shrubs by girdling them are generally concerned about the negative aesthetic appearance of such sites, and loss of valuable property as a result of such activities. Business owners are particularly concerned because negative aesthetics can result in lost business. Recovery of aesthetic appearance of business property might include labor and costs of replacement plants and trees, costs of methods to mitigate flooding or reduce erosion, and costs associated with implementation of wildlife damage management methods. They are also concerned about direct loss of the use of property and of income which might have been gained from the sale of commercially valuable resources, loss of aesthetic value of flowers, plants, and gardens consumed by deer, and lost time contacting local health departments and wildlife management agencies on health and safety issues.

2.3.4 Effects on Wetlands

Some members of the public may be concerned about possible effects to wetlands which might occur as a result of WS MDM programs. Beaver dam removals during programs to manage damage caused by beavers sometimes occur in wetland-like habitat, or in areas inundated by water resulting from flooding by this species' activities. This Subsection examines those activities.

Beavers build dams primarily in smaller riverine wetlands or wetland-like habitats (intermittent and perennial streams and creeks). Dam material usually consists of mud, sticks, and other vegetative material. Their dams obstruct the normal flow of water and typically change the preexisting wetlands' hydrology from flowing or

circulating waters to slower, deeper, more expansive waters that accumulate bottom sediment. The depth of the bottom sediment depends on the length of time an area is covered by water, and the amount of suspended sediment in the water.

Beaver dams, in time, can establish new, but different wetlands. The U.S. Army Corps of Engineers and the Environmental Protection Agency's regulatory definition of a wetland (40 CFR 232.2) is:

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

The preexisting habitat and the altered habitat have different ecological values to the fish and wildlife native to the area. Some species will abound by the addition of a beaver dam, while others will diminish. For example, some species of darters listed as federally endangered require fast moving waters over gravel or cobble beds which beaver dams can eliminate, thus reducing the habitat's value for these species. In areas where bottomland forests are flooded by beaver, if left unchecked, a change is species composition over time will occur. Hardwood trees are killed from flooding and mast production declines. Conversely, beaver dams can potentially be beneficial to some wildlife such as river otter, neotropical birds and waterfowl.

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

The intent of most dam removal operations is not to drain old established wetlands. With few exceptions, requests from public and private individuals and entities that WS receives involve dam removal to return an area to the condition that existed before the dam had been built, or before it had been affecting the area for more than a few years. Wildlife Services beaver damage management activities are primarily conducted to address damage to agricultural crops, timber resources, public property such as roads and bridges, and water management structures. Beaver dam removal activities are conducted primarily on small watershed streams, tributary drainages and ditches. These activities can be described as small, exclusive projects conducted to restore water flow through previously existing channels.

In the majority of instances, beaver dam removal is accomplished by manual methods. During the Fiscal Year 1998 to 2002 time period WS personnel breached 787 beaver dams by hand using manual methods (USDA-WS MIS Database 2002). In some instances binary explosives are utilized to breach dams. WS personnel used binary explosives to breach 100 dams from FY 1998-2002 (USDA-WS MIS Database 2002). WS personnel do not utilize heavy equipment such as trackhoes or backhoes for beaver dam removal. Only the portion of the dam blocking the stream or ditch channel is breached. In some instances, WS activities involve the installation of structures to manage water levels at the site of a breached beaver dam.

If the area does not have hydric soils, it usually takes many years for them to develop and a wetland to become established; this often takes greater than 5 years as indicated by the Swampbuster provision of the Food Security Act. Most beaver dam removal by WS is allowed under exemptions stated in 33 CFR parts 323 and 330 of Section 404 of the Clean Water Act or parts 3821 and 3822 of the Food Security Act. However, the removal of some beaver dams can trigger certain portions of Section 404 that require landowners to obtain permits from the Corps of Engineers prior to removing a blockage. WS personnel determine the proper course of action upon inspecting a beaver dam impoundment. Subsection 4.4.2.5 describes the procedures used by WS to assure compliance with the pertinent laws and regulations.

2.3.5 Humaneness of Methods Used by WS

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

According to the AVMA (1987), suffering is described as a *". . . highly unpleasant emotional response usually associated with pain and distress."* However, suffering *". . . can occur without pain . . . ,"* and *". . . pain can occur without suffering . . ."* Because suffering carries with it the implication of a time frame, a case could be made for *" . . . little or no suffering where death comes immediately . . . "* (CDFG 1991), such as shooting.

Defining pain as a component in humaneness of WS methods appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain, and identifying the causes that elicit pain responses in humans would *". . . probably be causes for pain in other animals . . ."* (AVMA 1987). However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (CDFG 1991).

Pain and suffering, as it relates to WS damage management methods, has both a professional and lay point of arbitration. Wildlife managers and the public would be better served to recognize the complexity of defining suffering, since *". . . neither medical nor veterinary curricula explicitly address suffering or its relief"* (CDFG 1991). Research suggests that some methods, such as restraint in leg-hold traps or changes in the blood chemistry of trapped animals, indicate "*stress*" (USDA 1997). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness.

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

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 within the constraints imposed by current technology and funding.

WS has improved the selectivity and humaneness of management techniques through research and development. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some MDM methods are used in situations where nonlethal damage management methods are not practical or effective.

Tennessee WS personnel are experienced and professional in their use of wildlife damage management methods, so that they are as humane as possible under the constraints of current technology, workforce and funding. Mitigation measures / SOPs used to maximize humaneness are listed in Chapter 4.

2.3.5.1 Humaneness of Using Drowning Sets for Euthanizing Beavers, Nutria and Muskrats

Some are concerned about beaver, nutria and muskrats that drown while restrained by foothold traps and these people consider drowning inhumane. There is considerable debate and disagreement among animal interest groups, veterinarians, wildlife professionals, fur trappers, and nuisance wildlife control specialists on this issue. The debate centers on an uncertainty as to whether the drowning animals are rendered unconscious by high levels of CO_2 and are thus insensitive to distress and pain (Ludders et al. 1999). The

AVMA identifies drowning as an unacceptable method of euthanasia (Beaver et al. 2001), but provides no literature citations to support this position. Ludders et al. (1999) concluded drowning is not euthanasia based on the animals not dying from CO_2 narcosis and reported CO_2 narcosis does not occur until 95 millimeters of mercury in arterial blood is exceeded. Ludders et al. (1999) showed death during drowning is from hypoxia and anoxia, and thus animals experience hypoxemia and concluded that animals that drown are distressed because of stress related hormones, epinephrine and norepinephrine, and therefore drowning is not euthanasia.

Carbon dioxide (CO_2) causes death in animals by hypoxemia and some animals (cats, rabbits, and swine) are distressed before death (Beaver et al. 2001). Even though these animals are distressed, the AVMA (Beaver et al. 2001) states this death is an acceptable form of euthanasia. Thus, the AVMA does not preclude distress or pain in euthanasia. In fact, the AVMA supports inducing hypoxemia related distress when necessary to reduce total distress, because reducing total distress is a more humane death.

Death by drowning in the classical sense is caused by the inhalation of fluid into the lungs and is referred to as "wet" drowning (Gilbert and Gofton 1982, Noonan 1998). Gilbert and Gofton (1982) reported that all submerged beaver do not die from wet drowning, but die of CO_2 induced narcosis, and the AVMA has stated the use of CO_2 is acceptable (Gilbert and Gofton 1982, Noonan 1998). Gilbert and Gofton (1982) reported that after beaver were trapped and entered the water, they struggled for 2-5 minutes followed by a period of reflexive responses. Andrews et al. (1993) stated that with some techniques that induce hypoxia, some animals have reflex motor activity followed by unconsciousness that is not perceived by the animal. Gilbert and Gofton (1982) stated it is unknown how much conscious control actually existed at this stage and they stated anoxia may have removed much of the sensory perception by 5-7 minutes post submersion.

However, Gilbert and Gofton (1982) have been criticized because levels of carbon dioxide in the blood were not reported (Ludders et al. 1999) and there was insufficient evidence that the beaver in their study were under a state of CO_2 narcosis when they died (V. Nettles, Southeastern Cooperative Wildlife Disease Study, letter to W. MacCallum, Massachusetts Division of Fisheries and Wildlife, June 15, 1998). Adding to the controversy, Clausen and Ersland (1970) did measure CO_2 in the blood for submersed restrained beaver, yet none of the beaver in their study died, so Clausen and Ersland (1970) could not determine if beavers die of CO_2 narcosis. Clausen and Ersland (1970) demonstrated that CO_2 increased in arterial blood while beaver were submersed and CO_2 was retained in the tissues. While Clausen and Ersland (1970) did measure the amounts of CO_2 in the blood of submersed beaver they did not attempt to measure the analgesic effect of CO_2 buildup to the beaver (letter from V. Nettles, D.V.M., Ph.D., Southeastern Cooperative Wildlife Disease Study to W. MacCallum, MA Division of Fisheries and Wildlife, June 15, 1998). When beaver are trapped using foothold traps with intent to "drown", the beaver are exhibiting a flight response. Gracely and Sternberg (1999) report that there is stress-induced analgesia resulting in reduced pain sensitivity during fight or flight responses. Environmental stressors that animals experience during flight or fight activate the same stress-induced analgesia (Gracely and Sternberg 1999).

The use of drowning trap sets has been a traditional wildlife management technique in trapping aquatic mammals such as beaver, nutria and muskrats. Trapper education manuals and other wildlife damage management manuals written by wildlife biologists recommend drowning sets for foothold traps set for beaver (Bromley et al. 1994, Dolbeer et al. 1994, Howard et al.1980, Miller and Yarrow 1994, Randolph 1988). In some situations drowning trap sets are the most appropriate and efficient method available to capture beaver, nutria and muskrat. For example, a drowning set attachment should be used with foothold traps when capturing beaver to prevent the animal from injuring themselves while restrained, or from escaping (Miller and Yarrow 1994). Animals that drown die relatively quickly (e.g., within minutes) versus the possible stress of being restrained and harassed by people, dogs, and other wildlife before being euthanized. Drowning sets make the captured animal and trap less visible and prevents injury from the trapped animal (i.e., bites and scratches) to people who may otherwise approach a restrained animal. Furthermore, some people may be offended by the sight of dead animals. Drowning places the dead animal out of public view. Some sites may be unsuitable for body-gripping traps or snares because of unstable banks, deep water, or a marsh with a soft bottom (a.k.a., muck), but these sites would be suitable for foothold traps.

Given the short time period of a drowning event, the possible analgesic effect of CO_2 buildup, the minimum if any pain or distress on drowning animals, the AVMA's acceptance of hypoxemia as euthanasia and the AVMA's acceptance of a minimum of pain and distress during euthanasia, the acceptance of catching and drowning muskrats approved by International Humane Trapping Standards (Fur Institute of Canada 2000), we conclude that drowning, though rarely used by WS, is acceptable. We recognize some people will disagree and are unswayed by WS decision to continue the use of this method.

2.4 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

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

The question could be raised pertaining to whether preparing an EA for an area as large as Tennessee would meet the NEPA requirements for site specificity. Wildlife damage management falls within the category of Federal or other agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to accurately describe such locations or times in an EA or EIS. The WS program is analogous to other agencies or entities with damage management missions such as fire and police departments, emergency clean-up organizations, insurance companies, etc. Although WS can predict some of the possible locations or types of situations and sites where some kinds of wildlife damage will occur, the program cannot predict the specific locations or times at which affected resource owners will determine a mammal damage problem has become intolerable to the point that they request assistance from WS. Nor would WS 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 State agencies. Such broad scale population control would also be impractical, or impossible, to achieve.

If a determination is made through this EA that the proposed action would have a significant environmental impact, then an EIS would be prepared. In terms of considering cumulative effects, one EA analyzing impacts for the entire State will provide a more comprehensive and less redundant analysis than multiple EA's covering smaller zones.

2.4.2 Effects on Public Use of Mammals

Many mammal species offer enjoyment to wildlife watchers and hunters and provide a significant economic contribution in Tennessee. Over 350 thousand Tennesseans who hunt, and the number of Tennessee residents who participate in some type of wildlife watching activity totals 1,655,000 (USDI, FWS, 2002). An additional 683,000 individuals reported some type of wildlife watching activity while visiting Tennessee during 2001 (USDI, FWS, 2002). During 2001, more than two and one-half million people participated in activities such as wildlife watching and hunting in the State. In pursuit of recreation related to photographing, feeding, watching, and hunting they contributed more than $1.375 billion to the economy of the State for expenses related to travel, equipment, feed, licenses, wildlife club memberships and other associated costs (USDI, FWS, 2002). Because mammals are such a substantial economic and recreational resource, there may be concerns that WS MDM actions related to managing damage by mammals might negatively affect these factors.

Beaver represent 55% of the total number of animals taken during MDM activities in Tennessee. From Fiscal year 1998 through Fiscal Year 2002, one thousand two hundred ninety beaver were killed by WS personnel conducting beaver damage management activities. This is an average of 258 beaver per year. During a five year time period from 1994-1998 (the latest date for figures published), an average of 876.6 beaver pelts per year were sold to licensed fur buyers in the state (TWRA, 2001). The number does not represent the total number of beaver captured or killed by individuals in the State, but only represent the number sold by hunters and trappers. With this level of take, the population trend for beaver continued to be increasing or stable throughout the State (E. Warr, TWRA, pers. comm., 2003).

Wildlife Services' biologists conduct no programs in Tennessee to eradicate native wildlife populations (see 2.3.3). The number of target and non-target animals taken during MDM operations has not and will not

adversely impact statewide populations of these animals and therefore will remain common and abundant for consumptive and non-consumptive use throughout the state. See Section 5.1 for specific information on target and non-target species population impacts.

2.4.3 WS's Effect on Biodiversity

The WS program does not attempt to eradicate any species of wildlife in Tennessee. WS operates in accordance with international, Federal and State laws, and regulations enacted to ensure species viability. Effects on target and nontarget species populations because of WS's lethal MDM activities are minor as shown in Section 5.1. The effects of the current WS program on biodiversity are not significant nationwide or statewide (USDA 1997).

2.4.4 Wildlife Damage is a Cost of Doing Business -- a "Threshold of Loss" Should Be Established Before Allowing Any Lethal Mammal Damage Management.

WS is aware that some people feel Federal wildlife damage management should not be allowed until economic losses reach some arbitrary predetermined threshold level. Such policy, however, would be difficult or inappropriate to apply to human health and safety situations. Although some damage can be tolerated by most resource owners, WS has the legal direction to respond to requests for assistance, and it is program policy to aid each requester to minimize losses. WS uses the Decision Model thought process discussed in Chapter 4 to determine appropriate strategies.

In a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie National Forest, et al., the United States District Court of Utah denied plaintiffs' motion for preliminary injunction. In part the court found that a forest supervisor needs only show that damage from wildlife is threatened, to establish a need for wildlife damage management (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 percentage of loss of a particular resource to justify the need for wildlife damage management actions.

2.4.5 Wildlife Damage Management Should not Occur at Taxpayer Expense, but Should be Fee- Based

It is the opinion of some that wildlife damage management should not be provided at the expense of the taxpayer or that it should be fee-based. WS was established by Congress as the agency responsible for providing wildlife damage management to the people of the United States. Funding for WS comes from a variety of sources in addition to Federal appropriations. Such non-Federal sources include State general appropriations, Local government funds (county or city), livestock associations, Indian tribes, and private funds which are all applied toward program operations. Federal, State, and Local officials have decided that some MDM by WS should be conducted by appropriating funds. Additionally, wildlife damage management is appropriate for government programs, since wildlife management is a government responsibility. A commonly voiced argument for publicly funded wildlife damage management is that the public should bear responsibility for damage to private property caused by public wildlife.

A Federal appropriation is allotted for the maintenance of a WS program in Tennessee. This allocation does not cover the costs of the program. The remainder of the WS program is entirely fee-based. Technical assistance is provided to requesters as part of the Federally-funded activities, but all direct assistance in which WS employees perform damage management activities is funded through cooperative agreements between the requester and WS. Thus, MDM by WS in Tennessee is fee-based to a high degree.

2.4.6 Cost Effectiveness of MDM

Perhaps a better way to state this issue is by the question "Does the value of damage avoided equal or exceed the cost of providing MDM?" The Council on Environmental Quality (CEQ) regulations (40 CFR 1502.23) does not require a formal, monetized cost-benefit analysis to comply with NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives being considered. The ADC EIS, Appendix L, p. 32 (USDA 1997) stated:

"Cost effectiveness is not, nor should it be, the primary goal of the APHIS ADC program. Additional constraints, such as environmental protection, land management goals, and others, are considered whenever a request for assistance is received. These constraints increase the cost of the program while not necessarily increasing its effectiveness, yet they are a vital part of the APHIS ADC program".

3.0 CHAPTER 3: OBJECTIVES

Chapter 3 examines objectives of the MDM program in Tennessee. The Government Performance and Results Act of 1993 require Federal agencies to develop program strategies and set goals which are measurable. Further, entities which cooperate with WS in MDM projects have developed objectives related to resolving wildlife damage. These goals may be driven by policy, governmental regulation, welfare of employees and the public, corporate image, customer satisfaction, or a combination of any of these. WS pursues goals related to wildlife damage management as set forth in the WS programmatic Strategic Plan (USDA 1989). Such goals may be reflected in local and state level wildlife damage management programs conducted by WS throughout the United States. Goals discussed in this EA reflect the most reasonable outcome of an effective MDM program in which Cooperators and WS participate.

3.1 SUMMARY OF OBJECTIVES

Wildlife Services will measure achievement of objectives for MDM Direct Assistance programs in Tennessee by attaining and/or maintaining an "adequate grade," as defined in section 3.3 and 3.4 for a set of defined objectives presented below:

- Reductions In Mammal-caused Human Health And Safety Incidents And/Or Maintenance Of Previously Attained Reductions Calculated As Damage Losses Averted Or Resources Saved
- Reductions In Damage To Agriculture Caused By Mammals And/Or Maintenance Of Previously Attained Reductions Calculated As Damage Losses Averted Or Resources Saved
- Reductions In Damage To Property Caused By Mammals And/Or Maintenance Of Previously Attained Reductions Calculated As Damage Losses Averted Or Resources Saved
- Reductions In Damage To Natural Resources Caused By Mammals And/Or Maintenance Of Previously Attained Reductions Calculated As Damage Losses Averted Or Resources Saved

3.2 DESCRIPTION OF OBJECTIVES

In this section objectives of the proposed action are discussed and ways that achievement of these objectives will be measured are presented. Measurement of success in wildlife damage management projects is usually difficult, often subjective, and dependent on sometimes variable objectives. The purpose of this discussion is to inform the public regarding views about damage caused by mammals, and expectations, or objectives of both WS and those who participate with WS in programs to reduce that damage.

3.2.1 Reductions in Damage to Agriculture

Farming continues to dominate Tennessee's landscape with approximately 91,000 farms producing and selling crops, livestock, and forest products. Over eleven million acres (46%) of the state's land area is in farmland (TASS 2002). Tennessee's top agricultural products include cattle and calves, broilers, hardwood lumber, dairy products, tobacco, cotton, nursery products, soybeans, corn, fruits and vegetables, wheat, and hogs. Agricultural production alone, excluding forest products, normally generates around $ 2 billion annually in farm cash receipts in Tennessee (TASS 2001). WS has received requests for assistance related to damage by mammals to several of these resources in the past. Some examples are beaver damage to clover, corn, soybeans, and hay, and predation on calves by coyotes (USDA-WS MIS Database 2002). Complainants sometimes feel that their livelihoods are threatened and have usually tried unsuccessfully to resolve such damage through various self-help techniques. Reducing damage to resources is often considered by farmers as necessary to insure an adequate income or to avoid serious problems with farm operations. The aim of WS MDM programs will be to provide solutions to mammal damage situations which will allow agricultural producers to obtain a net gain in production as a result of a reduction in mammal damage. Prudent measures for reducing or eliminating mammal-caused damage will be recommended to requesters or implemented by WS in direct assistance programs. Such activities may include any of the approved methods summarized in Subsection 4.2.4., and may be directed toward resolving damage caused by any mammal species listed in Subsection 1.2.

3.2.2 Reductions in Mammal-caused Human Health and Safety Incidents

A number of complainants who seek assistance from WS regarding real or potential threats to human health and safety are concerned with the threat of rabies associated with bats and striped skunks (USDA-WS MIS Database 2002). Most individuals are aware of the symptoms associated with rabies and they feel uncomfortable or threatened by the presence of the animal and perceived or real threats associated with it. Some individuals seem informed about potential diseases and discuss them readily. In addition, 65% of the requests WS received for assistance with problems related to coyotes involved human health and safety issues (USDA-WS MIS Database 2002).

Mammals pose a threat to air passenger safety at airports (USDOT 1997). Although very few flights result in plane crashes and the death of those aboard, some people are apprehensive about flying because of the threat of a wildlife/aircraft strike. For them resolution of threats to aircraft traffic posed by mammals at airports is very important. WS receives several requests each year from airport managers for assistance in resolving damage threats posed by mammals as part of their program to insure safety at airports.

Resolving mammal damage of this nature is the primary goal of both those experiencing damage and WS. Programs are tailored to achieve this end, and cooperators and WS actively participate in implementing various components of a project. Such activities may include any of the approved methods summarized in Subsection 4.2.4, and may be directed toward resolving damage caused by any mammal species listed in Subsection 1.2.

3.2.3 Reductions in Damage to Property Caused by Mammals

During FY 1998 - 2002 annual property related losses to mammal damage in Tennessee reported to WS averaged $43,252 per year (USDA-WS MIS Database 2002). Types of property damaged included, but were not limited to, residential and non-residential buildings, landscape ornamentals and shrubs, dikes and impoundments, pets, aircraft, equipment and machinery, electrical utilities, bridges, and vehicles (USDA-WS MIS Database 2002). Sometimes damages could be rectified through repairing damaged property, as in cases where mammals had caused damage to residential and non-residential buildings by gnawing or tearing holes in the exterior of these types of buildings, or filling holes in levees caused by beaver and muskrat burrowing activity. Such repair or cleanup costs are sometimes factored in as part of the damage values. Damage resulting from mammal consumption of garden products or fruits was irreconcilable and costs of replanting or purchasing what was grown at a commercial source may have been factored into the loss value. These loss values represent real investments by persons who experienced damage. That segment of the public which contacts WS regarding damage to property usually has specific objectives in mind. These objectives always include eliminating damage, or reducing it to acceptable levels. WS works with individuals and entities to design professional and responsible programs based on sound wildlife management to address such damage. Methods developed for implementation to reduce or eliminate damage to property may include any of the approved methods summarized in Subsection 4.2.4 and may be directed toward resolving damage caused by any mammal species listed in Subsection 1.2.

3.2.4. Reductions in Damage to Natural Resources Caused by Mammals

Natural resource damage by mammals in Tennessee consists of, but is not limited to, incidents such as flooding of bottomland hardwood forest, and predation on endangered species as discussed in Subsection 1.3.5. Natural resource managers and the public are often concerned with total elimination of such damage because natural resources are often viewed as rare, and some are nonrenewable. WS cooperates with individuals seeking resolution of damage to natural resources in programs which often are designed on a case by case basis because of the frequently unique nature and setting of such damage. Consideration for preserving other valuable resources is often requisite to such damage management activities. As discussed in Subsection 1.3.5, Wildlife Services often conducts MDM projects for the protection of threatened and endangered species. In Tennessee, WS personnel have conducted projects aimed at reducing predation on endangered Gray and Indiana bats by raccoons, as well as removing feral hogs to reduce damage to nests made by ground nesting birds such as Bachman's sparrows (*Aimophila aestivalis*) (E. Penrod, WS, pers. comm., 2003). WS may develop other programs in Tennessee to address mammal damage to natural resources in the future. Such activities may

include any of the approved methods summarized in Subsection 4.2.4, and may address damage by any mammal species listed in Subsection 1.2.

3.3 METHODS FOR MEASURING ACCOMPLISHMENTS OF OBJECTIVES IN DIRECT ASSISTANCE PROGRAMS

All MDM program objectives discussed have reductions in damage as a common denominator. However, quantifying levels of reductions in damage, or documenting degrees of reduction in damage is sometimes difficult. Participants with WS in MDM programs often are not familiar with attaching dollar loss values to previously existing damage, and records of costs related to attempts to deal with mammal damage are poorly kept. For that reason, historical loss values are sometimes missing and WS derives only current loss values when a site is inspected during damage evaluation activities. This situation is further complicated by the fact that no scientifically based method for standardizing calculations of losses related to human health and safety threats exist. Valuable information about dollar costs to the public regarding human health and safety threats, or actual damage or death to humans, may not be reported because of the absence of established loss values. However, some factors related to expectations of cooperators regarding damage abatement may be used to provide acceptable indicators of accomplishment in MDM programs. In addition, factors measurable by WS can serve to supplement or further validate those indicators.

Losses in general are often thought of in terms of what is damaged or destroyed when mammals become a problem. Things such as acres of crops or acres of trees damaged, roads and bridges, or damages to airplanes resulting from mammal strikes are concrete losses which are directly apparent. However, other losses just as meaningful are financial costs for equipment replacement, repair, medical costs for injuries or disease, cost of seeds for replanting of crops, and many others. There are also often collateral costs which are an outgrowth of mammal damage, or subsequent efforts to address this damage. These latter two types of indirect losses are often overlooked. Losses of this nature, such as lost time because of work stoppages, extra man hours required to address incidents which occur as a result of mammal damage, loss in yields because of later replanting of crops may account for an excessive quantity of total losses occurring as a result of mammal damage. For the purposes of this EA, WS will define damage losses in the following ways:

A. Losses directly related to the presence of damaging mammals such as, but not limited to:

- Mammals flooding or otherwise damaging timber, crops, and pasture.
- Damage to residential and non-residential structures as a result of mammals damaging the exterior or interior of these structures.
- Mammals damaging golf courses, trees and shrubs, or other landscaping through various activities.
- A mammal strike to an airplane which damages the plane or injures or kills people.
- Costs of increased man hours or material for cleanup or repair of damage caused by mammals.
- Costs of MDM programs or techniques for reducing or eliminating the damage caused by mammals.

B. Losses indirectly related to the presence of damaging mammals such as, but not limited to:

- Veterinary costs and husbandry costs for animals infected or infested by mammal-borne diseases, or parasites.
- Reduced yield in crops because of late replanting where mammals have destroyed or caused damage to such crops.
- Medical costs and lost days of work associated with contraction and treatment of mammal-borne diseases among humans.

3.3.1 Qualitative Methods

3.3.1.1 Cooperator Assessment of Work Plan Accomplishments as a Measure of Achieving Objectives

Communications between cooperators and WS during implemented programs are evolving processes in which information is shared about progress, problems and contingencies. Through the process both parties have the opportunity to develop possible changes in program activities, address safety and protocol issues, and obtain further information about each other's roles. Cooperators also have opportunity to critique and grade a program's effectiveness. This input by cooperators will be used to determine efficacy of damage reductions by WS in MDM programs. WS personnel may gather this information during visits to the project site; during discussions with the cooperator, or through voluntary written information provided by the cooperator. Present Federal restrictions prohibit WS from conducting customer satisfaction surveys. However, informal gathering of such information can be done and documented by the local WS Office.

In direct assistance MDM programs WS presents cooperators with some type of work plan outlining what will be done during a project. Descriptions may include the type of damage to be addressed and the methods to be used, as well as the species that will be addressed, and any site specific procedures. These work plans are designed with consideration for cooperator needs, WS policy and procedure, best management practices for the specific project, and sound wildlife management practices. To obtain a measurement of objectives for a MDM program, WS categorizes opinions of Cooperators about effectiveness into the following numeric rating groups of 0 or 1:

A. Adequate (rating of 1): Cooperator opinions gathered by verbal or written communication and kept on file in WS records on that project fit this category when the cooperator makes a statement that affirms that a program has been successful in resolving totally, or in an acceptable part, the damage related to the species being addressed. Normally this input will be sought from the primary contact person the cooperator has assigned.

Most MDM projects in the Tennessee WS program are dated and last for one year or less. Often cooperators request the renewal of such programs under new cooperative agreements at or near the expiration date of such agreements. WS will interpret the request by a cooperator for a renewal of the program as a grade of "adequate" and an indicator that the program has satisfactorily achieved damage reduction objectives.

Some MDM programs in Tennessee are requested because cooperators have sought a continuation of such projects in anticipation of a recurrence of damage which has historically been very costly. In some instances, such as the recurrence of damage to natural resources and property damage by beavers, cessation of programs by WS has resulted in damage levels returning to pre-program proportions in less than three years. In such instances, cooperators are concerned with reducing damage to acceptable levels during initial programs, and maintaining those reductions in subsequent programs. This will be a factor used to determine accomplishment of objectives in MDM programs in Tennessee where cooperators have indicated and WS has concluded that initial objectives have been met, but new programs have been requested. When other programs are negotiated by cooperators to retain damage reduction levels previously gained, statements by them about that maintenance will be indicators that the objectives were met. In subsequent programs where maintaining the reduced damage levels previously achieved are an objective, statements by cooperators which indicate that an acceptable level of damage reduction has been maintained will be used as evidence of achievement of objectives. These ratings will become part of the grading process outlined in this Section of which an example is presented in Table 3.1.

B. Inadequate (rating of 0): Statements by cooperators indicating that acceptable damage reduction levels were not achieved or maintained are placed on record at the local WS office to indicate less than satisfactory achievement of objectives for a particular MDM program as measured by cooperator opinion. Such statements may be records of verbal communication with

the cooperator by the MDM program specialist or the supervisory biologist, or may be written documentation by the cooperator. These ratings become part of the grading process outlined in this Section of which an example is presented in Table 3.1.

3.3.2 Quantitative Methods

3.3.2.1 Observed / Calculated Damage Reductions as a Measure of Achieving Objectives

Damage assessments by WS personnel are usually conducted when visiting a damage site and developing recommendations for solutions. Since these assessments usually occur before any work is done at a site, WS will use such evaluations to derive benchmark values for mammal damage losses which might occur without intervention of direct assistance programs. Such values may be used for site-specific reference or may be used to establish indices for similar mammal damage projects.

The use of damage loss values to determine if site specific objectives have or have not been met will be accomplished by comparing time-framed loss values before damage management activities began with time-framed loss values during or immediately following a MDM program. For instance, losses incurred by a cooperator during a one year interval prior to WS activities could be calculated and one-year losses occurring during, or following, a WS implemented MDM program could be compared. If latter losses for a comparable time interval are less than former losses, the project will be given an adequate rating (rating of 1). If this is not the case and the latter losses are greater than, or equal to, the former losses an inadequate rating (rating of 0) will be given.

The following rules may be used by WS to obtain benchmark and comparison data:

- WS MDM program managers may use any reasonable time-frame for damage-loss value calculations, but pre- and post-time frames will be equal in the number of days being evaluated. Blocks of time used for calculations could be any time frame from a few days to one year. This would depend on the length of time cooperators have tracked losses, what elements of loss have been tracked, and length of a MDM program implemented, or length of time a MDM program continues through cooperative agreement renewals.
- WS MDM program managers may use any component of a specific project to calculate losses for analysis and conclusions. For instance, if WS conducts a county-wide program to reduce damage by beaver, the MDM program manager may use only standing hardwood timber as the indicator resource if that is the primary protected resource and is the primary target of beaver for the county. Further, if only one property owner's resource is being damaged in that county, the WS MDM program manager may use that property owner's resource to measure damage and use a current board foot per acre measurement as a benchmark for comparison of losses.

3.3.2.2 Observed / Calculated Resources Saved as a Measure of Achieving Objectives

As discussed earlier in this section, cooperators sometimes request and receive WS MDM services to protect resources because historical evidence related to their projects demonstrates that during periods of time in which no MDM activities are conducted damage by mammals increases to unacceptable proportions. In these continuing programs, previous time-framed damage-loss values may be outdated or unavailable. In these instances, WS often establishes the saving of resources as objectives either in work plan outlines or in communications with cooperators. Saving resources which might otherwise be lost to damage by wildlife is an important priority to many resource managers who cooperate with WS. In addition, this aspect of agency mission objectives is considered by some to be pivotal to sound wildlife damage management (B. Dunlap, WS, pers. comm., 2003). Resources saved might be viewed as that component of resources which are not destroyed, threatened, or reduced in value by the activity of damaging wildlife, or that portion of resources, such as manpower, equipment, material, or effort not expended to combat losses to wildlife. Projects that result in the saving of any resources that would have been lost without a MDM program will be given an adequate rating (rating of 1). Those projects that do not meet this criterion will be given an inadequate rating (rating of 0). Resources saved as a result of MDM

programs in Tennessee may be used by some WS program managers as a component for determining whether objectives are achieved.

In order to appropriately determine resources saved in MDM programs, it is essential to identify the nature of damage to certain resources, and the way that such damage can occur. For instance, the presence of mammals on the runway of an airport, during times when flights are arriving or departing, presents a threat to both aircraft and occupants therein (USDOT 1997) although no damage has yet occurred. Again, the presence of rabid skunks or raccoons in a neighborhood can provide a rabies threat to the local residents. In both of these examples the resource is human health and safety and the damage is a safety or disease threat. It follows then, that if a MDM action or program disperses mammals from a runway and thereby eliminates the threat to the safety of 250 air passengers, or reduces a local population of skunks or raccoons in a residential area where rabies may be a threat to 100 residents; both programs may be evaluated for resources saved. On the one hand, the airport action preserved 250 human lives from a potential safety threat and on the other the residential action preserved 100 human lives from a potential health threat. WS addresses resource protection with consideration for such potential damage, and in calculating what resources are saved as a result of MDM programs this kind of damage will be factored into deriving conclusions about achieving objectives.

Determining the value and quantity of resources saved as a result of MDM programs becomes more straightforward when known losses can be calculated from historical data about a site where mammal damage has occurred. However it is an extremely complicated issue, primarily because indices for resources lost during periods of no MDM activities are often incomplete or lacking and changes in the value or quantity of a managed resource are sometimes continuous. For example, the number of human lives protected by a MDM program at an airport that scares mammals from the vicinity of runways changes from hour to hour and day by day. Again, a resource such as an agricultural crop changes in value by the season and amount of effort expended by the producer to tend it. There are however, some instances in which known resources are expended or lost in the absence of MDM activities and these can be compared to the same or similar resource savings or losses during MDM programs to derive values for resources saved. An example could be a situation where a county road crew expended 200 additional man hours for two consecutive years to replace culverts and repair a road destroyed by flooding resulting from beaver stopping up the culverts under the road. However, when a MDM program was instituted, no beaver related flooding occurred during the year-long program. The following year another MDM program was initiated and records of the county highway department showed that again, no additional man-hours were expended repairing road damage at this site caused by beaver for the second year. It follows that 400 man hours, or their dollar equivalent, represented resources saved by the county highway department. In this scenario, a score of "adequate" or "inadequate" (1 or 0, respectively) would be obtained and could be used as part of the evaluation to determine if the objectives were met for the program.

3.4 DETERMINATION OF OVERALL OBJECTIVE GRADE

Success in meeting objectives for the Tennessee MDM program will be determined using any combination which incorporates both qualitative and quantitative data, but the choice of components may depend on the availability and appropriateness of data. Thus a WS program manager may use Cooperator assessments, combined with observed/calculated damage reductions, or Cooperator assessments combined with observed/calculated resources saved to formulate a conclusion of record for the MDM program. Likewise, the WS program manager may use Cooperator assessments and a combination of observed/calculated damage reductions and observed/calculated resources saved to formulate a conclusion of record. This latter method is depicted in Table 3.1. A typical record would always contain Cooperator input grades, and could contain both damage reduction and resources saved grades, or only one of the two. Each separate record would have at least two grades.

Conclusions about accomplishments related to objectives in a statewide MDM program will be derived using both cooperator input (qualitative information) and WS calculated data (quantitative information), as available and appropriate, in the following way:

- A numeric rating will be obtained for each project by averaging together the qualitative and quantitative ratings that are derived from evaluating each specific program.
- A majority (51% or greater) grade of "Adequate" based on pooled grades from all MDM projects in Tennessee during the selected time frame will satisfy a conclusion that the program successfully met objectives set forth.
- WS MDM program managers will calculate and record a conclusion concerning program objectives on an annual basis for the overall statewide MDM program. This record will be derived by calculating a grade for each cooperative program upon its completion to derive individual values to be pooled for final statewide conclusions about accomplishment of objectives.

An example summary of individual projects with project grades, final totals and calculation of the annual MDM grade is presented in Table 3.1. This prototypical program depicts the completion and scoring of 10 MDM programs during the year and indicates that eight of ten programs received an "adequate (rating of 1)" from Cooperators and eight programs received an "adequate" rating as determined by WS calculations. Following the formula in the table, a final grade of 80% is derived. Since a grade of 51% was needed, the imaginary MDM program was successful in meeting objectives.

Table 3.1. Summary Of Example Cooperative MDM Programs with Derived Grades and Calculated Score from Pooled Results for the Purpose of Determining Success in Meeting Overall MDM Program Objectives.

COOPERATIVE PROGRAMS	A COOPERATOR GRADE (0 or 1)	B DAMAGE REDUCTION GRADE (0 or 1)	C RESOURCES SAVED GRADE (0 or 1)
1. Agricultural Protection Program # 1	1	1	
2. Agricultural Protection Program # 2	0	1	
3. Human Health And Safety Protection Program # 1	1		1
4. Human Health And Safety Protection Program # 2	1	1	
5. Human Health And Safety Protection Program # 3	1	1	
6. Natural Resources Protection Program # 1	0		1
7. Natural Resources Protection Program # 2	1		0
8. Property Protection Program # 1	1	0	
9. Property Protection Program # 2	1		1
10. Property Protection Program # 3	1	1	
NUMERICAL TOTALS	8	5	3
FINAL SCORE IN PERCENT $\frac{\frac{1}{2}A + \frac{1}{2}(B+C)}{\text{\# Programs}} \times 100 = \frac{4+4}{10} \times 100 = 80\%$			

4.0 CHAPTER 4: ALTERNATIVES INCLUDING THE PROPOSED ACTION

Chapter 4 contains a discussion of the project alternatives, including those that will receive detailed environmental impacts analysis in Chapter 5 (Environmental Consequences), alternatives considered but not analyzed in detail, with rationale, and mitigation measures and SOP's for wildlife damage management techniques. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues used to develop mitigation measures. Evaluation of the affected environments will be addressed in more detail in Chapter 5.

Alternatives were developed for consideration using the WS Decision Model (Slate et al. 1992) as described in Chapter 2 (pages 20-35), Appendix J (Methods of Control), Appendix N (Examples of WS Decision Model), and Appendix P (Risk Assessment of Wildlife Damage Control Methods Used by USDA, Wildlife Services Program) of the ADC FEIS (USDA 1997).

The No Action alternative is a procedural NEPA requirement (40 CFR 1502), and is a viable and reasonable alternative that could be selected. This alternative serves as a baseline for comparison with the other alternatives. The No Action alternative, as defined here, is consistent with the Council on Environmental Quality's (CEQ's) definition (CEQ 1981).

Alternatives analyzed in detail are:

1) **Alternative 1 - Continue the Current Federal MDM Program.** This is the Proposed Action and is the "No Action" alternative as defined by the Council on Environmental Quality for analysis of ongoing programs or activities.

2) **Alternative 2 - Nonlethal Required Before Lethal Control.** This alternative would not allow lethal control by WS until all nonlethal methods had been tried and found to be inadequate in each damage situation. .

3) **Alternative 3 - Technical Assistance Only.** Under this alternative, WS would not conduct any direct operational MDM activities in Tennessee. If requested, affected requesters would be provided with technical assistance information only.

4) **Alternative 4 - No Federal WS MDM.** This alternative consists of no Federal MDM program by WS. Affected resource owners would be left to their own devices to address mammal damage in Tennessee.

4.1 DESCRIPTION OF THE ALTERNATIVES

4.1.1 Alternative 1 - Continue the Current Federal MDM Program (No Action/Proposed Action)

The proposed action is to continue the current portion of the WS program in Tennessee that responds to requests for MDM to protect agriculture, human health and safety, natural resources, and property in Tennessee. One component of MDM in the Tennessee WS program has the goal of minimizing human health and safety threats and property damage in urban and rural environments. Primary species of concern related to damage in these environments are raccoons, coyotes, groundhogs, skunks, and beavers. Damage by these or other mammal species also may be addressed by WS in MDM programs aimed at reducing losses or the risk of loss to agricultural crops, livestock, timber, and any other agriculture-related resource. In addition, damage caused by mammal species to natural resources, including threatened and endangered species, wildlife, natural flora, parklands, recreation areas, peculiar habitats, etc. may be addressed through programs conducted by WS. Elimination or alleviation of damage to property such as residential and non-residential buildings, water resources, dikes, dams, impoundments, drainages, landscape plantings, golf courses, grasses and turf, pets, zoo animals, trees, or any other properties would be an objective of WS MDM programs contemplated under this EA.

WS' objective would be to attempt to respond to all requests for assistance with, at a minimum, technical assistance or self-help advice, or, where appropriate and when cooperative or congressional funding is available, direct damage management assistance in which professional WS Wildlife Biologists or Specialists conduct damage management actions. An Integrated Wildlife Damage Management approach would be

implemented which would allow use of any legal technique or method, used singly or in combination, to meet requester needs for resolving conflicts with mammals. Lethal methods used by WS could include shooting, trapping, snaring, and FDA and EPA approved chemicals. Nonlethal methods used by WS could include fencing, netting, deterrents/repellents, exclusion, harassment, habitat alteration, or live-capture and translocation for some individuals of some species. However, non-lethal methods would not always be applied as a first response to each damage problem. 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. In many situations, the implementation of nonlethal methods such as exclusion-type barriers would be the responsibility of the requester which means that, in those situations, WS's only function would be to implement lethal methods if determined to be necessary. MDM by WS would be allowed in the State, when requested on private property or public facilities where a need has been documented upon the completion of an *Agreement for Control*. All management actions would comply with appropriate Federal, State, and Local laws. Appendix B provides a more detailed description of the methods that could be used under the proposed action.

4.1.2 Alternative 2 - Nonlethal Required Before Lethal Control

This alternative would not allow the use of lethal methods by WS as described under the proposed action until all nonlethal methods had been attempted to relieve damage caused by mammals, and these methods were found to be ineffective or inadequate. Although personnel experienced in MDM generally know when and where nonlethal control techniques would work, this alternative could result in the use of methods that are known to be ineffective in particular situations. This would be likely to increase the costs of MDM efforts and would allow unacceptable levels of damage to continue until requirements of this strategy could be met. Appendix B provides a more detailed description of the methods that could be used under this alternative.

4.1.3 Alternative 3 - Technical Assistance Only

This alternative would not allow for WS operational MDM in Tennessee. WS would only provide technical assistance and make recommendations when requested. Producers, property owners, agency personnel, or others could conduct MDM using traps, shooting, vertebrae pesticides or any nonlethal or lethal method that is legal available to them. Property owners and land managers could implement their own mammal damage management program, use contractual services of private businesses, use volunteer services, or take no action. This alternative would place the immediate burden of operational damage management work on the property owners and other federal, state, or county agencies. Appendix B describes a number of methods that could be employed by private individuals or other agencies after receiving technical assistance advice under this alternative.

4.1.4 Alternative 4 - No Federal WS MDM

This alternative would eliminate WS' Federal involvement in MDM in Tennessee. WS would not provide direct operational or technical assistance and requesters of WS services would have to conduct their own MDM without WS input. Information on MDM methods would still be available to producers and property owners through such sources as USDA Agricultural Extension Service offices, TWRA, universities, or pest control organizations or companies. Property owners and land managers could implement their own mammal damage management program, use contractual services of private businesses, use volunteer services, or take no action. This alternative would place the immediate burden of operational damage management work on the property owners and other federal, state, or county agencies.

4.2 MDM STRATEGIES AND METHODOLOGIES AVAILABLE TO WS IN TENNESSEE

The strategies and methodologies described below include those that could be used or recommended under Alternatives 1, 2 and 3 described above. Alternative 4 would terminate both WS technical assistance and operational MDM by WS. Appendix B is a more thorough description of the methods that could be used or recommended by WS.

4.2.1 Integrated Wildlife Damage Management (IWDM)

For more than 70 years, WS has considered, developed, and used numerous methods of managing wildlife damage problems (USDA 1997, P. 2-15). The efforts have involved research and development of new methods and the implementation of effective strategies to resolve wildlife damage.

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. IWDM is the implementation and application of safe and practical methods for the prevention and control of damage caused by wildlife based on local problem analyses, and the informed judgment of trained personnel. The WS Program applies IWDM, commonly known as Integrated Pest Management (IPM) (WS Directive 2.105), to reduce damage through the WS Decision Model (Slate et. al. 1992) described in the FEIS (USDA 1997).

The philosophy behind IWDM is to implement functional damage management techniques in an overall effective manner, while minimizing the potentially harmful effects on humans, target and nontarget species, and the environment. IWDM draws from the largest possible array of options to create a combination of techniques appropriate for the specific circumstances. IWDM may incorporate cultural practices (i.e. animal husbandry), habitat modification (i.e. barriers, exclusionary methods), animal behavior modification (i.e. scaring), population management (i.e. local population reduction, redistribution of animal populations through live-capture and translocation), or any combination of these, depending on the characteristics of the specific damage problems and other criteria, such as management objectives of state wildlife agencies. In selecting management techniques for specific damage situations consideration is given to the:

- Species responsible,
- Magnitude and geographic extent of damage,
- Duration and frequency of the damage,
- Prevention of future damage (lethal and nonlethal techniques), and
- Environmental concerns such as T&E species in the same area.

The cost of IWDM may be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

WS employs different strategies to resolve wildlife damage problems. In certain situations, WS may provide cooperators with the information necessary to resolve the problem themselves (technical assistance). In others, WS may directly resolve the problem (direct assistance). However, the most common strategy to resolve wildlife damage is to use a combination of these approaches.

4.2.2 The IWDM Strategies Employed by WS

4.2.2.1 Technical Assistance Recommendations

"Technical assistance" as used herein is information, demonstrations, and advice on available and appropriate wildlife damage management methods. The implementation of damage management actions is the responsibility of the requester. In some cases, WS provides supplies or materials that are of limited availability for non-WS entities to use. Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, several management strategies are described to the requester for short and long-term solutions to damage problems. These strategies are based on the level of risk, need, and the practicality of their application.

Under APHIS NEPA Implementing regulations and specific guidance for the WS program, WS technical assistance is categorically excluded from the need to prepare an EA or EIS. However, it is discussed in this EA because it is an important component of the IWDM approach to resolving mammal damage problems.

4.2.2.2 Operational Damage Management Assistance

Operational assistance is the conduct or supervision of damage management activities by WS personnel. Operational damage management assistance may be initiated when the problem cannot effectively be resolved through technical assistance alone, and when *Agreements for Control* or other comparable instruments provide for direct damage management by WS. The initial investigation defines the nature, history, extent of the problem, species responsible for the damage, and methods that would be available to resolve the problem. Professional skills of WS personnel are often required to effectively resolve problems, especially if restricted use pesticides are necessary, or if the problems are complex.

4.2.2.3 Education/Outreach Programs

Education/outreach is an important element of WS' program activities, because wildlife damage management is about finding "balance" or co-existence between the needs of people and 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 sustaining damage, lectures and demonstrations are provided to farmers, homeowners, and other interested groups. WS frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS' personnel, other wildlife professionals, and the public are updated on recent developments in damage management technology, laws and regulations, and agency policies. WS provides informational leaflets about mammal damage management, biology, and ecology. Tennessee WS program annually provides hundreds of mammal leaflets and handouts to the public about MDM. This information is disseminated by means of school programs, exhibits, and calls from requesters.

4.2.2.4 Research and Development

The National Wildlife Research Center (NWRC) functions as the research unit of WS by providing scientific information and development of methods for wildlife damage management that is effective and environmentally responsible. NWRC scientists work closely with wildlife managers, researchers, field specialists and others to develop and evaluate wildlife damage management techniques. NWRC scientists have authored hundreds of scientific publications and reports, and are respected world-wide for their expertise in wildlife damage management.

4.2.2.5 Examples of WS Operational and Technical Assistance in MDM in Tennessee.

The following examples serve as illustrations of WS Operational and Technical Assistance MDM projects. They are intended to present realistic examples of on-going MDM projects only and are not a conclusive or all encompassing list of all MDM projects conducted by WS in Tennessee.

Management of Wildlife Hazards to Aircraft and Air Passengers in Tennessee

WS participates with the Federal Aviation Administration under a MOU to provide information or services, upon request, to airports in Tennessee. WS evaluates wildlife hazards at airports upon request, provides such airports with Wildlife Hazard Assessments which outline wildlife hazards found, and assists airports in developing Wildlife Hazard Management Plans to address wildlife threats. WS also assists airports in obtaining the necessary permits for the purpose of managing hazard threats posed by species such as white-tailed deer. IWDM strategies are employed and recommended for these facilities.

WS's current program in Tennessee utilizes one full-time and several part-time employees to conduct IWDM programs and to monitor wildlife hazards at airports to insure the protection of human lives and aircraft. In addition to direct operational activities consisting of various harassment, live capture and lethal removal techniques aimed at potentially injurious wildlife, WS personnel provide ongoing technical advice to airport managers regarding methodologies to reduce the presence of wildlife in airport environs. WS may also oversee various habitat management projects implemented by airport personnel in order to provide technical expertise about methods. In addition, WS promotes improved mammal strike record

keeping and maintains a program of mammal identification and monitoring of mammal numbers at participating airports.

WS may receive requests in the future from airports previously discussed, or any other airports in Tennessee, for assistance in resolving wildlife hazards to aviation. WS may provide technical assistance and / or direct operational assistance using any combination of approved methods discussed in this EA which are appropriate for use in airport environments.

Management of Damage Caused by Beaver

Wildlife Services personnel conduct operational beaver damage management projects at the request of various Federal and State agencies, organizations, and individuals to reduce beaver damage to bottomland hardwood timber, levees and dams, waterfowl refuges, agricultural crops, commercial timber, roads and bridges, natural areas and other property.

When conducting operational beaver damage management activities, WS personnel utilize a variety of lethal methods to remove beaver. These methods include conibear and foothold traps, snares, and shooting. When warranted, beaver dams are breached by manual methods or through the use of binary explosives. WS personnel often advise cooperators of drainage problems such as excessive siltation and drainage blockages other than beaver dams.

Often individuals experiencing damage caused by beaver will be referred to WS by other Federal agencies as well as State agencies. When receiving such calls, WS personnel provide the requester with the techniques, both lethal and nonlethal, that can be utilized to address damage caused by beaver. In some instances, individuals will request operational assistance from WS after techniques are discussed with them.

Management of Threats to Human Health caused by Raccoons

The Tennessee Wildlife Services program cooperates with WS programs in other states, and various State Agencies to implement an oral rabies vaccination (ORV) program in Tennessee. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal. The disease can be effectively prevented in humans and many domestic animals species, but abundant and widely distributed reservoirs among wild mammals complicate rabies control. The vast majority of rabies cases reported to the Centers for Disease Control and Prevention (CDC) each year occur in raccoons (*Procyon lotor*), skunks (primarily *Mephitis mephitis*), and bats (Order *Chiroptera*).

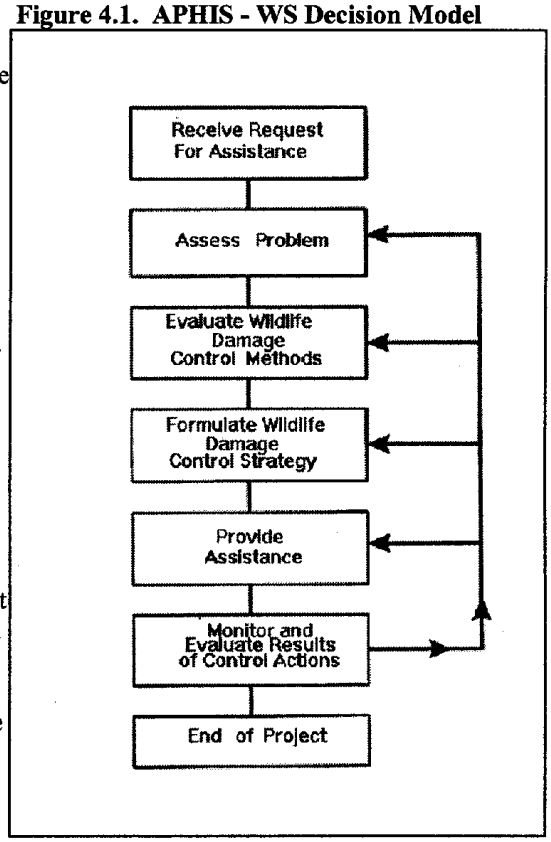
Raccoon rabies presents a human health threat through potential direct exposure to rabid raccoons, or indirectly through the exposure of a pet that had an encounter with a rabid raccoon. The number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested and the number of post exposure treatments are all greater when raccoon rabies are present in the 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.

Wildlife Services personnel utilize aircraft and hand baiting to distribute ORV baits to a delineated area in Tennessee which has been determined to be part of the ORV barrier to stop the westward expansion of raccoon rabies (USDA 2001). WS personnel are also involved in rabies monitoring and surveillance activities which include the capture and release or lethal collection of raccoons to take biological samples for testing to determine the effectiveness of the ORV program.

4.2.3 WS Decision Making

WS personnel use a thought process for evaluating and responding to damage complaints that are depicted by the WS Decision Model described by Slate et al., in 1992 (Figure 4.1). WS personnel are frequently contacted after requesters have tried or considered nonlethal methods and found them to be impractical, too costly, or inadequate for acceptably reducing damage. WS personnel assess the problem; evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic and social considerations. Following this evaluation, methods deemed to be practical for the situation are incorporated into a management strategy. After this strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of the WS Decision Model (Slate et al. 1992), most damage management efforts 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.

Figure 4.1. APHIS - WS Decision Model



4.2.4 Mammal Damage Management Methods Available for Use. (See Appendix B for detailed descriptions)

4.2.4.1 Nonchemical Methods

Agricultural producer and property owner practices consist primarily of nonlethal preventive methods such as **cultural methods[1] and habitat modification.**

Animal behavior modification refers to tactics that alter the behavior of mammals to reduce damages. Some but not all of these tactics include the following:

- Propane exploders
- Pyrotechnics
- Visual repellents and scaring tactics
- Electronic guards

Animal husbandry practices include modifications in the level of care or attention given to livestock (depending on the age and size of the livestock). Animal husbandry practices include, but are not limited to, the use of:

- guard animals
- herders
- carcass removal
- fencing
- pasture selection

Habitat modification is used whenever practical to attract or repel certain wildlife species or to separate livestock from predators. For example, WS may recommend that a producer clear brush from lambing or

[1]Generally involves modifications to the management of protected resources to reduce their vulnerability to wildlife damage.

calving pastures to reduce available cover for predators. Habitat management also may involve manipulating beaver impoundment water levels to reduce damage or conflict caused by flooding and inundation. Water control devices and pond levelers are installed to regulate the volume of water and can be effective in reducing flooding in certain situations. Water control devices and pond levelers also are utilized as a means of exclusion at road culverts.

Beaver Dam Breaching/Removal. Beaver dam breaching/removal involve the removal of debris deposited by beaver that impedes water flow. Debris would be removed from beaver dams with binary explosives or hand tools.

Live capture and relocation can be conducted to reduce damage caused by certain mammals. Various capture devices such as box or cage traps, and nets can be used to live capture mammals for relocation. In some instances permits are required by the State wildlife agency to capture and remove certain mammals.

Lure crops/alternate foods are crops planted or other food resources provided to mitigate the potential loss of higher value crops.

Sport hunting/trapping can be part of a MDM strategy to enhance the effectiveness of harassment techniques or used to reduce local populations of mammals. For example, WS sometimes directs sport hunters to contact TWRA about areas where white-tailed deer causing damage, or informs individuals requesting assistance about the option of utilizing sport hunting as a management tool.

Shooting is selective for the target species and may involve the use of spotlights and rifles or shotguns. Calls and decoys may also be utilized with shooting. WS personnel using firearms receive firearms safety training as specified by appropriate WS directives.

Foothold Traps can be effectively used to capture a variety of mammals. Placement of traps is contingent upon habits of the respective target species, habitat conditions, and presence of nontarget animals.

Snares are capture devices comprised of a cable formed in a loop with a locking device. Snares are usually placed in travel ways. Snares may be used as either a lethal or nonlethal method. Snares are generally easier to keep operational than foothold traps during inclement weather.

Cage traps are live capture traps used to trap a variety of small to medium sized mammals. Cage traps are available in a variety of sizes. A cage traps is typically made of galvanized wire mesh, and consists of a treadle in the middle of the cage that triggers the door to close behind the animal being trapped.

Body grip (Conibear type) traps are designed to cause the quick death of the animal that activates the trap. Body grip traps usually range in size from #110 to #330. Safety hazards and risks to humans are usually related to setting, placing, checking, or removing traps.

Denning is the practice of finding coyote dens and eliminating the young, adults, or both to stop an ongoing predation problem or prevent future depredation on livestock.

Aerial Shooting or aerial hunting (shooting from an aircraft) is a commonly used coyote damage management method; it especially can be effective in removing offending coyotes that have become "bait-shy" to trap sets or are not susceptible to calling and shooting. WS uses aerial hunting to remove coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, and other permitted animals.

4.2.4.2 Chemical Methods (See Appendix D for EPA labels and MSDS)

Repellants. Several products are available that are designed to act as repellants for certain mammals. Most of these are taste repellants used on trees, shrubs, garbage, fences and other objects. Some of the trade names for repellants include:

- Hinder®

- Ropel® Animal, Rodent, and Bird Repellent
- Ropel® Garbage Protector
- Deer Away® Big Game Repellent

As with most repellents, frequent reapplication is often necessary to obtain continued results.
Carbon dioxide (CO_2) gas is an American Veterinary Medical Association (AVMA) approved euthanasia method which is sometimes used to euthanize mammals which are live captured and when relocation is not a feasible option (Beaver et al. 2001). Live animals are placed in a container or chamber into which CO_2 gas is released. The animal quickly expires after inhaling the gas.

Gas cartridges are incendiary devices designed to give off carbon monoxide and other poisonous gases and smoke when ignited. They are used to fumigate burrows of certain rodents and other mammals.

Toxicants are chemicals that kill instead of repel animals. The use of toxicants by WS personnel in TN is directed primarily at reducing damage caused by rodents. All toxicants used by WS personnel are registered under FIFRA and administered by the EPA. WS personnel who use toxicants are certified to use such products by the Tennessee Department of Agriculture according to established rules and regulations set forth by that agency. One toxicant utilized by WS in Tennessee is Zinc Phosphide (ZP). ZP is a heavy, finely ground black powder that is practically insoluble in water. When ZP comes in contact with moisture, it slowly decomposes and releases phosphine gas (PH_3). Another toxicant that may be used is Aluminum phosphide.

Warfin and Diphacinone are anticoagulant rodenticides used to control rodents around buildings and other structures.

Ketamine (Ketamine HCl) is a dissociative anesthetic that is used to capture wildlife, primarily mammals, birds, and reptiles. It is used to eliminate pain, calms fear, and allays anxiety.

Telazol (tiletamine) is another anesthetic used in wildlife capture. It is 2.5 to 5 times more potent than ketamine; therefore, it generally works faster and lasts longer.

Xylazine is a sedative that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia.

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. There are DEA restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified WS personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with DEA and state regulations.

4.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

Several alternatives were considered, but not analyzed in detail. These were:

4.3.1 Lethal MDM Only by WS

Under this alternative, WS would not conduct any nonlethal control of mammals for MDM purposes in the State, but would only conduct lethal MDM. This alternative was eliminated from further analysis because some mammal damage problems can be resolved effectively through nonlethal means. For example, a number of damage problems involving the encroachment of smaller mammals such as squirrels into buildings can be resolved by installing barriers or repairing of structural damage to the buildings, thus excluding the animal. Further, such damage situations as immediately shooting a coyote or white-tailed deer on a runway might not be possible, where as scaring them away through noise harassment might resolve the air passengers' threat at once. In addition, a lethal-only program does not satisfy wildlife management objectives of WS, TWRA, and USFWS.

4.3.2 Compensation for Mammal Damage Losses

The compensation alternative would require the establishment of a system to reimburse persons impacted by mammal damage. This alternative was eliminated from further analysis because no Federal or State laws currently exist to authorize such action. Under such an alternative, WS would not provide any direct management or technical assistance. Aside from lack of legal authority, analysis of this alternative in the FEIS indicated that the concept has many drawbacks (USDA 1997):

- It would require larger expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation. A compensation program would likely be significantly more costly than the current program. In Tennessee, damage reported to WS by all species of damaging mammals exceeded $5.75 million during FY 1998 - 2002, yet the current WS program of abating such damage only costs about $162,000 federally appropriated funds per year. In addition, damage reported as $5.75 million for Tennessee was actually far less than occurred in reality, since only $2,200 in costs related to human health and safety were derived, because of the difficulty of determining such damage values.
- Compensation would most likely be below full market value.
- It would be difficult, if not impossible, to assess and confirm losses in a timely manner for all requests, and, therefore, many losses could not be verified and would remain uncompensated.
- Compensation would give little incentive to resource owners to limit damage through improved cultural, husbandry, or other practices and management strategies.
- Not all resource owners would rely completely on a compensation program and unregulated lethal control would most likely continue as permitted by State law.
- Compensation would not be practical for reducing threats to human health and safety.

4.3.3 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 on private, State, Local and Federal government lands wherever a cooperative program was initiated in the State.

In Tennessee, eradication of native mammal species is not a desired population management goal of State agencies or WS. Although generally difficult to achieve, eradication of a local population of nutria (*Myocastor coypus*) may be the goal of individual MDM projects in fulfillment of Executive Order 13112 On Invasive Species (see Subsection 1.8.2.6). This is because the nutria is not native to North America and is only present because of human introduction. However, eradication as a general strategy for managing mammal damage will not be considered in detail because:

- All State and Federal agencies with interest in, or jurisdiction over, wildlife oppose eradication of any native wildlife species.
- Eradication is not acceptable to most people.

Suppression would direct WS program efforts toward managed reduction of certain problem populations or groups. In areas where damage can be attributed to localized populations of mammals, WS can decide to implement local population suppression as a result of using the WS Decision Model. Problems with the concept of suppression are similar to those described above for eradication.

It is not realistic or practical to consider large-scale population suppression as the basis of the WS program. Typically, WS activities in the State would be conducted on a very small portion of the sites or areas inhabited or frequented by problem species.

4.3.4 Bounties

Payment of funds (bounties) for killing some mammals suspected of causing economic losses have not been supported by Tennessee State agencies such as TWRA and TDA as well as most wildlife professionals for

many years (Latham 1960, Hoagland 1993). WS concurs with these agencies and wildlife professionals because of several inherent drawbacks and inadequacies in the payment of bounties, including:

- Bounties are generally ineffective at controlling damage, especially over a wide area such as Tennessee,
- Circumstances surrounding the take of animals are typically arbitrary and completely unregulated,
- It is difficult or impossible to assure animals claimed for bounty were not taken from outside the damage management area, and
- WS does not have the authority to establish a bounty program.

4.3.5 Reproduction Control

Reproductive control is often considered for use where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). Use and effectiveness of reproductive control as a wildlife population management tool is limited by population dynamic characteristics (longevity, age at onset of reproduction, population size and biological/cultural carrying capacity, etc.), habitat and environmental factors (isolation of target population, cover types and access to target individuals, etc.), socioeconomic and other factors. 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. Research into reproductive control technologies, however, has been ongoing, and the approach will probably be considered in an increasing variety of wildlife management situations.

Reproductive control for wildlife could be accomplished either through sterilization (permanent) or contraception (reversible, initial treatment usually followed by a booster and annual follow-up treatments).

Sterilization could be accomplished through:

- Surgical sterilization (vasectomy, castration, and tubal ligation),
- Chemosterilization
- Gene therapy.

Contraception could be accomplished through:

- Hormone implantation (synthetic steroids such as progestins)
- Immunocontraception (contraceptive vaccines)
- Oral contraception (progestin administered daily).

Research into the use of these techniques would consist of laboratory/pen experimentation to determine and develop the sterilization or contraceptive material or procedure, field trials to develop the delivery system, and field experimentation to determine the effectiveness of the technique in achieving population reduction.

The use of hormones was investigated (Matschke 1976, 1977 a, b, c, Roughton 1979), and eventually rejected as an effective and efficient reproductive control technique for deer. Additionally, concerns related to costs and logistics of widespread distribution of drugged baits, dosage control and ingestion of baits by children and nontarget animals make oral contraception (by steroids) largely impractical (Lowery et al. 1993). More recently, immunocontraception has been studied in various situations and locations, but its potential use appears limited due to considerable constraints regarding treatment and follow-up treatment of a sufficiently large number of target animals, varying immunogenecity of vaccines, genetic backgrounds of individual animals, age, nutritional status, stress and other factors (Becker and Katz 1997, Becker et al. 1999). Immunocontraceptive vaccines prevent conception by stimulating the production of antibodies that bioneutralize proteins or hormones essential for reproduction (Miller et al. 2000). The use of porcine zona pellucida (PZP) as a contraceptive agent in wildlife management has been investigated recently (Kirkpatrick et al. 1990, Turner and Kirkpatrick 1991, Turner et al. 1992 and 1996), but to date, there is no published documentation that immunocontraceptive

vaccines have successfully reduced any free-ranging deer herd or population. Additionally, Underwood and Verret (1998) reported that despite 5 years of PZP treatment, the Fire Island, NY white-tailed deer population continued to grow, albeit at a slower rate. Other components of the reproductive system have been studied for immunocontraception as well, such as GnRH (Becker and Katz 1997, Becker et al. 1999).

Recently, Canadian researchers at Dalhousie University (Halifax, Nova Scotia) have investigated the use of a single-dose immunocontraceptive vaccine based on liposome delivery of PZP antigens (Spay Vac ™), and reported a 90% reduction in pup production by gray seals (*Halichoerus grypus*) (Brown et al. 1997). Fraker et al. (in press) reported that fertility of an island population of fallow deer (*Dama dama*) was greatly reduced by a single administration of Spay Vac ™ during the first year of treatment; a longer- term assessment is underway. Refinement of the delivery system and field application/experimentation on the ability of Spay Vac ™ to reduce free-ranging cervid populations will occur in subsequent years.

Turner et al. (1993) note that although contraception in white-tailed deer may be used to limit population growth, it will not reduce the number of animals in excess of the desired level in many circumstances. They 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. In sum, although immunocontraceptive technology has been variously effective in laboratories, pens, and in island field applications, it has not been effective in reducing populations of free-ranging white-tailed deer.

Development of a single-shot sterilization technique as an alternative to immunocontraception was investigated by Rutgers University scientists in 2000. One possible approach is gene therapy which could accomplish reproductive control via sterilization through producing death of the anterior pituitary cells that synthesize luteinizing hormone (LH), which triggers ovulation in females and spermatogenesis in males. Efficacy testing and development of a delivery system will be investigated over the next few years.

The use of reproductive control is subject to Federal and State regulation. Additionally:

- No chemical or biological agent to accomplish reproductive control for free-ranging mammals has been approved by Federal and Tennessee authorities,
- For cervids, reproductive control has not been shown to reduce free-ranging populations or damage,
- If an effective tool was legally available, and if the project area was fenced., it would take many years for some mammal populations to stabilize at a lower level, and ongoing damage would continue to occur at unacceptably high levels, and
- There are considerable logistic, economic and socio-cultural limitations to trapping, capturing and chemical treatment of the hundreds or thousands of mammals that would be necessary to affect an eventual decline in the population. Because there is no tool currently available for field application, and due to considerable logistic, economic, and socio-cultural limitations to the use of fertility control on free-ranging mammals, this approach is not considered for further analysis in this EA.

4.4 MITIGATION AND STANDARD OPERATING PROCEDURES FOR MAMMAL DAMAGE MANAGEMENT TECHNIQUES

4.4.1 Mitigation in Standard Operating Procedures (SOPs)

Mitigation measures are any features of an action that serve to prevent, reduce, or compensate for effects that otherwise might result from that action. The current WS program, nationwide and in Tennessee, uses many such mitigation measures and these are discussed in detail in Chapter 5 of the FEIS (USDA 1997). Some key mitigating measures pertinent to the proposed action and alternatives that are incorporated into WS's Standard Operating Procedures include:

- The WS Decision Model thought process which is used to identify effective wildlife damage management strategies and their effects.
- Reasonable and prudent measures or alternatives are identified through consultation with the USFWS and are implemented to avoid effects to T&E species.

- EPA-approved label directions are followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects to the environment when chemicals are used in accordance with label directions.
- Drugs are used according to the Drug Enforcement Agency, FDA, and WS program policies and directives and procedures are followed that minimizes pain.
- All controlled substances are registered with DEA or FDA.
- WS employees would follow approved procedures outlined WS Field Manual for the Operational Use of Immobilizing and Euthanizing Drugs (Johnson, et al. 2001).
- WS employees that use controlled substances are trained to use each material and are certified to use controlled substances under Agency certification program.
- WS employees who use pesticides and controlled substances participate in State approved continuing education to keep abreast of developments and maintain their certifications.
- Pesticide and controlled substance use, storage, and disposal conform to label instruction and other applicable laws and regulations, and Executive Order 12898.
- Material Safety Data Sheets for pesticides and controlled substances are provided to all WS personnel involved with specific WDM activities.
- All WS Specialists in the State who use restricted chemicals are trained and certified by, or else operate under the direct supervision of, program personnel or others who are experts in the safe and effective use of chemical MDM materials.
- Research is being conducted to improve MDM methods and strategies so as to increase selectivity for target species, to develop effective nonlethal control methods, and to evaluate nontarget hazards and environmental effects.

Some additional mitigating factors specific to the current program include:

- Management actions would be directed toward localized populations or groups of target species and/or individual offending members of those species. Generalized population suppression across the State, or even across major portions of the State, would not be conducted.
- WS uses MDM devices and conducts activities for which the risk of hazards to public safety and hazard to the environment have been determined to be low according to a formal risk assessment (USDA 1997, Appendix P). Where such activities are conducted on private lands or other lands of restricted public access, the risk of hazards to the public is even further reduced.

4.4.2 Additional Mitigation Specific to the Issues

The following is a summary of additional mitigation measures that are specific to the issues listed in Chapter 2 of this document.

4.4.2.1 Effects on Target Species Populations

- MDM activities are directed to resolving mammal damage problems by taking action against individual problem mammals, or local populations or groups, not by attempting to eradicate populations in the entire area or region.
- WS take is monitored by comparing numbers of mammals killed by species or species group (e.g., carnivore) with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause significant adverse effects to the viability of native species populations (See Chapter 5).

4.4.2.2 Effects on Nontarget Species Populations Including T&E Species

- WS personnel are trained and experienced to select the most appropriate method for taking problem animals and excluding nontargets. For example, WS personnel utilize pan tension devices or alter trap triggers in order to exclude or reduce the capture of non-target species.
- WS has consulted with the USFWS regarding potential effects of control methods on T&E species, and abides by reasonable and prudent alternatives (RPAs) and/or reasonable and prudent measures (RPMs)

established as a result of that consultation. For the full context of the Biological Opinion see the ADC FEIS, Appendix F (USDA 1997). Further consultation on species not covered by or included in that formal consultation process will be initiated with the USFWS and WS will abide by any RPAs, RPMs, and terms and conditions that result from that process to avoid jeopardizing any listed species.

- WS uses chemical methods for MDM that have undergone rigorous research to prove their safety and lack of serious effects on nontarget animals and the environment.

4.4.2.3 Effects on Human Health and Safety

- WS personnel are trained and supervised in the use of MDM methods, including firearms, watercraft, explosives, traps, immobilization drugs, and vertebrate pesticides to ensure that they are used properly and according to policy. Furthermore, WS personnel using restricted-use vertebrate pesticides will be certified according to EPA and Tennessee State laws. WS personnel using binary explosives in MDM will be certified to use them according to WS policy and directives, and WS specialists using firearms will routinely receive firearms safety training according to WS policy.

4.4.2.4 Effects on Socio-cultural Elements and Economics of the Human Environment

- Whenever practicable, WS personnel perform components of mammal removal activities, such as shooting and euthanizing, away from public view.
- In addition, animals which are transported after being killed are concealed from public view when they must be transported in areas of human habitation, in an effort to reduce adverse effects on the aesthetic quality of the environment.

4.4.2.5 Effects of Beaver Dam Removal on Wetland Wildlife Habitat

- WS specialists remove beaver dams in accordance with federal and state laws and regulations for environmental protection. Beaver dam removal would be conducted to restore drainage or the stream channel for an area, or if an area has an established silvicultural or other agricultural, commercial / industrial activity, and where such an area has not become an established wetland.
- Property owners will be required to obtain a Section 404 permit from the U.S. Corps of Engineers for areas determined to be wetlands, for dams that have more than 10 cubic yards of fill associated with them, or if the project would alter the waters into a use it was previously not subject, where the flow or circulation of waters would be impaired or the reach of the waters reduced.

More detail pertaining to beaver dam removal is found in the discussion of methods used by WS in Appendix B.

4.4.2.6 Humaneness of Methods Used by Wildlife Services

- WS personnel kill captured target animals that are slated for lethal removal as quickly and humanely as possible. In most field situations, a shot to the brain with a small caliber firearm is performed which causes rapid unconsciousness followed by cessation of heart function and respiration. This is in concert with the American Veterinary Medical Association's definition of euthanasia (AVMA 2000).
- Research continues with the goal of improving the selectivity and humaneness of management devices.
- WS personnel recommend the use of various nonlethal methods such as exclusion, habitat and animal behavior modification, where these are applicable.
- WS personnel use trap lures and set traps in locations that are conducive to capturing the target animal, but minimize potential effect on nontarget species. Further, all damage management methods would be used in a manner that minimizes pain and suffering of individual animals, to the extent that the method is effective and its use is practical.

5.0 CHAPTER 5: ENVIRONMENTAL CONSEQUENCES

Chapter Five provides information needed for making informed decisions in selecting the appropriate alternative for meeting the purpose of the proposed action. This chapter analyzes the environmental consequences of each alternative in relation to the issues identified for detailed analysis in Chapter 2. This section analyzes the environmental consequences of each alternative in comparison with the No Action Alternative to determine if the real or potential effects would be greater, lesser, or the same. Therefore, the proposed action or current program alternative serves as the baseline for the analysis and the comparison of expected effects among the alternatives. The background and baseline information presented in the analysis of the current program alternative thus also applies to the analysis of each of the other alternatives.

The following resource values within the State are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, floodplains, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. These resources will not be analyzed further.

Cumulative Effects: Discussed in relationship to each of the alternatives analyzed, with emphasis on potential cumulative effects from methods employed, and including summary analyses of potential cumulative impacts to target and nontarget species, including T&E species.

Irreversible and Irretrievable Commitments of Resources: Other than minor uses of fuels for motor vehicles and other materials, there are no irreversible or irretrievable commitments of resources.

Effects on sites or resources protected under the National Historic Preservation Act: WS MDM actions are not undertakings that could adversely affect historic resources (See Section 1.8.2.4).

5.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

5.1.1 Alternative 1 - Continue the Current Federal Mammal Damage Management Program (The Proposed Action/No Action)

5.1.1.1 Effects on Wildlife Including Target and Nontarget Species and T&E species

5.1.1.1.1 Effects on Target Species Mammal Populations

The authority for management of resident wildlife species has traditionally been a responsibility left to the states. The Tennessee Wildlife Resources Agency is the state agency with management responsibility over animals classified by state law as protected. TWRA provided information where available regarding population estimates for certain species, but was unable to provide any definitive estimates of population sizes for some species. TWRA commented on the validity of WS determinations of actions affecting populations.

The analysis for magnitude of impact generally follows the process described in Chapter 4 of USDA (1997). Magnitude is described in USDA (1997) as " . . . *a measure of the number of animals killed in relation to their abundance.*" Magnitude may 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 data when available. Generally, WS only conducts damage management on species whose population densities are high and usually only after they have caused damage. Table 5.1 shows the numbers of mammals killed by species and method as a result of WS MDM activities in Tennessee from FY 1998 through FY 2002.

NEPA requires federal agencies to determine whether their actions have a "significant impact on the quality of the human environment." A declining population of a resident wildlife species does not necessarily equate to a "significant impact" as defined by NEPA if the decline is collectively condoned or desired by the people that live in the affected human population. It is reasonable and proper to rely on the representative form of government within a state as the established mechanism for determining

the "collective" desires or endorsements of the people of a state. WS abides by this philosophy and defers to the collective desires of the people of the State of Tennessee by complying with State laws and regulations that govern the take or removal of resident wildlife. Although the analysis herein indicates mammal populations are not being affected to the point of causing a decline, if at some point in the future they are, then such a decline would not constitute a "significant" impact as defined by NEPA so long as the actions that cause the decline are in accordance with state law, and concomitantly, with the collective desires of the people of the State.

Table 5.1. Number of Animals Killed by WS in Tennessee during FY 1998 – 2002.

SPECIES	METHOD								TOTALS		
	TRAPS						CHEMICAL		Target/UT	NT	Total
	Cage	Body-Gripping	Foot-hold	Snare	Shooting	Other	Zinc Phosphide	Other			
Beaver	1	1040	81	54	114				1290		1290
Bobcat			1	1					2		2
Cats, F.	16				2				18		18
Coyote			5	76	5	6			92		92
Dogs, F.				2					2		2
Fox, Red			3	5					8		8
Ground-hog	1	61		2	1				65		65
Mole (All)						7			7		7
Muskrat		17							4	13	17
Opossum	88	1							89		89
Otter, River		47		1						48	48
Rabbit, Cotton-tail				1	83				83	1	84
Raccoon	56	15	7	3	1				61	21	82
Rat, Norway							380		380		380
Skunk, Striped	115	5			20			26	161	5	166
Squirrel, Gray					2				2		2

5.1.1.1.1.1 Bat Populations Information and Effects Analysis

Bats are the only mammals that can truly fly. They are exceeded only by rodents as the most numerous mammals, both in number of species and number of individuals (Greenhall and Frantz 1994, National Audubon Society 2000). Bats bodies are generally well furred and forelimbs are enlarged and developed as wings with membranes attached to 4 greatly elongated fingers, which spread when in flight and draw together when at rest. The "thumb" projects from the end of the "forearm" as a small but sharp claw that is used as the animal crawls about. Wing membranes are often naked and translucent (National Audubon Society 2000). The motion of bats in the air appears to be more of a swimming motion, where they rotate their wings to catch air with the membrane, as opposed to birds which flap their wings (National Audubon Society 2000). Although most North American bats have small eyes, their visual acuity is good (Humphrey 1982). However, insectivorous bats locate food and avoid objects by means of echolocation, which is similar to radar or sonar (Humphrey 1982).

While flying, the bat emits through its nose or mouth a continuous series of supersonic sounds. These sounds bounce off objects and are picked up by the bats complex ears (National Audubon Society 2000).

Bats are nocturnal, leaving the roosts around dusk, and usually flying to a stream, pond, or lake, where they obtain a drink by skimming the surface and dipping their lower jaw into the water. Bats in North America are virtually all insectivorous, feeding on a variety of flying insects, many of which are harmful to humans (Greenhall and Frantz 1994). Insectivorous bats obtain food by various means of capturing their prey mostly while in flight. During these feeding flights they often fly close to animals, including humans and sometimes cause alarm (National Audubon Society 2000).

Among the 40 species of bats found north of Mexico, only a few cause problems for humans. Bats congregating in groups are called colonial bats; those that live a lone existence are known as solitary bats. The colonial species most often encountered in and around human buildings in the United States are the little brown bat, (*Myotis lucifugus*), the Mexican free-tailed bat (*Tadarida brasiliensis*), the pallid bat (*Antrozous pallidus*), the Yuma myotis (*Myotis yumanensis*), and the evening bat (*Nycticeius humeralis*). Solitary bats typically roost in tree foliage or under bark, but occasionally are found associated with buildings, some only as transients during migration (Greenhall and Frantz 1994).

Fourteen species of bats are known to occur in Tennessee (Whitaker, Jr. and Hamilton, Jr., 1998). Some of these are federally listed as threatened, endangered, or as species of management concern. Additionally, those bats and others are state listed as endangered, threatened, or as species of special concern under TWRA's T&E program. Table 5.2 identifies the bat species found in Tennessee. Further, information related to occurrence and roosting / nesting / hibernating information is given. Several bat species in Tennessee are known to roost, raise young, or hibernate in various human structures. Such behavior sometimes causes human/bat conflicts, especially perceived or actual threats of rabies, by people who encounter bats in such locations.

Table 5.2 Bats Found in Tennessee (From Whitaker, Jr. and Hamilton, Jr., 1998)

Common Name	Scientific Name	Occurrence	Roosting / Rearing / Hibernating Habitat	Status in TN*
Big Brown Bat	***Eptesicus fuscus***	year-round, statewide	buildings during the spring, summer, and winter, caves in the winter	PN
Eastern pipistrelle	***Pipistrellus subflavus***	common during summer and migration	Hollow trees, buildings, caves	PN
Evening Bat	***Nycticeius humeralis***	common in western and central portion of state	caves, hollow trees, buildings, barns, under bridges	PN
Gray Bat	***Myotis grisescens***	year round, probably most of state; recorded in 49 counties	caves; cave like habitats; migrate between summer and winter caves	PN, FE, SE
Hoary bat	***Lasiurus cinereus***	Summer, uncommon, most of state	trees, under clusters of leaves except in winter when may roost in hollow trees, abandoned buildings	PN
Indiana Bat	***Myotis sodalis***	year round; central and eastern portions of state	Limestone caves; floodplain and riparian forests, other habitats are used	PN, FE, SE, CHD

Common Name	Scientific Name	Occurrence	Roosting / Rearing / Hibernating Habitat	Status in TN*
Little Brown Bat	***Myotis lucifugus***	year round, eastern two-thirds of state; restricted to locales with caves in winter	caves, mines, underground quarries in winter; barns, buildings (especially attics) in summer	PN
Northern bat	***Myotis septentrionalis***	year round, eastern two-thirds of state	caves, under loose tree bark, rock shelters in cliff lines and abandoned mines, bridges and abandoned buildings	PN
Rafinesque's Big-eared bat	***Corynorhinus rafinesquii***	year round, statewide, except northeastern portion of state	caves, old mines, protected rock shelters along cliff lines, abandoned buildings, bridges, cistern, large, hollow trees	PN
Eastern red Bat	***Lasiurus borealis***	year round (primarily winter), statewide	forests, beneath clusters of leaves, except winter, then hollow trees, fallen logs, and even leaf litter of forest floor	PN
Seminole Bat	**Lasiurus seminolus**	year round, southern one half of state	trees (beneath clusters of leaves), in clumps of Spanish moss	PN
Silver-haired Bat	***Lasionycteris noctivagans***	winter migrant, locally across state	hollow trees, tree cavities, crevices beneath peeling bark during the summer, rock fissures of cliff lines and cave entrances in winter	PN
Eastern Small-footed myotis	***Myotis leibii***	year round (mostly in winter), majority of the state, except upper third of middle portion of state	caves, rock shelters, cliff fissures, old mines, quarries, abandoned buildings, bridges	PN
Southeastern myotis	**Myotis austroriparius**	year round, distributed western portion of state	caves, large hollow trees, abandoned buildings	PN

* Codes: F = Federal listing, S = State listing, E = Endangered, PN = Protected non-game, CHD = Critical Habitat Determined

During FY 1998 - 2002, WS responded to 81 complaints (annual average = 16.2) from the public regarding damage or threats of damage by bats. Species of bats were not identified. Resources protected included human health and safety, buildings, and general property. Damage included perceived rabies threats, other threats, droppings and nuisance. The public reported $2,600 in damages associated with these complaints. Almost all complaints were handled through providing technical assistance advice and public education regarding these mammals. More than 90% of all complaints involved bats which had wandered into living or working spaces of buildings, or were roosting in various structures (USDA -WS MIS Database 2002). Most situations were resolved through providing an escape route for the

intruding bat, by capturing and releasing it, or by exclusion of roosting animals. WS routinely makes recommendations that bats be excluded from buildings by various proven techniques.

In future program activities bat damage will continue to be handled primarily by WS through various technical assistance projects. Program activities would continue to feature such non-lethal control methods as exclusion, live capture/release and habitat manipulation. To reduce the possibility of adversely affecting a bat maternity colony, WS would implement and recommended to persons receiving technical assistance that all exclusion and habitat manipulation be conducted from September 1 to early November, when practicable. Many bat species, except big brown bats, would have migrated at that time, and the rearing of young would have been completed. MDM activities conducted after this date would therefore be highly unlikely to disturb maternity colonies of any species during critical young-rearing periods. Conducting exclusionary and other projects at this time would also give big brown bats, or other species which overwinter in Tennessee, an opportunity to find alternate roost sites before extremely cold weather.

Most requests for WS assistance would likely occur in relation to bats inhabiting human-occupied buildings. Federally listed T&E bat species in Tennessee are not generally found associated with man-made structures and so it is unlikely that any federally listed T&E bats would be found occupying such habitats (H. Henry, TVA, pers. comm., 2003). For that reason, it is highly unlikely that programs to address bat damage in such sites would affect any federally listed T&E bat species. If the need arises, WS will consult with a qualified biologist to positively identify bats prior to removing them in order to eliminate any chance of harming a rare or listed species.

Based upon the above information, WS would have no adverse impacts on bat populations in the state.

5.1.1.1.1.2 Beaver Population Information and Effects Analysis

Beavers (*Castor canadensis*) are large, bulky rodents whose most prominent features include a large scaly, paddle shaped tail and orangish colored incisors (Hill 1982). Most adults weight from 15.8 - 38.3 kg (35-50 lbs) with some occasionally reaching more than 45 kg (100 lbs), and are the largest North American rodents (Miller and Yarrow 1994). They range in most of Canada and the United States, with the exception of portions of Florida and the desert southwest. Beaver are active throughout most of the year and are primarily nocturnal, but it is not uncommon to see them during the daylight hours. Beavers living along a river or large stream generally make bank burrows with multiple underwater entrances. Those in quiet streams, lakes, and ponds usually build dams and a lodge (National Audubon Society 2000). Sign of beaver in an area include gnawing around the bases of trees and trees which have fallen as a result of this gnawing. Tree parts are stripped of bark, which is a primary beaver food.

Beavers were trapped extensively during the 19th and part of the 20th century, and as a result, disappeared from much of their range (Novak 1987). Now reestablished over most of the continent, and protected from overexploitation, the beaver has become a pest in some regions. Dams built and maintained by beaver may flood stands of commercial timber, highways, and croplands. However, the dams also help reduce erosion, and the ponds formed by the dams may create a favorable habitat for many forms of life (Hill 1982).

Beavers occur mostly in family groups that are comprised of 2 adult parents with 2-6 offspring from the current or previous breeding season. Average family group size has been documented as ranging from 3.0 to 9.2 (Novak 1987). Beaver abundance has been reported in terms of families per kilometer of stream or per square kilometer of habitat. Novak (1987)

summarized reported beaver family abundance as ranging from 0.31 to 1.5 families per kilometer of stream, which converts to 0.5 - 2.4 families per mile of stream. Densities in terms of families per square kilometer have been reported to range from 0.15 to 3.9 (Novak 1987), which is the same as 0.24 to 6.3 per square mile.

Beaver are present in all 95 Tennessee counties, and their population is considered stable to increasing across the State (E. Warr, TWRA, pers. comm., 2003). No population estimates were available for beavers in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 632,000 acres of wetlands in Tennessee (Hefner et al. 1994) including an estimated minimum of 60,000 miles of streams (USFWS 2001). Using the conservative estimate of 3 beavers per family group and an abundance of 0.5 families per stream mile provided by Novak (1987), the minimum statewide beaver population estimate for Tennessee could be estimated at 90,000 beavers.

The TWRA has declared that for the majority of the State there is a year-round season with no limit for beaver. There are some counties in the extreme eastern part of the State where the beaver hunting and trapping season conforms to the traditional furbearer hunting and trapping seasons. Figures pertaining to the total annual harvest of beaver are not available.

During FY1998-2002 WS responded to 166 (average = 33/yr) requests for assistance with beaver damage in which complainants reported $5,539,875 in damages. Beaver damaged natural resources such as timber and reclamation sites, natural streams, agricultural crops, commercial timber, roadways, drainage and irrigation structures, and other property through flooding, damming, and feeding (USDA-WS MIS Database 2002).

During FY 1998-2002 WS killed 1,290 beavers (average of 258/yr) in Tennessee in all damage management projects (USDA-WS MIS Database 2002). The majority of the beaver killed were in MDM projects in west and middle Tennessee where the season is year round and there is no limit on the number of beaver that can be taken. Beaver populations either increased or remained stable in the state during that same period. In future programs, WS may be requested to address damage being caused by beavers anywhere in Tennessee to protect any resource being damaged or threatened. Based upon current and an anticipated increase in beaver damage management activities in the future, it is possible that WS could kill 1,500 beavers per year in all MDM programs in Tennessee.

Based upon the above information, WS limited lethal take of beavers would have no adverse impacts on overall beaver populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the beaver population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.3 Black Bear Population Information and Effects Analysis

The American black bear (*Ursus americanus*) is the smallest and most widely distributed of the three North American bear species (Pelton 1982). This species is a compact, heavily structured mammal with relatively massive legs and feet. Adult male black bears weigh from 120-280kg (265-617 pounds) and measure from 130-190 cm (51-61.7 inches) in length from the tip of the nose to the tip of the tail. Adult females weigh from 45-182kg (100-400 pounds) and measure from 110-170 cm (45-67 inches) in total length. The normal color is black with a brownish muzzle and frequently, a white V-shape across the throat or chest (Novak et al. 1987). Black bears mate in June and July and sow (female) bears produce litters that average between 1-5, with two cubs usually the norm. Although black bears are primarily nocturnal,

they may be seen at any time. They occupy ranges of 20-25 km^2 (8-10 mi^2), and sometimes up to 40 km^2 (15mi^2). The home range of the male black bear is about double that of the female. Black bears are powerful swimmers and climb trees for protection or food. Although they are in the order Carnivora, their diet includes all types of vegetation including twigs, buds, leaves, nuts, roots, fruit, corn, berries, and newly sprouted plants. Black bears will rip open bee trees to feast on honey, honeycomb, bees, and larvae. They will also tear apart rotting logs for grubs, beetles, crickets, and ants. The black bear wades in streams or lakes, snagging fish with its jaws or pinning them with a paw. The black bear's diet also includes small to medium-size mammals or other vertebrates, and even livestock such as cattle, sheep, and goats. Bears are often a problem around open dumps, becoming dangerous as they lose their fear of humans. Occasionally, people have been killed by black bears (National Audubon Society 2000). Habituated, food conditioned bears pose the greatest threat to humans and such bears are usually found in association with campgrounds, and sites where people regularly feed them (Herrero 1982, 1985, Kolenosky and Strathearn 1987).

In North America, black bear densities range from 0.1 to 1.3 bears/km^2 depending on region and habitat. Densities are greatest in highly diverse forests at a relatively early stage of development. In unhunted and lightly hunted populations, the annual survival rate of adult female black bears is about 80-90% with adult male survival slightly less. As hunting pressure increases, the number of males decreases more rapidly than that of females because of their greater vulnerability to hunting (Fraser et al. 1982). The statewide population of black bears for Tennessee is estimated to be between 750 to 1,500 bears and is believed to be increasing (Vaughan and Pelton 2003).

Black bears are classified as a big game species in Tennessee and seasons and harvest limits are set annually by the TWRA. During the 1998 – 2002 bear hunting season, an average of 143.4 bears per year was legally harvest in Tennessee.

No black bears have been killed in WS MDM programs in Tennessee. WS personnel occasionally receive requests for assistance, but WS has provided only technical assistance for these complaints in the past, and always refers complainants to TWRA or the Great Smoky Mountains National Park for further action. Any direct damage management actions by WS to address black bear damage in Tennessee in future programs would be conducted as part of an informed wildlife management activity coordinated with TWRA for the purpose of meeting state wildlife resource management objectives. Such projects would usually involve live-capture and translocation of bears causing damage. Some bears could be killed in actions to protect human health or safety, or livestock. Any lethal control of bears would be coordinated TWRA.

Based upon the above information, WS limited lethal take of black bears would have no adverse impacts on overall black bear populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the black bear population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.4 Bobcat Population Information and Effects Analysis

The bobcat (*Lynx rufus*) , 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. This species is actually 2-3 times larger than most domestic cats and appears more muscular and fuller in body. Bobcats are capable of hunting and killing prey that range from the size of a mouse to that of a deer. Rabbits, tree squirrels, ground squirrels, woodrats, porcupines, pocket gophers, and ground hogs comprise most of their diet. Opossums, raccoon, grouse, wild turkey, and other ground nesting birds are also eaten. Occasionally, insects and reptiles can be part of a bobcat's diet. They also resort to scavenging. They are

opportunistic predators, and may feed on livestock and domestic animals such as poultry, sheep, goats, house cats, small dogs, exotic birds and game animals, and rarely, calves (Virchow and Hogeland 1994). McCord and Cardoza (1982) reported the cottontail rabbit to be the principal prey of bobcats throughout their range.

Bobcats reach densities of about 1 per 0.7 km^2 (1 per ¼ mi^2) on some islands in the Gulf Coast of the southeastern Untied States. Densities vary from about 1 per 1.3 km^2 (1 per ½ mi^2) in coastal plains to about 1 cat per 107 km^2 (1 per 66 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 Bailey's (1972) study of bobcats in southeastern Idaho. Causes of natural mortality for adult bobcats include starvation (Hamilton 1982), disease and predation (Lembeck 1978), and injuries inflicted by prey (Fuller et al. 1985).

No population estimates were available for bobcats in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support bobcats and bobcat densities average 1 per 33 mi^2, a conservative statewide bobcat population could be estimated at over 780 bobcats.

Bobcats are regulated furbearers in Tennessee, and the TWRA established seasons and harvest quotas for the purpose of managing their populations in the state. As mandated through the Convention on International Trade in Endangered Species (CITES), the TWRA requires that all bobcats pelts to be sold must be tagged. There is no estimation of the total number of bobcats killed annually in Tennessee.

Two bobcats have been killed in WS MDM programs in Tennessee from FY 1998-2002. These bobcats were taken during MDM programs to protect human health and safety and air traffic safety at airports in Tennessee. From FY 1998-2002, one individual contacted WS for assistance with damage caused by bobcats in the state. In future programs, WS may be requested to address damage being caused by bobcats anywhere in Tennessee to protect any resource being damaged or threatened. Based upon current and an anticipated increase in bobcat damage management activities in the future, it is possible that WS could kill 50 bobcats per year in all MDM programs in Tennessee. In the future, WS MDM projects might involve live-capture and translocation of bobcats where such actions would align with TWRA wildlife management objectives for this species. Some bobcats could be killed in actions to protect human health or safety, or livestock.

Based upon the above information, WS limited lethal take of bobcats would have no adverse impacts on overall bobcat populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the bobcat population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.5 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, however, from nearly black to red or nearly white in

some individuals and local populations. Most have dark or black guard hairs over their back and tail (Green, et al. 1994). They sometimes breed with domestic dogs producing hybrids called "coydogs" (National Audubon Society 2000). The size of coyotes varies from about 20 to 40 lbs (9 – 18 kg) (Novak, et al., 1987).

Coyotes range throughout the U. S. east to New Brunswick and Novia Scotia. The populations with the highest densities occur on the Plains and in the south-central U. S., including Texas. The distribution of coyotes in eastern North America has expanded during this century, beginning in 1900-20. Now, all eastern states and provinces have at least a small population of coyotes (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 0-80% in different populations (Gier 1968). This variation is influenced by a number of factors, but causes large annual variation in total number of coyotes breeding. In a study in Texas, the percentage of females having litters varied from 48-81% (Knowlton 1972). Pups are born after a gestation period of 60-63 days, with litter sizes varying primarily with prey availability. Gier (1968) reported average litter sizes of 4.8-5.1 in years with low rodent numbers, but litters of 5.8-6.2 during years with high rodent numbers. Litter sizes of 1-19 pups have been reported (National Audubon Society 2000).

The coyote is probably the most extensively studied carnivore (Bekoff 1982), and considerable research has been conducted on population dynamics. However, because of the coyote's broad geographic range, density information should not be extrapolated from one area to another. Data from scent-station indices suggest that density increases from north to south. Coyote densities as high as $2/km^2$ ($5/mi^2$) have been reported in the southwestern and west-central U. S., but are lower in other portions of the country including eastern North America, although few studies have accurately determined densities (Voigt and Berg 1987). In Tennessee, home ranges of adult coyotes may exceed $8/mi^2$ (TWRC 2003).

Many references indicate that coyotes were originally found in relatively open habitats, particularly grasslands and sparsely wooded areas of the western United States. Whether or not this is true, 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).

Coyotes often include many items in their diet. Rabbits are one of the most common prey. 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 dump sites and take small domestic pets such as cats and dogs (Voigt and Berg 1987).

Coyote populations in Tennessee are considered stable by the Tennessee Wildlife Resources Agency (E. Warr, TWRA, pers. comm., 2003).). No population estimates were available for coyotes in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support coyotes, coyotes are only found in rural habitat, coyote home ranges average 1 per 8 mi^2, and

home ranges of coyotes do not overlap, a conservative statewide coyote population could be estimated at over 3,200 coyotes.

There are no limits set on the take of this species, and they may be taken year-round. Information regarding the total number of coyotes killed in Tennessee annually is not available.

WS provided technical assistance for 48 requests (average = 9.6 / yr) for assistance with coyote damage in Tennessee during FY 1998-2002. This tally represents only those coyote complaints for which WS employees initiated some kind of assistance activity. Most coyote complaints are referred to TWRA and no record is made by WS regarding the outcome. Individuals requesting assistance reported $4,000 (average = $2,000/incident) in damages resulting from coyote depredation on calves during the period. The majority of requests for assistance centered on threats to human health and safety by coyotes. Complainants are rarely able to provide loss values for human health and safety threats. Coyote damage reported to WS was related to threats to human health or safety, predation on other animals, and nuisance (USDA-WS MIS Database 2002).

WS killed 92 coyotes (average = 18.4/ yr) in all MDM programs in Tennessee during FY 1998-2002. Almost all of these were killed in programs to protect aircraft and air passengers at airports (USDA-WS MIS Database 2002). In future programs, WS may be requested to address damage being caused by coyotes anywhere in Tennessee to protect any resource being damaged or threatened. Based upon current and an anticipated increase in coyote damage management activities in the future, it is possible that WS could kill 250 coyotes per year in all MDM programs in Tennessee. Many of these would be removed in projects aimed at protecting air passenger safety and aircraft, while a substantial number might be killed to reduce human safety threats in residential areas and to protect livestock, agriculture, and pets. Few if any coyotes in residential areas and airports are hunted and few are trapped by fur trappers. This number would have no effect on overall coyote populations in the state. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS limited lethal take of coyotes would have no adverse impacts on overall coyote populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the coyote population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.6 Eastern Cottontail Rabbit Population Information and Effects Analysis

There are 9 species of cottontail rabbits in North America, north of Mexico. The eastern cottontail (*Sylvilagus floridanus*) is the most abundant and widespread of all these. Although in Tennessee, there are swamp rabbits (*Sylvilagus aquaticus*), Allegheny cottontails (*Sylvilagus obscurus*) and eastern cottontails, damage associated with the rabbits is almost without exception caused by the eastern cottontail (Craven 1994).

The eastern cottontail is approximately 37-48 cm (15-19 inches) in length and weighs 0.9-1.8 kg (2-4 lbs.). Males and females are basically the same size and color. These animals 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. They are rarely found in dense forest or open grasslands, but fallow crop

fields, such as those in the Conservation Reserve Program may provide suitable habitat. Within these habitats they spend their entire lives in an area of 10 acres or less. Occasionally they may move a mile or so from summer range to winter cover or to a new food supply. In suburban areas, rabbits are numerous and mobile enough to fill any "empty" habitat created when other rabbits are removed. Population densities vary with habitat quality, but 1 rabbit per 0.4 hectares (1 acre) is a reasonable average (Craven 1994). Rabbits live only 12-15 months, yet make the most of time available reproductively. They can raise as many as 6 litters per year of 1-9 young (usually 4-6), having a gestation period of 28 -32 days. If no young were lost, a single pair together with their offspring could produce 350,000 rabbits in 5 years (National Audubon Society 2000).

No population estimates were available for cotton-tailed rabbits in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support rabbits, rabbits are only found in rural habitat, and rabbit densities average 1 per acre, a conservative statewide rabbit population could be estimated at over 11 million rabbits.

Cottontails are a regulated game species in Tennessee and are harvested recreationally and for food. The TWRA sets seasons and limits on this species annually. No figures are available regarding the total number of cottontail rabbits killed in Tennessee each year.

During FY 1998-2002 WS provided technical assistance in Tennessee to address eastern cottontail rabbit damage at only a few sites. Fifty percent (2 of 4) of damage reported involved turf and flowers. A total of $300 damage to all resources was reported for cottontail rabbits in Tennessee during FY 1998-2002.

Wildlife Services personnel in Tennessee killed 84 cottontail rabbits during the FY 1998 – 2002 time period (USDA-WS MIS Database 2002). These rabbits were removed as part of an integrated management plan at airports to protect human health and safety and aircraft.

Requests for assistance from WS may be made by those experiencing damage from rabbits anywhere in the state to protect any resource being damaged. In such programs, WS could kill as many as 500 cottontail rabbits per year in Tennessee. Almost all of these would be removed from urban, commercial, or industrial habitat. However, this level of take is inconsequential to the numbers of animals taken by hunters each year and is not expected to affect populations of the species in the state. Cottontail rabbit damage management activities would target single rabbits or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property.

Based upon the above information, WS limited lethal take of cottontail rabbits would have no adverse impacts on overall rabbit populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the cottontail rabbit populations in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.7 Elk Population Information and Effects Analysis

Elk (*Cervus elaphus*) are very large cervids with thick necks and slender legs. They are brown or tan above with darker underparts and a rump patch and tail of yellowish brown. Males, or "bulls," have dark brown manes on the throat and large many-tined antlers. They have a huge ponderous muzzles and a dewlap. These animals breed in late August - November and a single calf is born after a gestation period of approximately 250 days

(deCalesta and Witmer, 1994). They live in variable habitat and in mountainous areas use high open mountain pastures in summer and lower wooded slopes, often of dense woods, in winter. Elk are very gregarious with the species main social unit being a herd of cows and calves. The size of these herds varies greatly and is sometimes composed of up to 400 individuals, with larger herds occurring in open areas. Bulls herd separately, remaining on the outskirts of cow-dominated herds. During rutting season, adult bulls join cow/calf herds, and may assemble a cow harem of females during breeding activities (National Audubon Society 2000).

Elk range from eastern British Columbia, central Alberta, central Saskatchewan, and southern Manitoba south to central New Mexico and Arizona, with great numbers in Washington, Montana, Wyoming, and Colorado. They also are found along the west coast from Vancouver Island to northern California. Isolated populations are found elsewhere in California, Nevada, Utah, Arizona, New Mexico, Oklahoma, South Dakota, Minnesota, and Michigan. There are smaller numbers in several eastern states (National Audubon Society 2000).

Before colonists settled in Tennessee, eastern elk were fairly common in the State. Mixed forests and grasslands provided adequate habitat for this large cervid. However, by the middle of the 19th century, elk had disappeared as a result of unregulated hunting, encroaching civilization, and loss of habitat.

The TWRA has begun reintroducing elk into an area of Tennessee. The elk are being located in Scott, Morgan, Campbell, Anderson and Claiborne counties, with the center of the zone being the Royal Blue Wildlife Management Area. TWRA plans to release approximately 450 elk during this reintroduction effort. Elk that wander outside of the restoration zone will be captured and moved back into the restoration zone if possible or may be destroyed if capture is not possible. TWRA has hired a full time elk biologist whose duties will be primarily to increase the amount of habitat suitable for elk which will help reduce conflicts with landowner interests. In addition to this duty, the biologist will be responsible for providing assistance to landowners to lessen any damage that elk may be causing to their property (TWRA 2003).

Wildlife Services provided technical assistance for one elk damage complaint in Tennessee during FY 1998 - 2002. Elk were reportedly damaging a golf course (USDA-WS MIS Database 2002). Normally those experiencing elk damage contact TWRA for assistance. In addition, WS killed no elk in MDM programs in the state during the same period. However, in the future, WS could be requested to provide MDM assistance for elk damage anywhere in the state to protect any resource being damaged by the species. Any direct damage management actions by WS to address elk damage in Tennessee in future programs would be conducted as part of an informed wildlife management activity coordinated with TWRA for the purpose of meeting state wildlife resource management objectives. Such projects would usually involve live-capture and translocation of elk causing damage. Some elk could be killed in actions to protect agriculture, human health or safety, or property. Any lethal control of elk would be coordinated TWRA.

Based upon the above information, WS limited lethal take of elk would have no adverse impacts on overall elk populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the elk population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.8 Feral Cat Population Information and Effects Analysis

Feral cats (*Felis catus*) are house 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 - 30.5 cm (8 - 12 inches) to their length. Colors range from black to white to orange, and an amazing variety of combinations in between. Other hair characteristics also vary greatly (Fitzwater 1994).

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 house 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 2 - 10 kittens during any month of the year. An adult female may produce 3 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 3 - 5 years. They are territorial and move within a home range of roughly 4 km^2 (1.5 mi^2). After several generations, feral cats can be considered to be totally 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 may take an annual toll of some 70 million animals and birds (Churcher and Lawton 1987). In addition, 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).

WS provided technical advice for 3 requests for assistance with feral cat damage in Tennessee during FY 1998-2002. Requesters reported $25 in damages resulting from feral cats during the period. Feral cat damage reported to WS was related to threats to human health or safety, and predation of captive birds (USDA-WS MIS Database 2002). No damage figures were provided for threats to human health and safety. Complainants are rarely able to provide loss values for human health and safety.

WS killed 18 feral cats in all MDM programs in Tennessee during FY 1998-2002 (USDA-WS MIS Database 2002). Additionally, 79 feral cats were either moved or freed after capture by WS during the same time period. This number is insignificant to the total population of this species in the state. In metropolitan areas of Tennessee, animal control officers capture and remove hundreds of feral cats each year (S. Bell, Madison Co. H.D., pers. comm., 2003). In future programs, WS may be requested to address damage being caused by feral cats anywhere in Tennessee to protect any resource being damaged or threatened. It is possible that WS could kill as many as 200 feral cats each year in MDM programs in the state. Many of these would be removed in projects aimed at protecting human health and safety, valuable wildlife, or captive birds and other animals. Feral cats are not viewed as furbearers in Tennessee and no hunters seek them as a game animal.

Based upon the above information, WS limited lethal removal of feral cats should have no adverse effects on overall populations of this species in Tennessee. Any MDM involving lethal control actions by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site. In those cases where feral cats are causing damage or are a nuisance and complete removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since these species are not considered part of the native ecosystem.

5.1.1.1.1.9 Feral Dog Population Information and Effects Analysis

In appearance, most feral dogs (*Canis familiaris*) are difficult, if not impossible, to distinguish from domestic dogs. Like domestic dogs, feral dogs (sometimes referred to as wild or free-ranging dogs) manifest themselves in a variety of shapes, sizes, colors, and even breeds. McKnight (1964) noted German shepherds, Doberman pinschers, and collies as breeds that often become feral. Most feral dogs today are descendants of domestic dogs gone wild, and they often 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 these 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 couldn't be classified as either feral or domestic based solely on their reaction to humans. Since many feral dogs have been pursued, shot at, or trapped by people, their aggressive behavior toward humans is not surprising. Gipson (1983) described the numerous lead pellets imbedded under the skin of a feral dog caught in Arkansas as a testament to its relationship with people (Green and Gipson 1994).

Feral dogs are usually secretive and wary of people. Thus, they are active during dawn, dusk, and at night much like other wild canids. They often travel in packs or groups and may have rendezvous sites like 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 foxes. 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 are the most widespread of the wild canids. They may occur wherever people are present and permit dogs to roam free or where people abandon unwanted dogs. Feral dogs probably occur in all of the 50 states, Canada, and Central and South America. They are also common in Europe, Australia, Africa, and on several remote ocean islands, such as the Galapagos. Home ranges of feral dogs vary considerably in size and are probably influenced by the availability of food. Dog packs that are primarily dependent on garbage may remain in the immediate vicinity of a dump, while other packs that depend on livestock or wild game may forage over an area of 130 km^2 (50 mi^2) or more (Green and Gipson 1994).

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

Like coyotes, feral dogs are best described as opportunistic feeders. They can be efficient predators, preying on small and large animals, including domestic livestock. Many rely on

carrion, particularly road-killed animals, crippled waterfowl, green vegetation, berries and other fruits, and refuse at garbage dumps (Green and Gipson 1994).

Feral dogs are highly adaptable, social carnivores. Most are about the size of a coyote or slightly larger. Many breeds of dogs are capable of existing in the wild, but after a few generations of uncontrolled breeding, a generalized mongrel tends to develop. Often it has a German shepherd or husky-like appearance. Feral dogs on the Galapagos Islands resemble the original introduced breeds: hounds, pointers, and Borzoi. 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, garbage dumps 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). In some areas of the United States, including Tennessee, feral dogs pose threats to air traffic by invading airport environments to forage (K. Stucker, R. Myers, S. Stopak, USDA-WS, pers. comm., 2003).

WS provided technical assistance for four feral dog complaints related to human health and safety during FY 1998 - 2002. Most complaints regarding dogs are referred to local animal control agencies since requesters are usually unable to determine whether the dog is feral or a pet. A record is only generated when some kind of technical assistance is provided by WS as a result of the contact.

WS killed 2 feral dogs in all MDM programs in Tennessee during FY 1998-2002 (USDA-WS MIS Database 2002). This number is insignificant to the total population of this species in the state. In future programs, WS may be requested to address damage being caused by feral dogs anywhere in Tennessee to protect any resource being damaged or threatened. It is possible that WS could kill as many as 100 feral dogs each year in MDM programs in the state. Many of these would be removed in projects aimed at protecting human health and safety, valuable wildlife or other natural resources, livestock, or other agriculture. Feral dogs are not viewed as furbearers in Tennessee and no hunters seek them as a game animal.

Based upon the above information, WS limited lethal removal of feral dogs should have no adverse effects on overall populations of the species in Tennessee. Any MDM involving lethal control actions by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing

damage at a local site. In those cases where feral dogs are causing damage or are a nuisance and complete removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since these species are not considered part of the native ecosystem.

5.1.1.1.1.10 Feral Swine Population Information and Effects Analysis

Feral swine (*Sus scrofa*), also known as "wild pigs," "wild boars," and "feral hogs," are medium-size hoofed mammals which look like domestic pigs. They usually have coarser and denser coats than their domestic counterparts and exhibit modified canine teeth called "tusks" which are usually 7.5-12.5 cm (3-5 inches) long, but may up to 23 cm (9 inches) long. These tusks 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 1.32-1.82 m (4 feet 6 inches to 6 feet). Males may attain a weight of 75-200 kg (165-440 lb) while females may weigh 35-150 kg (77-330 lbs). These animals mate any time of year but peak breeding times usually occur in January-February and early summer. Litters sizes are usually 3-12 (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 4 months. Feral hogs may begin to breed before 6 months of age and sows can produce 2 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. This species is found in variable habitat in much of the southern United States. Populations are usually clustered and not widespread. Feral swine are game animals in Texas, Tennessee, North Carolina, Puerto Rico, Hawaii, and Florida (Wood and Barrett 1979, Mayer and Brisbin 1991).

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). They have also been reported to kill considerable numbers of domestic livestock, especially young animals, in some areas (Barrett and Birmingham 1994). Several diseases are associated with feral swine populations (Table 1.1).

In Tennessee, feral hogs are defined as "any wild hog found in Tennessee, except on Catoosa, South Cherokee, Cove Mountain and Foothills WMA's" (TWRA 2002). On most private lands, the season for feral hogs is year round with no limit on the number of animals that can be taken. Additionally, hunters are not required to tag or check feral hogs taken. On publicly owned land in the State, the season generally coincides with scheduled white-tailed deer hunts. During the 1998 – 2002 wild boar seasons in Tennessee, an average of 239.4 boars per year were killed. The majority of these swine were killed in the eastern portion of the state.

During FY 1998-2002 only 1 feral swine complaint was handled by WS in Tennessee. In that instance wild pigs had caused $2,500 in damages to lawns, gardens, shrubs, and trees (USDA-WS MIS Database 2002). Feral swine damage may be addressed by WS MDM programs in response to requests by the public at any location in Tennessee. Agricultural producers may request assistance with managing damage to standing crops or disease threats to domestic livestock. Natural resource managers may request assistance to protect natural areas, parks or recreation areas, or T&E species. Public health agencies may request assistance in controlling

feral swine populations where disease threats to humans may be present (Table 1.1). WS may use any legal methods among those outlined by Barrett and Birmingham (1994) as suitable for feral swine damage management in MDM programs.

No feral swine were killed by WS in all MDM programs during FY1998-2002 (USDA-WS MIS Database 2002). Because feral swine populations are not large in Tennessee and damage caused by them has not been widespread, or of great magnitude, large-scale damage management activities by WS are not expected to occur. Removal of a small herd or a few individuals will sometimes reduce damage considerably where natural resources, agriculture, or property is affected (Barrett and Birmingham 1994). However, damage may increase dramatically in areas where this species has ample resources and opportunity to expand. WS may receive requests for MDM programs to address damage in such locations in the future. It is possible that WS could kill up to 500 individuals of this species in Tennessee each year in those programs. However, such population reduction is not expected to affect overall statewide populations of the species because of high reproductive rates exhibited by these animals (Barrett and Birmingham 1994). Feral swine damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property.

Based upon the above information, WS limited lethal take of feral swine would have no adverse impacts on overall feral swine populations in the state. Any MDM involving lethal control actions by WS would be restricted to isolated individual sites. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site. In those cases where feral swine are causing damage or are a nuisance and complete removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since these species are not considered part of the native ecosystem. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the feral hog population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.11 Fox Population Information and Effects Analysis

5.1.1.1.1.11.1 Gray Fox Population Information and Effects Analysis

The gray fox (*Urocyon cinereoargenteus*) is among the most beautiful of North American furbearers. It is common in many parts of the U. S. where deciduous woodlands provide habitat. Yet this secretive carnivore is seldom seen. This species is somewhat smaller in stature than the red fox, having shorter legs and extremities. Gray foxes exhibit striking pelage which has grizzled upper parts resulting from individual guard hairs being banded with white, gray, and black. A predominance of black-tipped hairs in the middle of the back forms a dark longitudinal stripe that extends into a conspicuous black mane of coarse hair at the top of the black -tipped tail. Portions of the neck, sides, and limbs are cinnamon-colored. The underparts are buff. White shows on the ears, throat, chest, belly, and hindlegs, and the black, white, and reddish facial markings provide distinctive accents (Fritzell 1987).

Gray fox adults weigh about 3 - 7 kg. (6.5 - 15 lbs.), with males being slightly larger than females. Generally, adult gray foxes measure 80 - 113 cm (31.5 - 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 U. S., 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 foxes prefer habitat with dense cover such as thickets, riparian areas, swamp land, or rocky pinyon-cedar ridges. In eastern North America, this species is closely associated with edges of deciduous forest. They can also be found in urban areas where suitable habitat exists (Phillips and Schmidt 1994).

Gray foxes mate from January - March and produce litters of 1-7 kits after a gestation period of 53 days (National Audubon Society 2000). They rear young in a maternity den, commonly in wood piles, rocky outcrops, hollow trees, or brush piles (Phillips and Schmidt 1994). The male parent gray fox helps tend the young but does not den with them. The young are weaned at 3 months and hunt for themselves at 4 months, when they weigh about 3.2kg (7 lbs). Rabies and distemper are associated with this species (National Audubon Society 2000).

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

Home ranges for gray foxes 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 foxes 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 foxes generally have larger home ranges than western animals (Fritzell 1987). For instance, 16 adult foxes were tracked for more than 1 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 foxes 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, it occasionally forages in trees and often takes refuge in them, especially leaning or thickly branched ones. The gray fox feeds heavily on cottontail rabbits, mice, voles, other small mammals, birds, insect, and much plant material, including corn, apples, persimmons, nuts, cherries, grapes, pokeweed fruit, grass, and blackberries. Grasshoppers and crickets are often a very important part of the diet in late summer and autumn (National Audubon Society 2000).

Gray fox populations in Tennessee are considered stable by the TWRA. No population estimates were available for gray foxes in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support gray fox, foxes are only found in rural habitat, and gray fox densities average 3.1/ mi^2, a conservative statewide gray fox population could be estimated at over 53,281 foxes.

Gray foxes are classified as regulated furbearers in Tennessee, and seasons and limits on take are set by TWRA. In certain counties in Tennessee, regulations vary from a year round season with no limit to the opposite extreme where the taking or killing of gray

foxes is illegal (TWRA, 2002). Gray fox populations in Tennessee are considered stable by the TWRA. Information regarding the total number of gray fox killed in Tennessee annually is not available.

Wildlife Services provided did not provide technical assistance for any gray fox damage complaints in Tennessee during FY 1998-2002. One gray fox captured by WS in a cage trap was freed during FY 1998-2002 (USDA-WS MIS Database 2002). In future programs, WS may be requested to address damage being caused by gray foxes anywhere in Tennessee to protect any resource being damaged or threatened. It is possible that WS could kill as many as 100 gray foxes each year in MDM programs in the state. Most of these would be removed in projects aimed at protecting resources in urban or industrial habitats. Few gray foxes are trapped for fur or hunted in these locales. Gray fox damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS limited lethal take of gray foxes would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the gray fox populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.11.2 Red Fox Population Information and Effects Analysis

The red fox (*Vulpes vulpes*) is a typically proportioned member of the dog family. The bushy and unusually long tail, pointed ears, slender muzzle, and slanted eyes coupled with its small dog size and typical reddish coloration, make the red fox instantly recognizable to most people. This species is also the most common and well-know 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 foxes. The white tip of the tail (which is much more prominent in North American foxes 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 - 7 kg.(7.7 - 15.4 lbs.), with males averaging about 1 kg. (2.2 lbs) heavier than females. Generally, adult foxes measure 100 - 110 cm (39 - 43 inches) from the tip of the nose to the tip of the tail. Juveniles in their first autumn are as large as adults (Voigt 1987). They occur over most of North America, north and east from southern California, Arizona, and central Texas. They are found throughout most of the U. S. with the exception of a few isolated areas. Prehistoric fossil records suggest that the red fox may not have inhabited much of the U. S., but were plentiful in many parts of Canada. However, it has been suggested that climatic factors, interbreeding with the introduced European red fox, extirpation of the gray and red wolf, and clearing of land for agriculture has possibly contributed to the present-day expansion and range of this species in North America (Voigt 1987).

Red foxes 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 U. S., where woodlands are interspersed with farmlands. The range of the species has expanded in recent years to fill habitats formerly occupied by coyotes. The reduction of coyotes in many sagebrush / grassland areas of Montana and Wyoming has resulted in increased fox numbers. Red foxes have also demonstrated their adaptability by establishing breeding populations in many urban areas of the U. S., 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 these 2 factors strongly influence red fox survival, habitat limits fox numbers but seldom limits distribution (Voigt 1987).

Red foxes mate from January - March and produce litters of 1-10 kits after a gestation period of 51-53 days. They rear young in a maternity den, commonly an enlarged groundhog or badger den, usually in sparse ground cover on a slight rise, with a good view of all approaches (National Audubon Society 2000). Juvenile foxes are able to breed before their first birthday, but in areas of high red fox densities, most yearlings do not produce pups (Harris 1979, Voigt and MacDonald 1984, Voigt 1987). Pups are born after a gestation period of 60-63 days, with litter sizes varying primarily with prey availability. Gier (1968) reported average litter sizes of 4.8-5.1 in years with low rodent numbers, but litters of 5.8-6.2 during years with high rodent numbers. Litter sizes of 1-19 pups have been reported (National Audubon Society 2000). These offspring disperse from the denning area during the fall and establish breeding areas in vacant territories, sometimes dispersing considerable distances. Red foxes are generally solitary animals as adults, except when mating (Phillips and Schmidt 1994). Rabies and distemper are associated with this species.

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 prairie 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 superabundant in many urban areas, densities as high as 30 foxes / km^2 (78 / mi^2) have been reported (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986), while in southern Ontario, densities of about 1 fox km2 (2.6 / mi^2) occur during spring. This includes both pups and adults. In small areas of the best habitat, 3 times as many foxes have been observed (Voigt 1987). However, these densities rarely occur extensively because of the dispersion of unsuitable habitat, high mortality, or the presence of competition such as coyotes (Voigt and Earle 1983). Cyclical changes in fox numbers occur routinely and complicate density estimates as well as management. These cycles can occur because of changes in prey availability, or disease outbreaks, especially rabies, among red foxes. For fox populations to remain relatively stable, mortality and reproduction must balance approximately.

Home ranges for red foxes in the eastern U. S. are usually from 500 - 2,000 ha. (1,235 - 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.

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

Red fox populations in Tennessee are considered stable by the TWRA. No population estimates were available for red foxes in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support red fox, foxes are only found in rural habitat, red

fox home ranges average 2.6/mi^2, and home ranges of foxes do not overlap, a conservative statewide red fox population could be estimated at over 44,687 foxes.

This species is a regulated furbearer, and seasons for take are set by TWRA. In certain counties in Tennessee, regulations vary from a year round season with no limit to the opposite extreme where the taking or killing of red foxes is illegal (TWRA, 2002). Information regarding the total number of red fox killed in Tennessee annually is not available.

WS provided technical advice for 5 requests (average = 1 / yr) for assistance with red fox damage in Tennessee during FY 1998-2002. Red fox damage reported to WS was related to threats to human health or safety and damage to golf courses and electrical utilities. No damage figures were provided for threats to human health and safety, because complainants are rarely able to provide loss values for this resource (USDA-WS MIS Database 2002). In one instance, red foxes were traveling inside "tunnels" in an electrical substation where electrical cables were located. The foxes were chewing and gnawing on the protective covering on the cables, which created the possibility of electrical "shorts" inside the substation.

Wildlife Services killed 8 red foxes (average = 1.6/ yr) in all MDM programs in Tennessee during FY 1998-2002 (USDA-WS MIS Database 2002). In future programs, WS may be requested to address damage being caused by red foxes anywhere in Tennessee to protect any resource being damaged or threatened. It is possible that WS could kill as many as 100 red foxes each year in MDM programs in the state. Many of these would be removed in projects aimed at protecting human health and safety. Almost all of these animals would be killed in urban or industrial habitats. Few red foxes are trapped for fur or hunted in these locales. Red fox damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS limited lethal take of red foxes would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the red fox populations in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.12 Groundhog Population Information and Effects Analysis

The groundhog (*Marmota monax*), also known as the "woodchuck," is a large rodent, often seen in pastures, meadows, and fields in Tennessee. They dig large burrows, generally 8-12 inches at the opening, sometimes 5 feet deep and 30 feet long with more than 1 entrance to a spacious grass filled chamber. Green vegetation such as grasses, clover, alfalfa forms its diet; at times it will feed heavily on corn and can cause extensive damage in a garden to other crops (National Audubon Society 2000). They may also jeopardize the integrity of earthen dams, present hazards to livestock and farm equipment as a result of burrowing; gnaw electrical cables, and damage hoses and other accessories on automobiles by gnawing (Bollengier 1994, USDA-WS MIS Database 2002).

The breeding season for groundhogs is usually from March through April (Bollengier, 1994). Female groundhogs usually produce from 4 to 6 young (Chapman and Feldhamer, 1982). The off-spring breed at age 1 and live 4 -5 years. If a pair of groundhogs and their offspring all

survived to breed as soon as possible, with an average litter size of 4 with a 1:1 sex ratio; they could produce over 645 groundhogs through their life time. Groundhogs range in the United States extends throughout the East, northern Idaho, northeastern North Dakota, southeastern Nebraska, eastern Kansas, and northeastern Oklahoma, as well as south to Virginia and Alabama.

Groundhogs are considered game animals in most states. There is usually no bag limit or closed season (Bollengier 1994). In Tennessee the season for groundhogs is year round with no limit on the number that can be taken. Information regarding the total number of groundhogs killed in Tennessee annually is not available.

No population data or density information was available for groundhogs in Tennessee. Field observations related to the presence of groundhogs in urban environments in Tennessee suggest that they are locally abundant in many such areas of the state (Brett Dunlap, WS, pers. comm. 2003).

During FY 1998-2002 WS responded to 36 requests for assistance with groundhog damage in Tennessee. Individuals requesting assistance reported $725, or an average of $20.14 per complaint, in damages to a variety of resources including gardens, buildings, lawns, and equipment, and dikes and impoundments (USDA-WS MIS Database 2002).

A total of 65 (annual average of 13) groundhogs were killed in all MDM activities conducted by WS in Tennessee during FY 1998-2002. It is possible that WS could be requested to provide MDM to address groundhog damage at any location in the state. Based upon current and an anticipated increase in groundhog damage management activities in the future, it is possible that WS could kill 1,000 groundhogs per year in all MDM programs in Tennessee.

Based upon the above information, WS limited lethal take of groundhogs would have no adverse impacts on overall groundhog populations in the state. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the groundhogs population in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.13 Mink Population Information and Effects Analysis

The mink (*Mustela vison*) is member of the weasel family and is about 46-61cm (18-24 inches) in length, including the somewhat bushy tail. These animals weigh about 0.7-1.4 kg (1.5-3 lbs). Females are about three-fourths the size of males. Both sexes are a rich chocolate-brown color, usually with a white patch on the chest or chin, and scattered white patches on the belly. The fur is relatively short with the coat consisting of a soft, dense underfur concealed by glossy, lustrous guard hairs. Mink also have anal musk glands common to the weasel family, and can discharge a disagreeable musk if frightened or disturbed (Boggess 1994a). They also mark their hunting territory with this fetid musk, which is as malodorous as a skunk's musk, although it does not carry as far (National Audubon Society 2000).

Mink are found throughout North America, with the exception of the desert southwest and tundra areas (Eagle and Whitman, 1987). They are shoreline dwellers and their one basic habitat requirement is a suitable permanent water area. This may be a stream, river, pond, marsh, swamp, or lake. They make their dens in muskrat houses, ban burrows, holes, crevices, logjams, or abandoned beaver lodges. They are active mainly at night and are active year-

round except for brief intervals during periods of low temperature or heavy snow (Boggess 1994a). They may, however, adjust hunting times to prey availability (National Audubon Society 2000).

Population densities for mink vary spatially according to habitat and may be influenced temporally by weather, trapping, and intraspecific aggression. Generally, populations are most dense in those states and provinces with abundant, stable aquatic habitat. In general, population densities typically range from 0.025 to 0.247 mink per acre (McVey et al. 1993). According to harvest statistics, Louisiana populations are most dense in swamps, followed by marshes and drained bottomlands (Linscombe et al. 1982). In Montana, Mitchell (1961) estimated that 280 mink inhabited a 33-km ^{2} (12.8 miles ^{2}) area, resulting in a density of 1 mink/11.8 ha (29.2 acres). However, the following year he estimated that there were only 109 mink in the area, a density of 1 mink/30.3 ha (74.7 acres). Fur harvest returns of 115 and 40 mink during the 2 years were comparable with returns from drained bottomland habitat in Louisiana. Marshall (1936) estimated densities from mink tracks in snow in Michigan. He reported 0.6 females in 1 km^2 (1.5/mi^2) of riverbank and a 1:1 sex ratio following heavy trapping. Errington (1943) counted 1 to 5 mink families occupying a 180-ha (450 acres) marsh in Iowa from 1933 to 1938. In 1939 no families were located. He felt that over-trapping was responsible for the low numbers, which continued after 1938. Errington also suggested that intraspecific aggression was responsible for the upper limit of mink inhabiting the marsh. McCabe (1949) estimated that there were 24 mink on a 445-ha (1,100 acres) refuge in Wisconsin during 1944, a density of 1mink/18.8 ha (46.3 acres). He estimated that during the next 4 years (1945–48) the population ranged from 7 to 10. His estimates were inversely related to duration and depth of snow cover but were poorly related to food supply (rabbits *[Sylvilagus* spp.] and mice *[Peromyscus* spp.]). McCabe suggested that excessive poaching and heavy trapping on the borders of the refuge caused the low mink numbers following 1944. Gerell (1971) worked in 2 study areas in Sweden. In a10,000-ha (25,000 acres) area he estimated that there were 11 and16 summer residents during 2 years, 1 mink/909 ha (2,245 acres)and 1 mink/625 ha (1,545 acres) respectively. In Gerell's (1971) other area, which included 10 km (6 miles) of riverbank, he estimated 3 and 6 summer residents in 2 years. In interior British Columbia, Ritcey and Edwards (1956) caught 11, 6, and 5 mink on 1.9 km (1.2 miles) of stream during 3years. Their densities were similar to the estimate of 1.5–3mink/km (2.5–5 mink/mile) of shoreline reported by Hatler (1976) for a coastal area of Vancouver Island. Mitchell (1961) reported that a turnover of the population occurred during a 3-year period, and Gerell (1971) concurred (Novak et al. 1987).

No population estimates were available for mink in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 632,000 acres of wetlands in Tennessee (Hefner et al. 1994) including an estimated minimum of 60,000 miles of streams (USFWS 2001). Using the assumption that 50% of the wetlands support a mink population, and an average density of 0.1 mink per acre, a conservative statewide mink population could be estimated at over 31,000 mink.

Mink are classified as regulated furbearers in Tennessee. Seasons and limits on take are set by TWRA. Information regarding the total number of mink killed in Tennessee annually is not available.

WS received no damage complaints during FY 1998-2002 pertaining to mink (USDA-WS MIS Database 2002). No mink were killed by WS in MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by mink anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, as many as 50 mink each year could be killed by WS in MDM programs to address such damage.

Based upon the above information, WS limited lethal take of mink would have no adverse impacts on overall populations of the species in Tennessee. TWRA has determined that there

is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the mink populations in the state of Tennessee (E. Warr TWRA, Pers. comm., 2003).

5.1.1.1.1.14 Muskrat Population Information and Effects Analysis

Muskrats (*Ondatra zibethicus*) are fairly large rodents with dense, glossy fur, dark brown above, lighter on the sides, paler below to nearly white on the throat. They have long scaly tails which are nearly naked and laterally flattened, tapering to a point but not paddle shaped as the beaver. They build houses, or lodges of aquatic plants, especially cattails, up to 2.4 m (8ft) in diameter and 1.5m (5 feet) high. These structures are usually built atop of piles of roots, mud, or similar support in marshy areas, streams, lakes, or along water banks. They also burrow in stream or pond banks with entrances often above water line. Other sign of the presence of muskrats includes feeding platforms built of cut vegetation in water or on ice, marked by discarded or uneaten grasses or reed cuttings, and floating blades of cattails, sedges, and similar vegetation near banks. This species is most active at dusk, dawn, and at night, but may be seen at any time of the day in all seasons, especially spring. Muskrats are excellent swimmers and spent much of their time in the water. They inhabit fresh, salt, and brackish waters of marshes, ponds, lakes, rivers, and canals in most of Canada and the U.S., except for Arctic regions, much of California, the southwestern U.S., Texas, and Florida (National Audubon Society 2000). They can be found in marshes, ponds, sloughs, lakes, ditches, streams, and rivers (Boutin and Birkenholz 1987).

Muskrats are highly prolific and produce 3-4 litters per year that average 5-8 young per litter (Wade and Ramsey 1986) which makes them relatively immune to overharvest (Boutin and Birkenholz 1987). Harvest rates of from 3 to 8 per acre have been reported to be sustainable in muskrat populations (Boutin and Birkenholz 1987). Muskrat home ranges have been shown to vary from 529 sq. ft to 11,970 sq. ft. (0.1 to 0.25 acres) with the size of home ranges occupied by muskrats depends on habitat quality and population density (Boutin and Birkenholz 1987).

No population estimates were available for muskrat in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 632,000 acres of wetlands in Tennessee (Hefner et al. 1994) including an estimated minimum of 60,000 miles of streams (USFWS 2001). Using the assumption that 50% of the wetlands support a muskrat population, an average home range of 0.25 acres per muskrat, only 1 muskrat occupies a home range, and no home ranges overlap, a conservative statewide muskrat population could be estimated at over 1.8 million muskrats.

Muskrats are classified as regulated furbearers in Tennessee, and seasons and limits for take are set by TWRA. Information regarding the total number of muskrat killed in Tennessee annually is not available.

Wildlife Services provided technical assistance for 9 muskrat damage complaints during FY 1998-2002. Total damage losses reported were $34,100. These loss values included damage to earthen dams, golf courses, turf, and watercraft (USDA-WS MIS Database 2002).

Muskrats usually cause only small area damage problems in Tennessee and WS only killed 17 for MDM purposes in FY 1998-2002 (annual average = 3.4). They sometimes threaten the integrity of earthen dams and therefore pose a threat to human safety and property at these sites. Muskrats may also cause damage to hobby and vegetable gardens and are implicated in erosion to yards where they burrow in drainage ditches in urban environments. In future programs, WS may be requested to address damage being caused by muskrats anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, it is highly unlikely that the program would kill more than 5,000 muskrats in the entire state in any year under the proposed action, which would be

a substantial increase in MDM activity for muskrats. Most of these animals would probably be taken in urban and industrial habitats where little or no trapping by fur harvesters is done. Muskrat damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property.

Based upon the above information, WS limited lethal take of muskrat would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the muskrat populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.15 Opossum Population Information and Effects Analysis

Opossums (*Didelphis virginiana*) are cat-sized., and are the only marsupials (possess a pouch in which young are reared) found north of Mexico (Seidensticker, et al. 1987). They frequent most of the eastern and central United States, except Minnesota, northern Michigan and New England, extending west to Wyoming, Colorado, and central New Mexico (National Audubon Society 2000). They are also found in parts of the southwestern U. S., California, Oregon, and Washington (Jackson 1994a). Adults range in size from less than 1 kg (2.2 lbs) to about 6 kg (13 lbs), depending on sex and time of year. They grow throughout life (Seidensticker, et al. 1987). They have a fairly broad range of pelage colors, but are usually considered as "gray" or "black" phase. Their fur is grizzled white above; long white hairs cover black tipped fur below. They climb well and feed on a variety of foods, including carrion which forms much of its diet. In addition, these animals eat insects, frogs, birds, snakes, small mammals, earthworms, and berries and other fruits; persimmons, apples, and corn are favorite foods (National Audubon Society 2000). They use a home range of 4-20 ha. (10-50 acres), foraging throughout this area frequently (Jackson 1994a), but concentrating on a few sites where fruits abound, when they are in season (Seidensticker, et al. 1987).

The reproductive season of the Virginia opossum typically occurs from December to February, depending on latitude, and extends into November (Gardner 1982). Gestation is short (average of 12.8 days) and 1-14 (National Audubon Society 2000) or 1-17 (Gardner 1982) young are born in an embryonic state, climb up the mothers belly to the marsupium (pouch) attach to teats, and begin to suckle. These young remain in the pouch for about 2 months at which time they will begin to explore and may be found traveling on their mother's back with their tails grasping hers (Whitaker, Jr., and Hamilton, Jr. 1998). Opossums live for only 1-2 years, with as few as 8% of a population of these animals surviving into the second year in a study in Virginia, conducted by Seidensticker, et al. (1987). In this 5 year study, it was also observed that there was a wide variation in opossum numbers, in what was considered excellent habitat for the species. These variations were observed seasonally and in different years. However, the mean density during the study was 3.9 / km^2 (2.4 / mi^2). This was comparable to other opossum population densities in similar habitats in Virginia.

No population estimates were available for opossums in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support opossums, opossums are only found in rural habitat, opossum densities average 1,536/acre, a conservative statewide opossums population could be estimated at over 10,700 opossums.

Many people in urban environments fear opossums, ostensibly because of their appearance and posturing, and report that these animals look dangerous or gruesome, hiss, and exhibit their teeth in a threatening manner (B. Dunlap, WS, pers. comm., 2003). WS received 16

complaints from individuals during FY 1998-2002 about opossum damage. Of these, 37.5% of complainants felt their health or safety was threatened by the presence of these animals. Other damage associated with opossums in Tennessee included fouling of residential buildings, damage to electrical utilities, and aircraft. Tennesseans reported $1,627 in damages to WS associated with opossums, during FY 1998-2002 (USDA-WS MIS Database 2002). Few damage figures were provided for threats to human health and safety, because complainants are rarely able to provide loss values for this resource (USDA-WS MIS Database 2002).

Opossums are classified as a regulated furbearer in Tennessee and seasons for take and bag limits are set by TWRA. Information regarding the total number of opossum killed in Tennessee annually is not available.

Wildlife Services killed 89 opossums (annual average = 17.8) in all MDM programs in Tennessee during FY 1998-2002 (USDA-WS MIS Database 2002). In future programs, WS may be requested to address damage being caused by opossums anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, it is possible that WS could kill as many as 250 opossums each year in MDM programs in Tennessee. These animals would be removed primarily from urban and suburban populations, which are not hunted. Few of these animals are trapped by fur trappers. Opossum damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. Removing this number of opossums will have no adverse affect on overall populations of the species in Tennessee. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local site.

Based upon the above information, WS limited lethal take of opossums would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the opossum populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.16 Other Rodent and Burrowing Mammal Population Information and Effects Analysis

5.1.1.1.1.16.1 Rats, Mice and Voles

Rats and mice belong to the rodent family Muridae and form the largest, most successful, and most adaptable group of mammals in the world. No other family contains more species and more individuals, or occupies a greater geographic range. The family currently includes 281 genera and 1,326 species worldwide, with 20 genera and 78 species in North America north of Mexico. These animals are found in every available habitat, and vary greatly in habits and form. Although there is no biological difference between rats and mice, rats are generally larger. The animals in this family range in size from the 8g (¼ oz.) Northern pygmy mouse to the 1.8 kg (4 lb) common muskrat. In the U.S. this family includes 3 subfamilies: New World rats and mice, voles and lemmings, and the 3 introduced Old World species of house rats and mice (National Audubon Society 2000).

For the purpose of this analysis, population information and effects of proposed MDM actions will be considered for only 3 species of New World mice, 3 species of voles, and 1 species of Old World rat. Those species include: deer mice (*Peromyscus maniculatus*), white-footed mice (*Peromyscus leucopus*), and eastern harvest mice (*Reithrodontomys humulis*) among New World rats and mice; meadow voles (*Microtus pennsylvanicus*),

pine vole (*Microtus pinetorum*) and prairie voles (*Microtus ochrogaster*) among voles; and Norway rats (*Rattus norvegicus*), among Old World rats and mice. These species are common in Tennessee and may cause damage to resources, including human health and safety, agriculture, property, and natural resources.

5.1.1.1.1.16.1.1 White-footed and Deer Mice

Fifteen species of native mice of the genus *Peromyscus* may be found in the United States. The 2 most common and widely distributed species are the deer and the white-footed mouse. Collectively, all species of Peromyscus are often referred to as "white-footed mice" or "deer mice." All of the Peromyscus species have white feet, usually white undersides, and brownish upper surfaces. Their tails are relatively long, sometimes as long as the head and body. The deer mouse and some other species have a distinct separation between the brownish back and white belly. Their tails are also sharply bicolored. It is difficult even for an expert to tell all of the species apart (Timm and Howard 1994).

The deer mouse is found throughout most of North America, while the white-footed mouse is found throughout the U. S. east of the Rocky Mountains except in parts of the Southeast. Both species use a variety of habitats including wooded and brushy areas, cultivated and open habitats, and human structures such as homes and outbuildings (Hawthorne 1994, National Audubon Society 2000). Both species are prolific breeders and may raise several litters of 1 - 8 young (average 3 - 5) after a gestation period of 21 -23 days. The young are weaned at 2 to 3 weeks of age and become sexually mature at about 7 - 8 weeks. Those born in spring and summer may breed the same year (Timm and Howard 1994).

Deer and white-footed mice principally cause problems by entering homes, cabins, and other structures that are not rodent-proof and building nests, storing food, and causing considerable damage to upholstered furniture, mattresses, clothing, paper, or other materials that they find suitable for nest-building. They can also cause extensive damage in reseeding programs, causing failure of such operations by feeding on planted seeds (Timm and Howard 1994).

In addition to this damage to planting efforts and human property, deer mice have been associated with 2 serious diseases in recent years: Lyme disease, a bacterial infection, and Hanta virus, a respiratory illness. Lyme disease is carried by deer ticks, tiny ticks that when immature reside on deer mice. Hanta virus appeared in New Mexico in the early 1990s and caused a number of deaths; it is carried by the deer mouse and has also been found in many regions in several other *Peromyscus* species as well as in *Microtus* species (Timm and Howard 1994, National Audubon Society 2000).

Other identified damage occurs at airports within the range of deer and white-footed mice, where these species act as attractant prey for various mammal and avian predators, especially coyotes, foxes, various hawks and owls. These predators often forage on airports where large populations of mice occur and thereby present special hazards to operating aircraft and air passengers and crews (K. Stucker, S. Stopak, USDA-WS, Pers. comm., 2003).

WS has provided technical assistance in the past in Tennessee to airports regarding methods to control numbers of mice in airport environs to reduce the attraction of predators to such properties. The aim of such reductions in numbers is to reduce the risk of air strikes involving predator species which use the airport for hunting. WS could be requested to provide MDM programs to address damage caused by white-footed and deer mice anywhere in Tennessee for protection of any resource being

damaged by these species. Some local populations of these species might be reduced as a result of MDM activities in a specific locale.

Based upon the above information, WS limited lethal take of white-footed and deer mice would have no adverse impacts on overall populations of the species in Tennessee. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of these rodents. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting damage management, including removal by WS, will be detrimental to the survival of the white-footed and deer mouse populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.16.1.2 Norway Rats and Roof Rats

The Norway rat (*Rattus norvegicus*) is a stocky burrowing rodent, unintentionally introduced into North America by settlers who arrived on ships from Europe. Also called the brown rat, house rat, barn rat, sewer rat, gray rat, or wharf rat, it is a slightly larger animal than the roof rat. Adult Norway rats weigh an average of 454 g (1 lb). Their fur is coarse and usually brownish or reddish gray above and whitish gray on the belly. Blackish individuals occur in some locations. They make a network of interconnecting tunnels for nesting, etc., and are colonial. They may burrow to make nests under buildings and other structures, beneath concrete slabs, along stream banks, around ponds, in garbage dumps, and at other locations where suitable food, water, and shelter are present (Timm 1994). They live in close association with people (Burt and Grossenheider 1964, Timm 1994, National Audubon Society 2000), and in urban areas they live in and around residences, in cellar, warehouses, stores, slaughterhouses, docks, and sewers. On farms they may inhabit barns, granaries, livestock buildings, silos, and kennels (Timm 1994). In summer they may inhabit cultivated fields (National Audubon Society 2000), developing extensive colonies of several hundred individuals at such sites (B. Dunlap, USDA, Pers. comm., 2003).

Norway rats are found throughout the U. S. and southern Canada, and the Pacific coast north to Alaska. They may be found in this range wherever humans live (Timm 1994, National Audubon Society 2000). They are primarily nocturnal, and usually become active about dusk, when they begin to forage for food and water. Some individuals may be active during daylight hours when rat populations are high. They have poor eyesight, relying more on hearing and the senses of smell, taste and touch. They are considered color blind (Timm 1994).

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

Norway rats breed year round (National Audubon Society 2000) but often peaks in spring and fall with reproductive activity declining during the heat of summer and often stopping completely in winter, depending on habitat. The average female rat has 4-6 litters per year with 2 - 22 young per litter (Timm 1994, National Audubon Society 2000). Twelve litters per year are possible (Burt and Grossenheider 1964, National Audubon Society 2000). Gestation is 21 - 26 days. Female rats may breed again within a day or 2 after a litter is born (Timm 1994).

WS handled 4 requests for assistance with Norway rat damage in Tennessee during FY 1998-2002 through various technical assistance actions. Complainants reported $2,000 in damages resulting from Norway rats during the period. Loss values were not obtained for all reports. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, and dikes and impoundments. Damage reported included gnawing, nuisance, other damage, and other threats (USDA-WS MIS Database 2002). Normally, complaints regarding damage by Norway rats are often handled by local health departments.

Wildlife Services killed 380 Norway rats in MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by Norway rats anywhere in Tennessee to protect any resource being damaged or threatened. In those cases where Norway rats are causing damage or are a nuisance, complete removal of the local population could be achieved. This would be considered to be beneficial to the human environment since such actions would be requested by the affected property owner or administrator. Although regional population effects would be minor, even if large regional or nationwide reductions could be achieved, this would not be considered an adverse impact on the human environment because the species is not part of native ecosystems. However, any local reductions or complete removal of local populations of Norway rats will have no adverse effect on regional or national populations of the species. Some local populations may be temporarily reduced as a result of MDM projects.

Based upon the above information, WS limited lethal take of Norway rats would have no adverse impacts on overall populations of the species in Tennessee. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of these rodents.

The Roof rat or Black rat (*Rattus rattus*) is a species of old world rat that was introduced into this country in the late 1500's to early 1600's (National Audubon Society 2000). The roof rat is similar in appearance to the Norway rat, but has a longer tail and a shorter nose (Whitaker, Jr., and Hamilton, Jr. 1998).

The roof rat is most abundant in the South (National Audubon Society 2000). While most abundant in coastal areas, in the eastern United States it can be found inland to east Arkansas, west Kentucky, north Alabama and Georgia, and in North Carolina and Virginia (National Audubon Society 2000).

Within its' range, the roof rat is commonly found inhabiting buildings. When found with Norway rats in the same building, roof rats will generally be found higher in the building, due to their ability to climb better than Norway rats. Roof rats generally nest and live in the walls of buildings (Whitaker, Jr., and Hamilton, Jr. 1998). Roof rats are capable of breeding when two to three months old. A female roof rat will typically have from four to six litters per year, and wean approximately 20 young (Whitaker, Jr., and Hamilton, Jr. 1998).

The roof rat is omnivorous, but prefers to feed on grain and seeds if they are available. Considerable damage to stored grains in the form of consumption and contamination is done by roof rats (National Audubon Society 2000). Because of their ability to climb, they often do damage to nuts and fruits while still on the tree (Whitaker, Jr., and Hamilton, Jr. 1998).

There were no request for assistance with roof rat damage in Tennessee during FY 1998-2002 through various technical assistance actions. Normally, complaints regarding damage by roof rats are often handled by local health departments.

Wildlife Services killed no roof rats in MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by roof rats anywhere in Tennessee to protect any resource being damaged or threatened. In those cases where roof rats are causing damage or are a nuisance, complete removal of the local population could be achieved. This would be considered to be beneficial to the human environment since such actions would be requested by the affected property owner or administrator. Although regional population effects would be minor, even if large regional or nationwide reductions could be achieved, this would not be considered an adverse impact on the human environment because the species is not part of native ecosystems. However, any local reductions or complete removal of local populations of roof rats will have no adverse effect on regional or national populations of the species. Some local populations may be temporarily reduced as a result of MDM projects.

Based upon the above information, WS limited lethal take of roof rats would have no adverse impacts on overall populations of the species in Tennessee. Impacts to such rodents would be minimal because any rodent control would be localized, and is supported by the high reproductive rate of these rodents.

5.1.1.1.1.16.1.3 Voles

Voles, also called meadow mice or field mice are compact rodents with stocky bodies, short legs, and short tails. Their eyes are small and their ears are partially hidden. Their underfur is generally dense and covered with thicker, longer guard hairs. They usually are brown or gray, though many color variations exist (O'Brien, 1994, National Audubon Society 2000).

There are 23 species of voles in the U. S. (Obrien 1994), and the genus Microtus to which meadow, pine and prairie voles belong, contains 15 (National Audubon Society 2000) or 17 (Jones et al. 1992) species. Of these the meadow, pine and prairie voles are relatively abundant, with meadow voles being the most widely distributed Microtus species in the United States. Prairie voles measure 13-18 cm (5-7 inches), and have gray to dark brown fur mixed with gray, yellow or hazel-tipped hairs, giving a "peppery appearance. Underparts are gray to yellow - gray. It is the most common vole in prairie habitats. Meadow voles measure 14-19 cm (5 ½-1 ½ inches) and their fur is gray to yellow - brown, obscured by black - tipped hairs. Northern subspecies may also have some red in their fur. The underparts are gray, at times washed with silver or buff (Obrien 1994). Pine voles measure 10.5-14.5 cm (4 1/8 – 5 ¾ inches), and have reddish-brown short soft fur above with grayish, washed with buff coloration below (National Audubon Society 2000). The pine vole utilizes tunnel systems that are usually one to several inches below ground.

Prairie voles range from southeastern Alberta, southern Saskatchewan, and southern Manitoba south to northwestern New Mexico, northern Oklahoma, northern Arkansas, Tennessee, and western West Virginia. There have been isolated populations in southeastern Texas and southwestern Louisiana. Meadow voles range from Alaska and Canada south and east to northern Washington, Idaho, Utah, New Mexico, Wyoming, Nebraska, northern Missouri, northern Illinois, Kentucky, Tennessee, northeastern Georgia, and South Carolina. Both species are found together in some habitats, since meadow voles live chiefly in lush, grassy fields, marshes, swamps, woodland glades, and mountaintops, while prairie voles live principally in dry grass prairie or mixed grassy-weedy situations. As a rule when these 2 species occur together, meadow voles inhabit the moist areas, while prairie voles inhabit the drier (National Audubon Society 2000). Meadow and prairie voles are active day and night, constructing many tunnels and surface runways with

numerous burrow entrances. A single burrow system may contain several adults and young (Obrien 1994).

The pine vole is found in the eastern United States ranging from New England to central Iowa, north to central Wisconsin, and in the southern states except for most coastal areas. Habitat for the pine vole is deciduous woodlands with thick leaf mold or thick herbaceous ground cover and sometimes parklike grassy areas (National Audubon Society 2000).

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

Voles may breed throughout the year, but must commonly in spring and summer (Obrien 1994), and may do so all year long in the south (National Audubon Society 2000). In the field, they have 1-5 litters / yr, and meadow voles have produced up to 17 litters / yr in a laboratory (Obrien 1994). Litter sizes range from 1-11, but usually average 3-6. The gestation period is about 21 days and young are weaned by the time they are 21 days old. Females mature in 35-40 days and life pans of voles are short; probably ranging from 2-16 months. In one population studied there was 88% mortality during the first month of life (Obrien 1994).

Large population fluctuations are characteristic of voles and generally peak every 2-5 years, but cycles are not predictable. Population densities are variable. Cole and Batzli (1979) found that prairie vole populations averaged 38 / ha (15 / acre) in prairie, 38 / ha (52 / acre) in bluegrass, and 244 / ha (99 / acre) in alfalfa. Among meadow voles, an Ontario, Canada population ranged from 80 - 400 ha (32 - 162 / acre) over 1 year, while an Illinois population ranged from 5 - 15 ha (2 - 6 / acre) also over one year. Much higher densities may be reached during population irruptions. A wide variety of predators feed on voles. Voles are relatively easy for most predators to catch and are active, and therefore available, day and night, year-round. Despite their vulnerability and availability, voles are not usually "controlled" by predators, because they have a high reproductive potential. Postpartum breeding is common and females may breed as early as one weeks of age. Synchronous breeding also occurs. These factors enable voles to increase at a faster rate than predators are able to reduce them (Pearson 1985).

WS responded to 21 requests (average = 4.2 / yr) for assistance with vole damage during FY 1998-2002. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $132,305 (average = $26,461 / yr and $6,300.24 / occurrence) in damages resulting from voles during the period. Resources affected included landscaping, turf and flowers, trees and shrubs, and soybeans. Damage included feeding, burrowing and digging, gnawing, and girdling (USDA-WS MIS Database 2002).

Determination of numbers of voles killed by MDM actions is difficult when lethal chemical methods such as zinc phosphide treatments are employed. This is because most animals killed by these methods die underground. Most vole damage

management actions by WS in Tennessee in the past have been addressed using zinc phosphide injected into vole burrows. These activities have been associated with damage to earthen dams with resultant threats to human safety as the integrity of these dams is threatened by burrowing of these animals. In addition, WS has conducted some MDM programs to reduce vole numbers at airports to reduce attractiveness of properties to predators and to reduce damage to landscape plants, seedlings, trees, shrubs, and other ground cover. In future programs, WS could receive requests for assistance in reducing damage caused by voles to any resource anywhere in Tennessee.

Based upon the above information, WS limited lethal take of voles would have no adverse impacts on overall populations of the species in Tennessee Impacts to such rodents would be minimal because any rodent control would be localized., and is supported by the high reproductive rate of these rodents. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting damage management, including removal by WS, will be detrimental to the survival of the vole populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.16.2 Chipmunks

Chipmunks belong to the family Sciuridae, which has 66 species in the U. S. and Canada, including tree and ground squirrels, marmots, prairie dogs, and a few lesser know genera. Chipmunks consist of 1 genus, *Tamias*, which is represented by 2 groups of this animal; the western and eastern chipmunk. There are 22 species of chipmunks in North America, 21 of which are western species. The single eastern species, *Tamias striatus,* is larger than its western relative and is also distinguished by different dentition. Analysis in this Subsection will be related to the eastern species.

The eastern chipmunk's range includes most of the eastern U. S., except the extreme south and along the southeastern seaboard (Williams and Corrigan 1994, National Audubon Society 2000). The eastern chipmunk is a brownish, ground-dwelling squirrel, typically 13-15cm (5-6 inches) long and weighing 90 g (3 oz.). The tail is 8-10 cm (3-4 inches) long and hairy, but it is not bushy (Williams and Corrigan 1994).

Chipmunks, generally forest creatures, have large, fur-lined internal cheek pouches for carrying nuts and seeds. They have black and white facial stripes, and 5 dark stripes separated by 4 pale ones, on the back and sides of their bodies. They cache a great deal of food in the form of seeds, nuts, fruits, and sometimes, green vegetation and insects. They hibernate in the winter, but awaken about every 2 weeks to feed, since they do not store body fat before hibernation. They are daytime animals, and are usually most active in early morning and late afternoon. They live mostly on the ground, but their nests may be either an underground burrow, or a hollow tree limb (National Audubon Society 2000). These burrows may often be well hidden near objects, such as stumps, wood piles, brush piles, basements, and garages or other buildings. The burrow entrance is usually about 5 cm (2 inches) in diameter with no obvious mounds of soil around them (Williams and Corrigan 1994, National Audubon Society 2000).

Eastern chipmunks have two mating periods, those being during early spring and again during the summer or early fall. There is a 31-day gestation period, producing 2-5 young (Williams and Corrigan 1994). First-year females not breeding in early spring may produce litters in late July or August (National Audubon Society 2000). The young are sexually mature within one year. Adults may live up to three years (Williams and Corrigan 1994).

Population densities of eastern chipmunks typically are 5-10 animals / ha (2-4 animals / acre) (Burt and Grossendeider 1976), and may be as high as 24 / ha (10 animals / acre) if

sufficient food and cover are available. Home ranges often overlap among individuals and are usually less than 92m (100 yds) across (Williams and Corrigan 1994).

No population estimates were available for chipmunks in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 14.5 million forested acres (U.S. Census Bureau 1999, TDA 2003). Using the assumption that 25% of the forested areas throughout the state have sufficient habitat to support chipmunks, chipmunks are only found in rural habitat, and chipmunk densities average 1 chipmunk per acre, a conservative statewide chipmunk population could be estimated at over 3.5 million chipmunks.

Throughout their North American range, chipmunks are considered minor agricultural pests. Most conflicts with chipmunks are nuisance problems. However, when chipmunks are present in large numbers they can cause structural damage by burrowing under patios, stairs, retention walls, or foundations. They may also consume flower bulbs, seeds, or seedling, as well as bird seed, grass seed, and pet food that is not stored in rodent-proof storage containers. In New England, chipmunks and tree squirrels cause considerable damage to maple sugar tubing systems by gnawing tubes. Chipmunks are classified as protected non-game in Tennessee.

Wildlife Services responded to 3 requests for assistance with chipmunk damage during FY 1998-2002. These complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $300 in damages resulting from chipmunks during the period. The reported resource affected was turf and flowers (USDA-WS MIS Database 2002).

No chipmunks were killed by WS in any MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by chipmunks anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, it is possible that WS could kill as many as 500 chipmunks each year in MDM programs in the state. These chipmunks would almost always be removed from urban, suburban, industrial or commercial habitats. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS limited lethal take of chipmunks would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the chipmunk populations in the state of Tennessee (E. Warr TWRA, Pers. comm., 2003).

5.1.1.1.1.16.3 Moles

Moles are often confused with voles and shrews, but can be distinguished by their hairless pointed snout extending nearly 1.3 cm (½ inch) in front of their mouth opening. The small eyes and the opening of the ear canal are concealed in the fur; there are no external ears. The forefeet are very large and broad, with the palms wider than they are long (Henderson 1994). These enlarged forefeet allow moles to tunnel through soil by executing a kind of breast stroke, enabling them to virtually swim through porous soil at about a foot a minute (National Audubon Society 2000). The toes are webbed to the base of the claws, which are broad and depressed. The hind feet are small and narrow with slender, sharp claws (Henderson 1994). Three mole species are found in Tennessee.

The eastern or common mole (*Scalopus aquaticus*) is found throughout all of Tennessee and inhabits open fields, waste areas, lawns, gardens and sometimes woods in well-drained loose soils. This species has short, velvety fur; gray in its northern range, brownish or tan in southern and western parts. The tail is short and nearly naked. Eastern moles measure 82-223 mm (3 1/4 - 8 3/4 inches) in total length (National Audubon Society 2000). They range throughout most of the eastern U. S. from southern Minnesota and extreme southeastern Wyoming, Kansas and central Texas east to the Atlantic and Gulf coasts (National Audubon Society 2000).

The hairy-tailed mole (*Parascalops breweri*) is found in mountainous and foothill habitat in extreme eastern Tennessee and inhabits well-drained., light soil, brushy areas, and occasionally lawns or golf courses adjacent to woods. The fur of this species is dense and silky, dark gray to nearly black. Hairy-tailed moles typically measure from 139 – 170 mm (5 ½ - 6 ¾ inches) in length (National Audubon Society 2000). The tail is short and hairy. They range throughout extreme southeastern Canada and New England southwest through the mountains of North Carolina and Tennessee, and west through eastern Ohio.

The star-nosed mole (*Condylura cristata*) is easily distinguished from other moles by the fringe of 22 fleshy tentacles surrounding the tip of its nose. The fur of this species is black and it has a long hairy tail. Star-nosed moles typically measure from 152 – 211 mm (5 7/8 – 8 ¼ inches) in length (National Audubon Society 2000). The habitat of the star-nosed mole is wet woods, fields or swamps primarily. Star-nosed moles range in the northeast from southeast Labrador south through much of Minnesota, northeast Indiana, north Ohio, south through the Appalachians, and along coastal Virginia (National Audubon Society 2000). Because of their habitat preference, they are seldom a problem to people (Whitaker, Jr. and Hamilton, Jr. 1998).

Moles eat several kinds of invertebrates including earthworms, grubs, beetles, beetle larvae, centipedes, ants, wasps, spiders, and flies, among others. The also eat seeds and some other plant materials. Their familiar damage, occurring as tunnels in gardens, lawns, golf courses and other grassy areas, results from their incessant search for food. They eat between 70% and 100% of their body weight each day (Godfrey and Crowcroft. 1960, Holbrook and Timm 1986, Henderson 1994). This animal stores food (Henderson 1994).

Eastern moles live in the seclusion of underground burrows, coming to the surface only rarely, and then often by accident. Hairy-tailed moles stay in burrows by day but may emerge at night to feed (National Audubon Society 2000). Researchers believe moles are solitary. On several occasions two or even three moles have been trapped at the same spot, but that does not necessarily mean they had been living together in a particular burrow. Networks of runways made independently occasionally join otherwise separate burrows (Godfrey and Crowcroft 1960, Henderson 1994).

During the mating season male moles will seek out a female in her burrow to mate (National Audubon Society 2000). Moles have few natural enemies, which allows them to maintain populations by producing only one annual litter of 2-6 (National Audubon Society 2000) or 3-5 offspring (Henderson 1994) each year. Gestation period of moles is approximately 42 days with young being born mainly in March and early April (Henderson 1994). Home range estimates for moles range form 1,385 to 114,486 sq. ft (Yates and Pedersen 1982).

No population estimates were available for moles in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 14.5 million forested acres (U.S. Census Bureau 1999, TDA 2003). Using the assumption that 25% of the non-

forested areas throughout the state have sufficient habitat to support moles, moles are only found in rural habitat, mole home ranges average 1 mole per 2.6 acre, and no home ranges overlap, a conservative statewide mole population could be estimated at over 720,000 moles.

Wildlife Services responded to 57 requests (average = 11.4 / yr) for assistance with mole damage during FY 1998-2002. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $1,250 in damages resulting from moles during the period. Loss values were not obtained for all reports. Resources affected included landscaping, turf, and flowers, and general property damage. Damage included burrowing, digging, and other damage (USDA-WS MIS Database 2002).

Wildlife Services killed seven moles in MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by moles anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, it is possible that WS could kill as many as 500 moles each year in MDM programs in the state. These moles would almost always be removed from urban, suburban, industrial or commercial habitats. Removing this number of moles will have no adverse effect on overall populations of the species in Tennessee. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS limited lethal take of moles would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from damage management, including removal by WS, will be detrimental to the survival of the mole populations in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.17 Raccoon Population Information and Effects Analysis

The raccoon (*Procyon lotor*), also called "coon," is a stocky mammal about 61-91 cm (2-3 feet) long, weighing 4.5 - 13.5 kg (10 - 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 1994b).

The raccoon is one of the most omnivorous of animals. It 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 1994b), and come into conflict with man frequently in urban and suburban environments by raiding garbage cans and pet food sources (Scott R. Stopak, WS, pers. comm., 2003).

The raccoon is found throughout most of the United States, with the exception of the higher elevations of mountainous regions and some areas of the arid southwest (Boggess 1994b, National Audubon Society 2000). Raccoons are more common in the wooded eastern portions of the United States than in the more arid western plains (Boggess 1994b), and are frequently found in cities or suburbs as well as rural areas (National Audubon Society 2000). Movements and home ranges of raccoons vary according to sex, age, habitat, food sources, season, and other factors. In general males have larger home ranges than females. Home range diameters of raccoons have been reported as being 1-3 km (0.6 - 2.9 mi.) maximum, with some home range diameters of dense suburban populations to be 0.3-0.7 km (0.2 - 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 and the additional difficulty of knowing 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 take of animals per unit area. For instance, Twichell and Dill (1949) reported removing 100 raccoons from tree dens in a 41 ha (101 acres) waterfowl refuge area, while Yeager and Rennels (1943) studied raccoons on 881 ha (2,177 acres) in Illinois and reported trapping 35-40 raccoons in 1939-39, 170 in 1939-40, and 60 in 1940-41. Slate (1980) estimated one raccoon/7.8 ha (19.3 acres) in New Jersey in predominantly agricultural land on the inner coastal plain. Raccoon densities of 100 per sq. mile (1 raccoon per 6.4 acres) can be attained around abundant food sources (Kern 2002). Kennedy et al. (1991) estimated 13 raccoons per 100 ha (1 raccoon per 19 acres) of lowland forest in Tennessee.

No population estimates were available for raccoons in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 75% of the rural lands throughout the state have sufficient habitat to support raccoons, raccoons are only found in rural habitat, raccoon densities average 1 raccoon per 19/acre, a conservative statewide raccoon population could be estimated at over 8.6 million raccoons.

In Tennessee, raccoons cause damage to gardens, residential and non-residential buildings, fish, and domestic fowl, 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 1994b).

Tennesseans are also concerned about health and safety issues associated with raccoons. These 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 these eggs can result in serious or fatal infections in other animals as well as humans (Davidson and Nettles 1997 and Table 1.1).

Raccoons are regulated furbearers in Tennessee. They are harvested for fur value and hunting and trapping seasons with bag and possession limits are been designated for the species by TWRA. Information regarding the total number of raccoons killed in Tennessee annually is not available.

Wildlife Services provided technical assistance for 54 requests from individuals with raccoon damage in Tennessee during FY 1998-2002. Complainants reported $3,955 in damages resulting from raccoons during the period. Loss values were not obtained for all reports. Fifty-seven percent of individuals contacted WS with regard to human health and safety issues (USDA-WS MIS Database 2002). Complainants are rarely able to provide loss values for human health and safety threats.

Wildlife Services conducts efforts to combat the spread of raccoon rabies in Tennessee. These activities are part of the national rabies barrier program covered under separate environmental analyses (USDA 2001). Other rabies monitoring or control activities may occur as part of this program.

Wildlife Services killed 82 raccoons (average = 16.2/ yr) in all MDM programs in Tennessee during FY 1998-2002 (USDA-WS MIS Database 2002). This number is insignificant to the

total population of this species in the state. In future programs, WS may be requested to address damage being caused by raccoons anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, it is possible that WS could kill as many as 500 raccoons each year in MDM programs in the state. These raccoons would almost always be removed from urban and suburban populations of the species. These populations are not hunted and few are trapped by fur trappers. Removing this number of raccoons will have no adverse affect on overall populations of the species in Tennessee. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS limited lethal take of raccoon would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the raccoon populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.18 River Otter Population Information and Effects Analysis

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

Human encroachment, habitat destruction, and overharvest have eliminated river otters from marginal portions of their range. However, present distribution spans the North American continent from east to west and extends from southern Florida to northern Alaska (Melquist and Dronkert 1987). In the 1950's the heaviest river otter populations in Tennessee were reported along the Hatchie River. The river otter was virtually non-existent in the remainder of the state (TWRA 2001). In 1975 the river otter was placed on the Tennessee threatened list through the enactment of Proclamation 75-15. River otter population increased in west Tennessee to the point where in 1989 the Wildlife Commission removed the river otter from the threatened list in all drainages west of Kentucky and Pickwick Lakes (TWRA 2001).

In the 1990's the TWRA initiated a large scale river otter reintroduction project in middle and east Tennessee. These efforts have been so successful that trapping seasons exist statewide now for these animals. River otters are now considered a regulated furbearer. Information regarding the total number of river otters killed in Tennessee annually is not available.

No population estimates were available for river otters in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 632,000 acres of wetlands in Tennessee (Hefner et al. 1994) including an estimated minimum of 60,000 miles of streams (USFWS 2001). Using the conservative estimate of one otter per 2.4 stream mile provided by Novak (1987), and river otters occur in one-half of the stream habitat in Tennessee, the minimum statewide river otter population estimate for Tennessee could be estimated at 12,500 river otters.

Wildlife Services responded to 4 requests for assistance with river otter damage during FY 1998-2002. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $700 in damages resulting from river otters during the period. Loss values were not obtained for all reports. Resources affected included boat docks, watercraft and fish (USDA-WS MIS Database 2002).

Wildlife Services killed 48 river otters (average = 9.6/yr) in Tennessee MDM programs during Fiscal Year 1998-2002 (USDA-WS MIS Database 2002). These animals were taken as unintentional nontargets during beaver damage management activities. A few river otters will probably continue to be taken as nontargets in WS MDM programs to address beaver or muskrat damage in the State in future years. It is probable that less that 50 river otters per year would be unintentionally taken in all such programs during a given year by WS.

Some aquaculture producers or fish hatchery managers could request assistance from WS to address the loss of fish taken by river otters. A few river otters may be killed in some of these instances. It is possible that as many as 25 river otters per year could be intentionally killed in WS conducted damage management programs to protect fish production in Tennessee.

Based upon the above information, WS limited lethal take of river otter would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur harvest and damage management, including removal by WS, will be detrimental to the survival of the river otter population in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.19 Skunk Population Information and Effects Analysis

5.1.1.1.1.19.1 Spotted Skunk Population Information and Effects Analysis

Spotted skunks (*Spilogale putorius*) are one of the smallest skunks, (about ½ the size of a house cat). The legs are short, and the tail long and bushy with a white tip. It has a black pelage with broken white stripes, and a white patch on the nose, and front of the ears. The average total length is 403-610 mm and tail length is 193-280 mm. The adult male weighs from 444-999 grams (1-2.5 lbs), and the female weighs from 363-567 grams (0.8-1.25 lbs) (Whitaker, Jr. and Hamilton, Jr. 1998).

The eastern spotted skunk ranges from Costa Rica and northeastern Mexico through the Great Plains of the central United States to the Canadian border. It is also found throughout the southeastern United States. The eastern spotted skunk has been found in open lowlands, mountainous country, and at altitudes of 2,400 m (7,875 feet) (Baker and Baker 1975). Few studies have been published on the home range, population density, and mortality of spotted skunks. Crabb (1948) found that the western spotted skunk in Iowa maintained a home range of 64.8 ha (160 acres) at densities of 2.2 / km2 (5.7 / mi2). He also noted movements of 4.8 km (3 mi) / night. However, spotted skunks are nomadic, do not occupy a territory, and do not defend a home range (Crabb 1948).

This species mates by April, the gestation period is variously reported as 50-70 days with an average litter size of 2-6. They are blind and average 1/3 ounce each. Some males are sexually mature, and they breed by 5 months. The young develop teeth by 40 days and are weaned by 55 days, after which they forage with the mother until late fall when they disperse (National Audubon Society 2000, KDFWR 2002).

The male gives no care to the young. The eyes of the young open at around 1 month and they can emit musk at about 46 days. They are weaned by 8 weeks. This species is nocturnal, and they climb trees more than other skunks. They are quicker and more alert, also. There is no true hibernation, just short inactive periods in the winter to conserve body fat. Several may den together in the winter. Populations up to 13 or more can be found per square mile. The males may wander farther, and dens distributed over the area seem to belong to the whole population, except in breeding season. They have a characteristic handstand defense mechanism which makes the skunk appear larger. The home range is generally from 1-1.3 miles in diameter, with female home ranges 1/3 as large (KDFWR 2002).). Skunk densities vary widely according to season, food sources

and geographic area. Densities have been reported to range from 1 skunk per 77/acres to 1 per 10/acres (Rosatte 1987).

Spotted skunks feed on a variety of items including beetles, grubs, bees and honey, mice, moles, rats, chipmunks, bird's eggs and fresh carrion (KDFWR 2002). They are more predaceous of than other species of skunks, and mammals appear to be a more important food source than arthropods (Howard and Marsh 1982). For example, Crabb (1941) found mammals in 90% of scats collected during winter in Iowa. Eastern cottontails appeared to be a major food item, along with meadow and prairie voles.

Adult spotted skunks can stay in burrows for several weeks during cold spells losing up to 30% of their body weight with no ill effects. Underground dens are either excavated or abandoned by other animals. They have 2-5 entrances with 1-3 nest chambers. Dens can have up to 60 feet of tunnels. Sections below the frost line are used in the winter when all but one entrance may be sealed. Deserted woodchuck and other small animal's burrows are frequently used as a den. Occasionally owl preys upon spotted skunks. This species can carry and transmit rabies (KDFWR 2002).

No population estimates were available for spotted skunks in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 25% of the rural lands throughout the state have sufficient habitat to support spotted skunks, skunks are only found in rural habitat, and skunks densities average 1 skunk per 77/acre, a conservative statewide spotted skunk population could be estimated at over 71,000 skunks.

Spotted skunks are protected furbearers in Tennessee and seasons and limits are set by the TWRA. Information regarding the total number of spotted skunks killed in Tennessee annually is not available.

No spotted skunks were killed either as targets or nontargets in any WS MDM programs in Tennessee from Fiscal Year 1998 – 2002 (USDA-WS MIS Database 2002). Because most WS MDM actions which target skunks in Tennessee allow identification of offending species, killing of spotted skunks as nontargets will be highly unlikely. It is possible WS could kill up to 50 spotted skunks annually during MDM programs in the state.

Based upon the above information, WS limited lethal take of spotted skunks would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur trapping and damage management, including removal by WS, will be detrimental to the survival of spotted skunk populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.19.2 Striped Skunk Population Information and Effects Analysis

Although easily recognized by their black and white fur, the striped skunk (*Mephitis mephitis*) may be most readily recognized by the odiferous smell of it's' musk. They are common throughout the United States and Canada (Rosette 1987). Striped skunks are primarily nocturnal and do not have a true hibernation period, although during extremely cold weather it may become temporarily dormant. The striped skunk is an omnivore, feeding heavily on insects such as grasshoppers and crickets, beetles and bees and wasps (Chapman and Feldhamer 1982). The striped skunk's diet also includes small mammals, the eggs of ground-nesting birds and amphibians. Striped Skunks are typically non-aggressive, and will attempt to flee when approached by humans (Rosatte 1987). However, when provoked, skunks will give a warning and assume a defensive posture

prior to discharging their foul-smelling musk. This musk is sulfur-alcohol compounds know as butylmercaptan (Chapman and Feldhamer 1982).

The striped skunk may use abandoned burrows of other animals as a home. They may also dig their own burrow, or use a protected place, such as a hollow log, crevice, or the space beneath a building. This species is currently the chief carrier of rabies in the United States (National Audubon Society 2000).

Adult skunks begin breeding in late February. Yearling females (born in the preceding year) mate in late March. Gestation usually lasts about 7-10 weeks, and there is usually only 1 litter annually. Litters commonly consist of 4-6 young. The home range of striped skunks is usually not consistent. It appears to be in relation to life history requirements such as winter denning, feeding activities, dispersal and parturition (Rosatte 1987). Other literature reported the home ranges of striped skunks to average between 2.2 and 4.9 km^2 (0.85 -1.9 $miles^2$) in rural areas of Minnesota and Illinois (Rosette, in Novak, et al. 1987). During the breeding season, males may travel larger areas in search of females. Skunk densities vary widely according to season, food sources and geographic area. Densities have been reported to range from 1 skunk per 77/acres to 1 per 10/acres (Rosatte 1987).

No population estimates were available for striped skunks in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 50% of the rural lands throughout the state have sufficient habitat to support stripped skunks, skunks are only found in rural habitat, and skunk densities average 1 skunk per 77/acre, a conservative statewide stripped skunk population could be estimated at over 142,000 skunks.

In Tennessee, the TWRA has established year round season with no limit on the taking of striped skunks. Information regarding the total number of striped skunks killed in Tennessee annually is not available.

Wildlife Services responded to 127 requests (average = 25.4/yr) for assistance with striped skunk damage during FY 1998-2002. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $6,375 (average = $1,275/ yr) in damages resulting from striped skunks during the period. Damage related to human health and safety was most commonly reported (78%)(USDA - MIS Database 2002). Loss values were not obtained for all reports, especially human health and safety. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, general property, residential and non-residential buildings, pets, and turf or flowers. Damage included burrowing/digging, odor, nuisance, rabies threats, and other threats (USDA - MIS Database 2002).

Wildlife Services killed 166 striped skunks (average = 33.2/yr) in all MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by striped skunks anywhere in Tennessee to protect any resource being damaged or threatened. Based upon current and an anticipated increase in striped skunk damage management activities in the future, it is possible that WS could kill 500 striped skunks per year in all MDM programs in Tennessee. This number would have no effect on overall striped skunk populations in the state. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS limited lethal take of striped skunks would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated fur trapping and damage management, including removal by WS, will be detrimental to the survival of striped skunk populations in the state of Tennessee (E. Warr TWRA, pers. comm., 2003).

5.1.1.1.1.20 Tree Squirrel Population Information and Effects Analysis

Tree squirrels are divided into three groups: large tree squirrels; red or pine squirrels; and flying squirrels. Large tree squirrels include fox *(Sciurus niger*), eastern gray *(Sciurus carolinensis*), western gray *(Sciurus griseus*), and tassel-eared *(Sciurus aberti*) squirrels. Only fox squirrels and eastern gray squirrels have been associated with notable levels of damage in the state (USDA-WS MIS Database 2002). For that reason only those two species will be treated in this Subsection. Further reference to "squirrels" as a group in this Subsection will be construed to mean these two species.

Fox squirrels measure 46- 69 cm (18 - 27inches) from nose to tip of tail. They weigh about 787 - 1,012g (1 ¾ - 2 ½ lbs). Color varies greatly, from all black in Florida to silver gray with a white belly in Maryland. Georgia fox squirrels usually have a black face. Ohio and Michigan fox squirrels are grizzled gray-brown above with an orange underside. Sometimes several color variations occur in a single population. Eastern gray squirrels are also variable in color. Some have a distinct reddish cast to their gray coat. The black color phase is common in some northern parts of their range. Eastern gray squirrels measure 41 - 51 cm (16 - 20 inches).They weigh from 567 - 794g (1 ¼ -1 ¾ lbs) (National Audubon Society 2000).

Gray and fox squirrels are found throughout most of the eastern U. S., including Tennessee. They inhabit mixed hardwood forests, especially those containing nut trees such as oak/hickory mix. Fox squirrels are also found in cypress and mangrove swamps and piney woods in the south. While these species are aptly named tree squirrels, they spend quite a bit of time on the ground foraging. However, gray squirrels rarely venture far from trees, while fox squirrels may wander into areas of weeds and fields in search of food (Burt and Grossenheider 1964, National Audubon Society 2000). Squirrels feed on a wide variety of foods and adapt quickly to unusual food sources. Typically they feed on wild tree fruits and nuts in fall and early winter. Acorns, hickory nuts, walnuts, and osage orange fruits are favorite fall foods. Nuts are often cached for later use. In late winter and early spring they prefer tree buds. In summer they eat fruits, berries, and succulent plant materials. Fungi, corn, and cultivated fruits are taken when available. They may also chew bark during high population peaks, when food is scarce and may eat insects and other animal matter (Jackson 1994b).

Gray squirrels produce young during early spring, while fox squirrels have litters around February to early March, but may actually produce at any time until early September (National Audubon Society 2000). Older adults of both species may produce two litters per year (Burt and Grossenheider 1964, Jackson, 1994b). The gestation period is 42-45 days, and about three young comprise a litter. Young begin to explore outside the nest at about 10-12 weeks of age (Jackson 1994b). Home ranges of squirrels range from 1.2 to over 40 acres in size (Flyger and Gates 1982).

Squirrel populations periodically rise and fall, and during periods of high populations they may go on mass emigrations, during which time many animals die. These species are vulnerable to numerous parasites and diseases such as ticks, mange mites, fleas, and internal parasites. Squirrel hunters often notice bot fly larvae, called "wolves" or "warbles," protruding from the skin of animals killed. These larvae do not impair the quality of the meat

for eating. In addition to being a food source for some people, squirrels are also prey for hawks, owls, snakes, and several mammalian predators. Predation seems to have little effect on squirrel populations. Typically about half the squirrels in a population die each year and wild squirrels over 4 years old are rare, while captive individuals may live 10 years or more (Jackson 1994b).

No population estimates were available for squirrels in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 14.5 million forested acres (U.S. Census Bureau 1999, TDA 2003). Using the assumption that 75% of the forested areas throughout the state have sufficient habitat to support squirrels, squirrels are only found in rural habitat, squirrel home ranges average 1 squirrel per 40 acres of forested habitat, and that home ranges do not overlap, a conservative statewide squirrel population could be estimated at over 272,000 squirrels.

Gray and fox squirrels are considered small game by the TWRA in Tennessee and appropriate seasons and bag limits are set by that agency. Information regarding the total number of squirrels killed in Tennessee annually is not available.

Wildlife Services responded to 43 requests for assistance with squirrel damage during FY 1998-2002. Most complaints were handled by providing technical assistance advice on methods for addressing damage. Complainants reported $9,000 in damages resulting from squirrels during the period. Loss values were not obtained for all reports. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, general property, residential and non-residential buildings, and truck gardens. Damage included feeding, gnawing, nuisance, and other damage (USDA-WS MIS Database 2002).

Wildlife Services killed two squirrels in all MDM programs in Tennessee during FY 1998-2002. This number is insignificant to the total population of the two species present in the state. In future programs, WS may be requested to address damage being caused by squirrels anywhere in Tennessee to protect any resource being damaged or threatened. Based upon an anticipated increase for requests for WS assistance, it is possible that WS could kill as many as 250 squirrels each year in MDM programs in the state. These squirrels would almost always be removed from urban and suburban populations of the species. These populations are not hunted. Removing this number of squirrels will have no adverse effect on overall populations of the species in Tennessee. Some local populations may be temporarily reduced as a result of MDM projects aimed at reducing damage at a local project site.

Based upon the above information, WS limited lethal take of squirrels would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated hunting and damage management, including removal by WS, will be detrimental to the survival of the squirrel populations in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.21 White-tailed Deer Population Information and Effects Analysis

White-tailed deer (*Odocoileus virginianus*) are small to medium-sized deer with tan or reddish brown pelts above in summer and grayish brown in winter. The belly, throat, nose band, eye ring and inside of the ears are white and the tail is brown with white above, often with a dark stripe down the center and white below. This species is conspicuous for the habit of raising the tail while alarmed and in flight, called "flagging," in which the tail appears as a large, bright flash of white. This communicates danger to other deer and helps young follow their mothers in flight (National Audubon Society 2000). The range in size of white-tailed deer is extreme. White-tailed deer in the northern extremes of its range where there is good

habitat will achieve weights of greater than 136 kilograms (300 pounds). By comparison, the tiny Florida Keys subspecies (*O.v. clavium*) commonly weigh less than 23 kilograms (50 pounds) (National Audubon Society 2000).

Male white-tailed deer are called bucks. They exhibit antlers, which are a pair of bony outgrowths of the frontal bone that normally are shed annually. The antlers begin growing in the early summer at which time they are covered with a skin that grows as the antlers do. The skin has short fine hairs called "velvet," containing a network of blood vessels, which nourish the growing bone beneath. By late summer the antlers are fully developed, and the "velvet" is rubbed off against small sapling by the animal, as the bone hardens. The bare bones then serve as sexual ornaments and rival males may use them as weapons in courtship battles during the breeding season, which is called the "rut." After mating season the antlers decalcify and the antlers detach from the frontal bone within 2-3 days of each other, fall to the ground, and are often and quickly found and eaten by various rodents which crave calcium (National Audubon Society 2000). Antler size depends on nutrition, age, and genetics (Craven and Hygnstrom 1994).

The white-tailed deer reproductive season varies according to geographic range. It may occur by the first two weeks in November in the north, but occur as late as January or February in the south. Females, called "does," may have 1-3 young, or "fawns," after a gestation period of approximately 202 days (Craven and Hygnstrom 1994). A young doe bred for the first time will usually have only one fawn, older does tow or three. The female remains near the fawns, returning to feed them only once or twice a day. Twin fawns are separated, which serves to protect them. Weaning occurs between 1 and 2 ½ months. Fawns stay with the mother until fall or winter, sometimes up to two years, but the doe generally drives off her young the previous year shortly before giving birth (National Audubon Society 2000).

White-tailed deer range throughout most of the U. S., except the far southwest, and also inhabit the southern half of the southern tier of Canadian provinces. This species inhabits farmlands, brushy areas, woods, and suburbs and gardens. Although they are primarily nocturnal, white-tailed deer may be active at any time. They move to feeding areas along established trails, then spread out to feed (National Audubon Society 2000). They thrive in agricultural areas interspersed with woodlots and riparian habitat. They favor early successional stages which keep brush and sapling browse within reach. Dense cover is used for winter shelter and protection (Craven and Hygnstrom 1994).

White-tailed deer feed on green plants including aquatic ones in summer. During the fall they feed on acorns, beechnuts, and other nuts, and agricultural crops such as corn and soybeans. In winter, they browse on woody vegetation, including the twigs and buds of viburnum, birch, maple, and many conifers. The four part stomach allows this species to feed on items that most other mammals cannot eat. White-tailed deer obtain nutrients directly from the food, as well as nutrients synthesized by microbes in its digestive system. (National Audubon Society 2000).

The white-tailed deer population in Tennessee has increased dramatically from an estimated 2,000 deer in 1940 to approximately 1,000,000 in 2003. White-tailed deer are present in all Tennessee counties, and occupy almost all undeveloped land that contains suitable habitat. Overall, the State's white-tailed deer population is healthy and productive (A. Peterson TWRA, pers. comm., 2003).

During Calendar Years 1998-2002 hunter take of white-tailed deer averaged 147,830 deer / yr in Tennessee (TWRA 2003a). Information regarding the total number of white-tailed deer killed in Tennessee annually is not available.

Wildlife Services responded to 14 requests for assistance with white-tailed deer damage during FY 1998-2002. The TWRA is responsible for managing damage associated with

white-tailed deer and WS refers most complaints to them. In some situations technical assistance advice on methods for addressing damage was provided. Complainants reported $13,900 in damages resulting from white-tailed deer during the period. Loss values were not obtained for all reports. Complainants are rarely able to provide loss values for human health and safety threats. Resources affected included human health and safety, aviation safety, gardens, golf courses, soybeans, and trees and shrubs. Damage included browsing and feeding, other damage, and other threats.

Wildlife Services has killed no white-tailed deer in all MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by white-tailed deer anywhere in Tennessee to protect any resource being damaged or threatened. It is possible that WS could kill as many as 1,000 animals of this species each year in MDM programs in the state. White-tailed deer damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property. These deer would almost always be removed from urban and industrial environments where hunting is generally not allowed or a possibility.

Based upon the above information, WS limited lethal take of white-tailed deer would have no adverse impacts on overall populations of the species in Tennessee. TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated harvest and damage management, including removal by WS, will be detrimental to the survival of the white-tailed deer population in the state of Tennessee (A. Peterson, TWRA, Pers. comm., 2003).

5.1.1.1.1.22 Emerging Non-Native Species Population Information and Effects Analysis

The expansion of range is a common occurrence in healthy mammal populations. Two mammal species, the nine banded armadillo and nutria have begun to expand their range into Tennessee in recent years. Requests for assistance in addressing damage caused by armadillos and nutria have been minimal. However, in the future, WS could be requested to address damage associated with these species. Population information and effects analysis are provided in this section.

5.1.1.1.1.22.1 Nine Banded Armadillo Population Information and Effects Analysis

The nine banded armadillo (*Dasypus novemcinctus*) is easily recognized due to its unique appearance. An opossum sized animal, the armadillo has a "shell", which is composed of ossified dermal plates covered by a leathery epidermis (Whitaker, Jr. and Hamilton, Jr., 1998). It is the only North American mammal which has an armor of these heavy bony plates (National Audubon Society 2000). Armadillos have prominent claws which are used for digging. Female armadillos produce one litter of young per year, which are identical quadruplets (National Audubon Society 2000).

Armadillos occupy a variety of habitats, including moist forests, pastures, and brushy or scrub lands (Whitaker, Jr. and Hamilton, Jr., 1998). Armadillos dig burrows for shelter. Armadillos do not hibernate, and cannot survive prolonged periods of below freezing weather (National Audubon Society 2000). Population densities for armadillos are reported to be from 0.05 to 3 per ha (0.02 – 1.2 per acre). The life expectancy of an armadillo in the wild is rarely more than two years (Whitaker, Jr. and Hamilton, Jr., 1998).

No population estimates were available for nine banded armadillos in Tennessee. Therefore the best available information was used to estimate statewide populations. There are over 22 million acres of rural land in Tennessee, with approximately 5 million acres considered cropland (U.S. Census Bureau 1999). Using the assumption that 25% of

the rural lands throughout the state have sufficient habitat to support nine banded armadillos, armadillos are only found in rural habitat, and armadillo densities average 1 armadillo per 5 acres, a conservative statewide nine banded armadillo population could be estimated at over 1,100 armadillos.

WS received one request for assistance with nine banded armadillo damage in Tennessee during FY 1998-2002. Landscaping was the resource being damaged. The complainant did not provide a financial amount associated with the damage (USDA-WS MIS Database 2002).

Wildlife Services killed no armadillos in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by armadillos anywhere in Tennessee to protect any resource being damaged or threatened. Based upon current and an anticipated increase in armadillo damage management activities in the future, it is possible that WS could kill 100 armadillos per year in all MDM programs in Tennessee.

Based upon the above information, WS limited lethal take of armadillos would have no adverse impacts on overall populations of the species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality from damage management, including removal by WS, will be detrimental to the survival of nine banded armadillos in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.1.1.22.2 Nutria Population Information and Effects Analysis

The nutria (*Myocastor coypus*) is a large, dark colored, semi-aquatic rodent that is native to South America. It was introduced to the United States in the late 1930's (Whitaker, Jr. and Hamilton, Jr., 1998). The nutria is somewhat similar to the native muskrat in appearance. Nutria have small eyes and ears. The tail is long, scaly, sparsely haired and round (National Audubon Society 2000). Nutria weigh on average about 12 pounds (Whitaker, Jr. and Hamilton, Jr., 1998).

Nutria primarily inhabit brackish or freshwater marshes, but are also found in swamps, rivers, ponds, and lakes. They live in dense vegetation, in abandoned burrows, or in burrows they dig along stream banks or shorelines (Wade and Ramsey 1986). The burrowing activity of nutria can severely damage levees, dikes, earthen dams, and other structures. Nutria feed on terrestrial or aquatic green plants, but also feed on crops adjacent to their habitat. Nutria will consume approximately 25% of its own weight in food each day (Whitaker, Jr. and Hamilton, Jr., 1998).

Nutria females begin breeding in their first year. Breeding can occur at any time during the year. In the right conditions nutria can produce up to 15 young per year (Whitaker, Jr. and Hamilton, Jr., 1998). In the wild, the life expectancy of nutria is approximately 2 years. Home ranges for nutria are estimated to be from 12 to 445 acres, and densities range up to 10 nutria per acre (Whitaker, Jr. and Hamilton, Jr., 1998).

No population estimates were available for nutria in Tennessee. Researchers with the University of Memphis have documented the presence of nutria in the southwest portion of the state. However, the population appears to be transient, being dependent on the severity of the winters (Randy Huskey, TWRA, pers. comm., 2004).

The TWRA classifies nutria as an invasive species, and there management objective is to eradicate the species in Tennessee or keep the population at the lowest level possible (Randy Huskey, TWRS, pers. comm., 2004). Wildlife Services is directed to manage damage caused by invasive species by Executive Order 13112.

Wildlife Services received no requests for assistance with nutria damage during FY 1998-2002.

Wildlife Services has killed no nutria in all MDM programs in Tennessee during FY 1998-2002. In future programs, WS may be requested to address damage being caused by nutria anywhere in Tennessee to protect any resource being damaged or threatened. The management objective of any WS nutria damage management activities would be coordinated with the TWRA management goal of population suppression or eradication. Nutria damage management activities would target single animals or local populations of the species at sites where their presence was causing unacceptable damage to agriculture, human health or safety, natural resources, or property.

In those cases where nutria are causing damage or are a nuisance and complete removal of the local population could be achieved, this would be considered a beneficial impact on the human environment since these species are not considered part of the native ecosystem.

5.1.1.2 Effects on Non-target Species Populations, Including T&E Species

Direct impacts on nontarget species occur if WS program personnel were to inadvertently kill, injure, or harass animals that are not target species. In general, these impacts result from the use of methods that are not completely selective for target species. WS take of non-target species during WDM activities is expected to be extremely low to non-existent. While every precaution is taken to safeguard against taking non-target species, at times changes in local animal movement patterns and other unanticipated events could result in the incidental take of unintended species. These occurrences are rare and should not affect the overall populations of any species under the current program. Mitigation measures designed and implemented to avoid adverse effects on non-target species are described in Chapter 4.

WS personnel are experienced and trained in wildlife identification, and to select the most appropriate methods for taking targeted animals and excluding non-target species. Non-target species are usually not affected by WS's non-lethal management methods, except for the occasional scaring from harassment devices. In these cases, affected non-target wildlife may temporarily leave the immediate vicinity of scaring, but would most likely return after conclusion of the action. Shooting is virtually 100% selective for the target species; therefore no adverse impacts are anticipated from use of this method. WS personnel use animal lures and set traps and snares in locations that are conducive to capturing target animals while minimizing potential impacts to non-target species. Any non-target species captured unharmed in a live trap would be subsequently released on site.

Any operational uses of MDM chemicals would be in accordance with labeling requirements under FIFRA and state pesticide laws and regulations that are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions are a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on non-target species populations. No adverse impacts from the use of chemical methods are anticipated. Based on a thorough Risk Assessment, APHIS concluded that, when WS program chemical methods are used in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the environment (USDA 1997).

Non-target species taken in Tennessee are recorded as Target - Unintentional (i.e., they were listed on the agreement as target species but were taken unintentionally during efforts to take other target species) or Non-target (i.e., they were not listed as target species on the agreement and were taken unintentionally during efforts to take target species). With this type of data recording, some species were targets in some situations and non-targets in others. Non-target mammals killed by WS during MDM activities in Tennessee during FY 1998-2002 included feral cats (3), feral dogs (1), gray fox (1), red fox (1) groundhog (1), muskrat (14), opossum (87), river otter (48), cottontail rabbit (1), raccoon (46), turtle (103) (USDA-WS MIS Database 2002). The level of non-target take for each of these species is insignificant and had no effect on their populations in the state. WS does not anticipate the level of non-target take to increase

substantially above current levels of take. Any other non-targets that may incidentally be taken by WS is expected to be minimal and should have no adverse effect on statewide populations. The TWRA concurs that Tennessee WS mammal damage management activities would have no adverse effects on native wildlife populations in Tennessee, including state listed T&E species, and species of concern (E. Warr, TWRA, pers. comm.. 2003). Analysis of impacts on feral cats, feral dogs, gray fox, red fox, groundhog, muskrat, opossum, river otter, cottontail rabbit, and raccoon are provided in Section 5.1.1.1. Analysis of turtle population impacts are provided in the following subsection.

One anticipated outcome of this Alternative is a slight reduction in beaver damage and associated beaver created impoundments. This reduction in beaver created impoundments would likely have an impact on other wildlife and plant species. The extent and nature of the impacts would depend upon the size of the beaver created impoundment and the diversity of plant and animal species in the area. Some species would flourish, while others would diminish.

5.1.1.2.1 Turtle Populations Information and Effects Analyses

Turtles in Tennessee are classified as a nongame species. Sport fishermen can take the common snapping turtle with sport fishing methods, or by the use of hoop nets in TWRA's Region 1 area. A fishing license is required to take turtles. The bag limit on common snapping turtles is five per day, and they must have a minimum shell length of 12 inches. Table 5.3 lists turtles found in Tennessee. Box turtles were excluded from this table.

Table 5.3 Turtles (Except Box Turtles) Found in Tennessee

SCIENTITIC NAME	COMMON NAME	STATUS
Chelydra serpentina	Common Snapping Turtle	
Macrochelys temminckii	Alligator Snapping Turtle	IM
Apalone Mutica	Smooth Softshell	
Apalone spinifera	Spiny Softshell	
Kinosternon subrubrum	Eastern Mud Turtle	
Sternotherus minor	Loggerhead Musk Turtle	
Sternotherus odoratus	Common Musk Turtle	
Chrysemys picta	Painted Turtle	
Clemmys muhlenbergii	Bog Turtle	FT(S/A), STE
Graptemys geographica	Common Map Turtle	
Graptemys ouachitensis	Ouachita Map Turtle	
Graptemys pseudogeographica	False Map Turtle	
Pseudemys concinna	River Cooter	
Trachemys scripta	Slider	

* Codes: F = Federal listing, S = State listing, E = Endangered., T= Threatened., IM = In Need of Management, (S/A) = Similar Appearance

Turtles comprise the highest non-target take by WS in MDM activities. In Tennessee, WS killed 103 (annual average = 20.6) turtles statewide during FY 1998-2002. This is very low in comparison to the number taken by commercial fishermen and trappers in the state each year. The most frequently taken species by WS were common snapping turtles. It is unknown how many of each of these species WS takes because records are not kept for turtles by species. However, the alligator snapping turtle, which is a State listed In Need of Management in Tennessee has a sedentary hunting behavior and is found in deeper waters, and, therefore, WS will probably take them infrequently. Effects on the Federal and State listed bog turtle (*Clemmys muhlenbergii)* is presented in section 5.1.1.2.2.2.1.

The level of take of all turtles in MDM programs by WS in Tennessee is insignificant in terms of the overall populations of any species, or of all species combined in Tennessee. Therefore, WS effects on

turtle populations are considered insignificant in terms of the overall population, or in relation to any individual species population in the State.

Based upon the above information, WS limited lethal take of turtles would have no adverse impacts on overall populations of any turtle species in Tennessee. The TWRA has determined that there is no evidence to suggest that human mediated mortality resulting from regulated harvest, including removal by WS, will be detrimental to the survival of any turtle populations in the state of Tennessee (E. Warr, TWRA, pers. comm., 2003).

5.1.1.2.2 Threatened and Endangered Species

The USFWS's and TWRA's list of Federal and State T&E species for Tennessee were reviewed by WS to determine if any T&E species might be affected by the proposed action. Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. WS has consulted with the USFWS under Section 7 of the Endangered Species Act (ESA) concerning potential impacts of WS MDM methods on T&E species and has obtained a BO (USDI 1992). For the full context of the BO, see Appendix F of the ADC FEIS (USDA 1997a - Appendix F). WS is also in the process of reinitiating Section 7 consultation at the National level to assure that potential effects on T&E species have been adequately addressed.

All T&E species listed in the state have been evaluated in relation to all WS MDM program actions to determine whether any listed species might be affected by those activities. Mitigation measures designed and implemented to avoid adverse impacts on T&E species are described in Chapter 4 (Subsection 4.4). Those measures should assure that the proposed action would not be likely to adversely affect any T&E species.

Beaver dams can adversely impact stream ecosystems by impounding habitat and increasing sedimentation in streams and affecting wildlife that depend on clear water, such as certain T&E species of fish and mussels. WS MDM actions related to beaver damage management projects which might affect the bog turtle, slackwater darter, and T&E mussel species populations in Tennessee are discussed in Subsection 5.1.1.2.2.2.

5.1.1.2.2.1 Critical Habitat Designations for Aquatic Animal Species

Critical habitat is defined in section 3(5)(A) of the Endangered Species Act (ESA) as: i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (I) that are essential to the conservation of the species and (II) which may require special management considerations or protection, and ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. "Conservation" means the use of all methods and procedures that are necessary to bring an endangered or a threatened species to the point at which listing under the ESA is no longer necessary. Regulations at 50 CFR 424.02(j) define special management considerations or protection to mean any method or procedure useful in protecting physical and biological features of the environment for the conservation of listed species.

Critical habitat receives protection under section 7 of the ESA through the prohibition against destruction or adverse modification of critical habitat with regard to actions carried out, funded, or authorized by a Federal agency. Section 7 also requires conferences on federal actions that are likely to result in the adverse modification or destruction of proposed critical habitat. Aside from the added protection that may be provided under section 7, the ESA does not provide other forms of protection to lands designated as critical habitat.

On July 1, 2004, critical habitat was designated for several species of mussels in Tennessee, Georgia, Alabama, and Mississippi. Unit 25 of this designation, which includes the Conasauga River (TN03150101012) in Bradley and Polk Counties in Tennessee, contains critical habitat for the following Federally endangered species: southern acornshell (*Epioblasma othcaloogensis*); ovate clubshell (*Pleurobema perovatum*); southern clubshell (*Pleurobema decisum*); upland combshell (*Epioblasma metastriata*); triangular kidneyshell (*Ptychobranchus greeni*); Alabama moccasinshell (*Medionidus acutissimus*); Coosa moccasinshell (*Medionidus parvulus*); southern pigtoe (*Pleurobema georgianum*); and fine-lined pocketbook (*Lampsilis altilis*). This rule became final on August 2, 2004.

The Service has designated critical habitat for five federally endangered mussels in the Tennessee and Cumberland River Basins (i.e., Cumberland elktoe (*Alasmidonta atropurpurea*), oyster mussel (*Epioblasma capsaeformis*), Cumberlandian combshell (*Epioblasma brevidens*), purple bean (*Villosa perpurpurea*), and rough rabbitsfoot (*Quadrula cylindrical strigillata*)), under the Act. This critical habitat designation includes 13 river and stream segments (units) in the Tennessee and/or Cumberland River Basins for these species. These critical habitat units encompass a total of approximately 885 river kilometers (rkm) (550 river miles (rmi)). Within the Tennessee River watershed, the critical habitat includes portions of the following stream reaches: Bear Creek (Mississippi, Alabama); Duck River (Tennessee); Obed River (Tennessee); Powell River (Tennessee, Virginia); Clinch River and its tributaries (Copper Creek and Indian Creek) (Tennessee, Virginia); Nolichucky River (Tennessee); and Beech Creek (Tennessee).

Within the Cumberland River watershed, the critical habitat includes portions of the following stream reaches: Big South Fork River and its tributaries (Bone Camp Creek, White Oak Creek, North White Oak Creek, New River, Crooked Creek, Clear Fork, and North prong Clear Fork) (Kentucky, Tennessee). This final rule was published in the Federal Register on August 31, 2004.

In addition to the July 1, 2004 critical habitat designations listed, the following are designated as critical habitats for T&E species in Tennessee: Permanent and intermittent tributaries to Cypress Creek and Middle Cypress Creek in Wayne County and the Buffalo River and its tributaries in Lawrence County (federally threatened slackwater dater); Powell River and Clinch River in Claiborne and Hancock Counties (federally threatened slender chub (*Erimystax* (=Hybopsis) cahni) and yellowfin madtom (*Noturus flavipinnis*)); Emory River, Obed River, Clear Creek, and Daddy's Creek in Morgan, Fentress, and Cumberland Counties (federally threatened spotfin chub (*Cyprinella* (=Hybopsis) *monacha*)); Citico Creek in Monroe County (federally endangered smoky madtom (*Noturus baileyi*)); Conasauga River in Polk and Bradley Counties (federally endangered amber darter (*Percina antesella*)).

5.1.1.2.2.2 Beaver Damage Management Impacts on Federally Listed Aquatic Animal Species

The bog turtle (*Clemmys muhlenbergii)*, slackwater darter (*Etheostoma boshungi*), and several mussel species have habitat factors which may affect their recovery or continued existence or health and are of special concern to the public and wildlife management agencies and entities. It is of considerable importance therefore, that analysis be conducted relative to the potential effects of WS actions at sites which might host such T&E populations, or locations that might have the potential to provide suitable habitat for them. This Subsection provides that analysis.

5.1.1.2.2.2.1 Bog Turtle Population Information and Effects Analysis

The bog turtle is a small turtle, 7.5 – 9cm (3 – 3.5 inches) in size. Bog turtle habitat includes shallow, slow, muck bottomed rivulets in sphagnum bogs, spring seeps, wet cow pastures, and shrub swamps (NatureServe, 2003). Due to its small size, habitat fragmentation has made it difficult for this turtle to manage successional changes in

habitat. Successional changes of the turtle's open wetland habitat type includes open meadows to wooded swamps, and the drainage and flooding of habitats through diversion or damming of feeder streams (USFWS, 2001). In Tennessee, the bog turtle is listed as Threatened due to its "Similarity of Appearance to a Threatened Taxon" (NatureServe, 2003). It is present in extreme northeast Tennessee.

Beaver activity can be both detrimental and beneficial to bog turtle habitat (NatureServe, 2003). In the short term, beaver activity such as damming feeder streams could negatively affect bog turtle habitat (USFWS, 2001). When evaluating beaver activity over a longer time expanse, the activity can be beneficial in the creation and maintenance of open canopy wetlands (NatureServe, 2003).

As stated in Section 2.3.4, the intent of WS beaver dam removal activities is not to drain established wetlands. If the determination was made that the removal of a beaver dam would require Section 404 permits, the requesting resource owner would be required to obtain the necessary permits prior to any beaver dam removal taking place.

WS will evaluate sites proposed for beaver damage management activity for potential presence of bog turtles based upon site specific maps provided by the USFWS. In those locations identified within the state where bog turtles have been recorded as present, WS will consult with USFWS and TWRA prior to taking action and make determinations about the presence of such species populations and the appropriateness of beaver damage management activity as it relates to bog turtle protection.

5.1.1.2.2.2.2 Slackwater Darter Population Information and Effects Analysis

The slackwater darter is a small (two inch) fish that occupies a narrow range in Tennessee due to its' habitat requirements (NatureServe, 2003). In Tennessee, critical habitat for the slackwater darter includes "all permanent and intermittent streams with flowing water from December to June, tributary to Cypress and Middle Cypress Creek" in Wayne County, and the Buffalo River and its tributaries in Lawrence County (USFWS, 2005). Slackwater darters appear to prefer habitat conditions found in small to moderately large streams with a moderate to slow current (USFWS, 2005). Preferred stream bottom conditions have an accumulation of leaves and detritus. However, the slackwater darter has been found in areas with stream bottom conditions that include silt, sand, small gravel and lacking an accumulation of leaves or detritus (USFWS, 2005).

The slackwater darter utilizes a distinctly different, but adjacent habitat for spawning (USFWS, 2005). The slackwater darter spawns in 2-4 inch deep seepage water in fields and open woods. The fish spawns from late January to March or early April when temperatures are at or above 14 degrees Centigrade (USFWS, 2005). In order to reach the spawning grounds, heavy rains are necessary to raise the water level in the stream and carry the darters to the spawning site (USFWS, 2005).

As stated in Section 2.3.4, the intent of WS beaver dam removal activities is not to drain established wetlands. If the determination was made that the removal of a beaver dam would require Section 404 permits, the requesting resource owner would be required to obtain the necessary permits prior to any beaver dam removal taking place.

WS will evaluate sites proposed for beaver damage management activities for potential presence of slackwater darters based upon site specific maps provided by the USFWS. In those locations identified within the state where slackwater darters have been recorded as present, WS will consult with USFWS and TWRA prior to taking action and make determinations about the presence of such species populations and the appropriateness of dam damage management activity as it relates to slackwater darter protection.

5.1.1.2.2.2.3 Mussel Populations Information and Effects Analyses

Several mussel species in Tennessee are federally listed as T&E (Appendix E). Fresh water mussels belong to the phylum Mollusca, possess two shells which attach by a hinge, are soft bodied, and feed through a process of filtering food items from flowing water. These animals are mobile and free swimming before reaching adulthood, but are sedentary as adults, moving only short distances using a "foot" to drag themselves across the bottom of a water body or stream. At some developmental stage before adulthood, many mussel species attach to the gills of fish and travel there as parasites for 20-70 days before sinking to the bottom to begin life as a sedentary adult (Hickman, et al. 1978).

Tennessee hosts a number of mussel species, of which 46 are federally listed as T&E. Of these, some are represented in Tennessee by more than one population. Those additional populations are categorized by USFWS as "Experimental Non-essential." For additional information on such populations, refer to USFWS T&E classifications (USFWS 2003). Appendix F provides an overview of mussel species and habitat types in which they are found in Tennessee.

As stated in Section 2.3.4, the intent of WS beaver dam removal activities is not to drain established wetlands. If the determination was made that the removal of a beaver dam would require Section 404 permits, the requesting resource owner would be required to obtain the necessary permits prior to any beaver dam removal taking place.

WS will evaluate sites proposed for beaver damage management activity for potential presence of listed mussel species based upon site specific maps provided by the USFWS. In those locations identified within the state where listed mussels have been recorded as present, WS will consult with USFWS and TWRA prior to taking action and make determinations about the presence of such species populations and the appropriateness of beaver damage management activity as it relates to listed mussel protection.

5.1.1.2.2.3 Beaver Damage Management Methods Information and Effects Analysis

5.1.1.2.2.3.1 Beaver Removal Methods and SOP Effects Analysis

In almost all beaver damage management projects WS employees use or recommend integrated methods. These methods may include lethal removal of problem beavers from selected sites. SOP's for such activities include assessment of the magnitude of damage, evaluation of natural water flow patterns and drainage characteristics, and decisions about techniques to remove beavers with minimal disturbance of sites. Beavers are captured using a variety of trap types, or by snares, as discussed in Appendix B. Activities conducted in water by WS in setting traps or snares to capture beavers are always performed in areas of relatively high beaver activity where individuals have created dams, lodges, or runways used to travel to and from feeding areas. These areas are almost always sites where beavers have greatly disturbed the soil, drainage substrate, and vegetation. The bottoms of streams, pools, ponds, and other water bodies in the vicinity of these beaver activities are often disturbed by digging, dredging, and dragging of materials as beaver build, travel, and feed (Novak, 1987). Sites such as those adjacent to dams and lodges are almost always heavily silted and strewn with sticks, leaves, and other debris. Very minimal activity, such as digging or walking on the bottom of streams and ponds is conducted by WS employees beyond these areas disturbed by vigorous beaver activity. Shooting of beaver is performed from the bank or from a boat and no contact with the bottom by WS personnel is made. This reduces the likelihood that any WS MDM activities related to beaver removal would disturb sites where T&E populations exist.

Prior to conducting beaver removal activities in areas designated as critical habitat, WS will consult with USFWS and TWRA and make determinations about the presence of such species populations and the appropriateness of beaver removal activity as it relates to T&E species protection. Therefore, WS MDM trapping and shooting activities related to the removal of beavers is not likely to adversely affect T&E species in the state.

5.1.1.2.2.3.2 Beaver Dam Removal Methods and SOP Effects Analysis

Removal of beaver dams during beaver damage management activities is discussed in Subsections 2.3.4, 4.4.2.5, 5.1.1.5, and Appendix B. SOP's are outlined for making determinations about the appropriateness of dam removal and for complying with water quality standards and permitting. The Tennessee Department of Environment and Conservation has determined that removal of most beaver dams during WS MDM programs would not require permitting in Tennessee, based on federal and state permitting requirements (R. Baker, TDEC, pers. comm., 2003). Situations which might require permitting are discussed in Appendix B.

WS either manually removes small beaver dams, or employs certified WS explosive specialists who use binary explosives for larger or more substantial dams. Manual removal of dams requires access to the most disturbed sites in beaver habitat. Almost all activity related to manual removal of such dams occurs within 10 feet of the center of the dam. This area is always dredged, dug, and littered by the beaver's dam building activity and it is unlikely that any mussels would be found in such close proximity to a dam. Material removed from these dams is either tossed on the bank of the water body or stream, or escapes to flow downstream. Mud and small materials such as bark and other plant debris also escapes downstream and tends to settle out within 40-60 feet. Small to medium limbs may drift further distances. Few large limbs are used in such dams.

Removal of beaver dams through the use of explosives is complex and requires careful analysis of several factors. This method requires consultation with local landowners, often with local and state agencies, and sometimes with federal agencies. Quantity of explosives to be used must be calculated and charges appropriately set. WS implements explosive projects using optimal explosive charges in order to adequately remove a beaver dam while at the same time minimizing effects on the environment. Considerations for appropriateness of the method and possible effects on adjacent habitat, channel substrate, and water release are contemplated. Typically, removal of a beaver dam using explosives, while producing some immediate water surge downstream, does not release large amounts of sediment for great distances downstream. The effects of appropriately calculated and placed charges tend to disperse material around the blast site or simply loosen the dam and allows upstream water pressure to erode the dam and carry and deposit it downstream. Both components of the binary explosive charge utilized by WS are completely expended in the combustion of the material and residues are practically nonexistent. As with manually removed beaver dams, most activities in the water are limited to within 10 feet of the dam site where some of the most disturbed portions of beaver habitat exist.

When removal of a beaver dam is conducted using explosives, it lifts and loosens the material and allows some of it to be dispersed downstream, heavier clays and waterlogged debris settle out within 20-40 feet of the dam site and most sedimentary material will settle out within 150-200 feet. The more swiftly flowing water created by removing the obstruction represented by the dam dilutes debris and disperses it thinly along the channel bed downstream. Waters normally clear below such sites within 30 minutes because adequate flow is usually returned to the channel. Disturbance by these activities is limited and almost always assists in restoring smoother and more rapid flow to natural drainages, which may improve water quality in most instances.

WS will evaluate sites proposed for beaver dam removal for potential presence of T&E species based upon site specific maps provided by the USFWS. In those locations identified within the state where T&E species have been recorded as present; WS will consult with USFWS and TWRA prior to taking action and make determinations about the presence of such species populations and the appropriateness of dam removal activity as it relates to their protection.

When T&E species are determined to be in close proximity to a proposed beaver dam removal site, WS will seek guidance and recommendations from USFWS about the feasibility of removal of such dams by explosives or other means. If USFWS determines that T&E species may be jeopardized as a result of the use of explosives, WS may propose to manually remove these dams and will consult with USFWS regarding the procedures to be used in such actions.

Manual removal may proceed through one of the following processes or a combination thereof:

a. WS could employ backhoes or trackhoes, in areas where their use was feasible, to rake beaver dams from drainages. This action would release water more slowly than explosives removal of these structures and would thus result in less likelihood of water surge and large amounts of sediment affecting downstream habitat. Properly executed, this technique can often remove a large amount of sediment producing mud of which the beaver dam is constituted, which can be deposited on the bank and will not be discharged downstream. This protocol might work well where such heavy equipment could be operated from public, farm, logging, or other access roads in close proximity to the affected area.

b. WS could use hand implements to remove all or most of the dam in one action occurring during one day to bring water behind the dam to a natural level. The rationale of this action would be to release impounded water in a relatively short time, but minimize the deposition of sediments downstream and around the dam site when compared with removal by explosives. Manual removal of 1 cubic yard of beaver dam manually usually takes at least one hour, and water is released gradually during this time. This protocol would work well with small dams which have resulted in moderate impoundment of a drainage, and could work as well with larger dams which possess a shallow profile and where impounded water averages less than two feet deep within 90 feet of the dam.

c. WS could use hand implements to partially breach the dam and then follow this treatment with consecutive deepening of these breaches after downstream waters had returned to pre-breached flow, continuing this until waters above the dam returned to normal levels. The rationale of this action would be to release impounded waters gradually over a longer period of time in such a way that hydraulic pressure and velocity did not result in the transfer of large amounts of sediment downstream. This protocol would work well with large dams where water is deeply impounded and may average more than two feet in depth within 90 feet of the dam. Additionally, dam removal using this method might work well with large dams which restrict water in large deep reservoirs where the dam is placed in a relatively shallow drainage waterway and the average water depth in the waterway is two feet or less.

d. WS could breach a dam partially, removing just enough depth necessary to reduce flooding damage yet maintain proper habitat conditions for T&E species. This will elicit dam repairing activities by beaver for the purpose of enhancing population management activities. In these cases, dams would not be totally removed and no significant water flow or sediment disturbance would occur. Only a few sticks and a small amount of soil, detritus, and leafy debris would be expected to be discharged downstream. This action

would have little effect on the turbidity of the water and stream flow would quickly disperse the small amount of debris.

Of the four possible scenarios discussed above, specific protocol to be used at a proposed project site will be mutually agreed upon among USFWS, TWRA, and WS. Conservation of T&E species at such a site will be of essence.

If the USFWS determines that a T&E species in a potentially affected site would be jeopardized by any action to remove a target beaver dam, WS would accept this conclusion and not attempt to remove the dam. Beavers may, however, be removed from the site and future population management activities proceed to ensure that no beavers use the area in subsequent seasons and years, if requested by a cooperator. Such population management activities would be conducted as outlined in Subsection 5.1.1.2.2.3.1 and might allow natural degradation and disappearance of the beaver dam in a few to several years.

5.1.1.2.2.4 Conclusions Pertaining to the Protection of Federally Listed T&E Species

WS has reviewed the USFWS list of T&E species for the state of Tennessee and has determined the proposed MDM program will "not likely adversely affect" any T&E species or critical habitat. This determination is based on an evaluation of WS methods in the USFWS 1992 Biological Opinion on the Animal Damage Control Program, and on the above information pertaining to beaver damage management activities specific to the Tennessee WS program. Furthermore, if WS MDM assistance is requested at a location where T&E species are known to be present, and this species and/or specific method(s) are not included in the 1992 BO, WS will consult with the USFWS prior to taking any management actions.

WS is also in the process of reinitiating Section 7 consultation at the program level to assure that potential effects on T&E species have been adequately addressed. WS will abide by any terms and conditions, reasonable and prudent alternatives (RPAs), and/or reasonable and prudent measures (RPMs) established as a result of this programmatic consultation to avoid jeopardizing any listed species. In Tennessee, WS has conducted informal Section 7 consultation with the USFWS regarding potential effects of the proposed MDM program on T&E species, and the USFWS concurs with WS' "not likely to adversely affect" determination (See Appendix G).

5.1.1.2.2.5 State Listed Species

The Tennessee Wildlife Resources Agency concurs that the WS MDM program in Tennessee will not adversely affect any State listed T&E species (see Appendix H).

5.1.1.3 Effects on Human Health and Safety

When used improperly or by untrained individuals, various methods used in mammal damage management projects could pose risks to humans. Methods analyzed that could pose risks to human health and safety include the use of explosives, chemicals, firearms, snares, foothold traps, conibear traps, and harassment with pyrotechnics. However, no accidents resulting in harm to any persons have occurred under the current WS MDM program in Tennessee. A formal risk assessment of WS operational management methods found that risks to human safety were low (USDA 1997). Wildlife Services SOP's include measures intended to mitigate or reduce the effects on human health and safety and are presented in Chapter 4. Risk to members of the public from WS' use of explosives to remove beaver dams, pyrotechnics to harass offending animals, or from use of chemicals, firearms, snares, foothold traps or body-gripping traps to take mammals would remain low due to adherence to WS policies, required safety precautions, and training.

Safety and Efficacy of Chemical Control Methods Used in MDM

Wildlife Services personnel uses binary explosives to remove beaver dams in certain situations. Wildlife Services personnel who use explosives are certified through comprehensive training and must be able to demonstrate competence and safety in their use. They are also required to adhere to WS policies as well as regulations related to explosives use, storage, and transportation enforced by the Bureau of Alcohol, Tobacco and Firearms, the Occupational Safety and Health Administration, and the Department of Transportation. When explosives are used, signs are placed to warn the public of these activities. Where dams are near roads, police or other road officials are used to stop traffic and public entry; an approach also used by Road Department crews when they use explosives, to ensure public safety. Therefore, no adverse effects to public safety are expected from the use of explosives by WS in Tennessee.

Under the proposed alternative WS may use certain EPA registered pesticides, including zinc phosphide for some rodent damage management, aluminum phosphide and sodium nitrate gas cartridges as anti-coagulant rodent baits, and den fumigants. All these chemicals are regulated by EPA under FIFRA, and Tennessee Pesticide Control Laws. Their use by WS personnel is carefully defined in WS Directives. Based on a thorough Risk Assessment, APHIS concluded that, when WS Program chemical methods, including those referenced above, are used in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible effects on the environment (USDA 1997). Therefore, MDM programs in Tennessee where such chemicals are used are not expected to adversely affect public safety.

Rodenticides. Several anticoagulant rodenticides are used to control commensal rodents and some field rodents around building and other structures. Common anticoagulants include warfarin and diphacinone. Anticoagulants are normally classified s multiple-dose toxicants. For the materials to be effective, animals must feed on the bait more than once. However, some newer formulations only require a single feeding to effective. Bair for rats and mice must be continuously available for 2 to 3 weeks for effective population control.

Zinc phosphide is a metallic toxicant most often used for rat, vole, muskrat, and nutria damage control. The odor of zinc phosphide is attractive to rodents by repulsive to most other animals. Tarter emetic is sometimes added to baits used to control rats. This safety feature will cause most other species to regurgitate any zinc phosphide baits they may consume. Its effectiveness for rat control is not compromised because rats are unable to regurgitate.

Aluminum phosphide and sodium nitrate gas cartridges

Aluminum phosphide is a fumigant for certain burrowing rodents and moles. Aluminum phosphide reacts with atmospheric moisture to release phosphine (PH_3) gas. Phosphine gas is a potent mammalian toxicant.

Gas Cartridges are placed in burrows/dens and are burned to create carbon monoxide gas to euthanize animals. Applicators must exercise caution to avoid burns to the skin or surrounding vegetation.

Non-lethal MDM chemicals that might be used or recommended by WS include repellents. Such chemicals must undergo rigorous testing and research to prove safety, effectiveness, and low environmental risks before EPA or FDA would register them. Any operational uses of chemical repellents would be in accordance with labeling requirements under FIFRA and state pesticide laws and regulations that are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions are a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on human health and safety.

Drugs used in capturing, handling, and euthanizing wildlife for wildlife hazard management purposes include ketamine hydrochloride, xylazine (Rompun), sodium pentobarbital, Beuthanasia-D, and a mixture of tiletamine and zolazepam (Telazol). Meeting the requirements of the AMDUCA should prevent any significant adverse impacts on human health with regard to this issue. Mitigation measures that would be part of the standard operating procedures include:

- All drug use in capturing and handling wildlife would be under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and APHIS-WS. As determined on a state-level basis by these 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 to avoid release of animals that may be consumed by hunters 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 drugs would be released well before state controlled hunting/trapping seasons which would give the drug time to completely metabolize out of the animals' systems before they might be taken and consumed by humans. In some instances, animals collected for control purposes would be euthanized when they are captured within a certain specified time period prior to the legal hunting or trapping season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems.

By following these procedures in accordance with AMDUCA, wildlife management programs would avoid any significant impacts on human health with regard to this issue.

Effects on Human Health and Safety from Non-Chemical MDM Methods

Firearms and pyrotechnics are only used by WS personnel who are experienced in handling and using them. Wildlife Services personnel use firearms to shoot mammals and euthanize animals caught in traps. Wildlife Services personnel are trained and given refresher courses to maintain awareness of firearm and pyrotechnic safety and handling as prescribed by WS policy. Therefore, no adverse effects to public safety are expected from the use of firearms or pyrotechnics by WS in Tennessee.

Wildlife Services personnel use snares and body-gripping (e.g. Conibear) traps, and foothold traps to take target mammals. Snares and traps are strategically placed to minimize nontarget take and minimize exposure to the public. Signs are used to post properties where traps are set to alert the public of their presence. In addition, large body-gripping traps are restricted to water sets according to WS policy, which further reduces threats to public safety.

Therefore, no adverse effects to public safety are expected from the use of firearms, snares, foothold traps, conibear traps, and pyrotechnics by WS in Tennessee.

Effects on Human Health and Safety from not Conducting MDM to Reduce Disease Threats or Outbreaks and Mammal Strike Hazards at Airports

People are concerned with potential disease threats; and injury and loss of human life as a result of mammal/aircraft collisions. An IWDM strategy, a combination of lethal and non-lethal means, has the greatest potential of successfully reducing this risk. All WDM methods could possibly be implemented and recommended by WS.

5.1.1.4 Effects on Socio-cultural Elements and Economics of the Human Environment

5.1.1.4.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species

As discussed in Subsection 2.2.3.1, some people form human affectionate-bonds with individual wild or feral mammals. For such, removal of these individual animals is considered objectionable because these animals may be considered pets, or the relationship which exists may be similar to that experienced with domestic pets. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls, 1994, Marks and Koepke 1994, Zasloff 1996, Archer 1997, Ross and Baron-Sorensen 1998, Meyers, 2000) and observations made

regarding this are probably applicable to close bonds which could exist between people and wild animals. Humans experience affection for pet animals which is similar in scope and meaning to human-human affections for some (Stephens and Hill 1996, Boyce 1998). Loss of this relationship may cause a sense of loss, the experiences of grief, the need for healing and acceptance of the loss and rebuilding, which can include establishing new bonds with other animals or engaging in other activities (Lefrancois 1999).

If humans establish affectionate relationships with wild animals which are comparable to that for domestic companion animals, removal of individual animals from certain sites by WS MDM actions may result in severing of those established bonds. However, as those affected individuals follow the usual human pattern related to the experience of loss, they will experience recovery and may establish new bonds with other animals. Wildlife Services MDM actions rarely remove all mammals or even all mammals of one species from a locale where actions occur. Individuals wishing to establish bonds with wild animals will still be able to interact with them. Wildlife Services MDM programs are not therefore, expected to markedly affect this element of the human environment.

Some individuals obtain aesthetic benefit from viewing animals in the wild and may feel that removal of animals from a locale by Wildlife Services MDM programs could affect their aesthetic enjoyment. In addition, some people do not believe that some mammals should even be harassed to stop or reduce damage problems. Some of them are concerned that their ability to view mammals is lessened by WS nonlethal harassment efforts. Regarding this, the public's ability to view wild mammals in a particular area would be more limited if the mammals are removed or relocated. However, immigration of mammals from other areas could possibly replace the animals removed or relocated during a damage management action. The opportunity to view or feed other wildlife would also be available if an individual makes the effort to visit other parks or areas with adequate habitat and local populations of the species of interest. In addition, WS MDM actions rarely remove all mammals or even all mammals of one species from a locale where actions occur. Sometimes the live capture and translocation or killing of some mammals results in complete, but usually temporary, removal of all of these mammals from one property, but adjacent properties in nearby neighborhoods still contain other mammals of the same species. In some instances in Tennessee where WS conducts such activities, other mammals are observed to re-populate the project area within a short time.

Again, as previously discussed, some individuals are offended by the presence of overabundant mammal species, and feel that their overall enjoyment of other mammals is diminished by the presence of such species. In cases where WS MDM actions reduce the numbers of such overabundant species, the removal or relocation of these animals would have the potential to actually enhance the aesthetic value of other wildlife for these affected humans, and would also have the potential to positively affect their view of wildlife in general.

5.1.1.4.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Damage to property would be expected to decrease under this alternative since all available damage management methods and strategies would be available for WS use and consideration.

5.1.1.5 Effects on Wetlands

Most MDM activities conducted by WS in Tennessee do not have the potential to affect wetlands, since they are not conducted near or in these sites. However, WS MDM activities related to wetlands or their environs, such as beaver dam removal, are conducted according to federal and state laws and guidelines enacted to minimize impacts to such habitats, and to provide guidance for such conduct. In addition, landowners are required to obtain the appropriate permits from the Corps of Engineers for removal of beaver dams of certain specifications and types specified by law, in order that regulatory agency oversight might be able to determine effects for such actions. Further, WS does not remove dams in established wetlands except to restore mitigation wetlands, but does so in instances, and at sites, where normal drainage may be restored to reduce damage and effects on natural habitat or other human resources.

Under this alternative, beaver impounded areas would be removed by hand or with explosives for the purpose of returning streams, channels, dikes, culverts, and irrigation canals to their original function. WS removes most beaver impoundments because they have flooded areas such as roads, crops, merchantable timber, pastures, and other types of property or resources that were not previously flooded. In FY 1998-2002, a total of 887 dams were removed in WS beaver damage management activities. Among these, 787 were removed by hand and 100 were removed with binary explosives (WS-MIS Database 2002). Most dams removed were created as a result of recent beaver activity because WS personnel receive most requests soon after affected resource owners discover damage and become aware of the WS program. Dams are removed in accordance with exemptions from Section 404 permit requirements established by regulation or as allowed under NWPs granted under Section 404 of the Clean Water Act (see Section 2.2.4 and Appendix B). The majority of impoundments that WS removes have been in existence for only a few months or years. These are not considered true wetland habitat and, therefore, do not possess the same wildlife habitat values as established wetlands. WS compliance with wetland protection laws and regulations assures that WS activities will not adversely affect wetland habitats.

Because of protective protocols which have been established for MDM actions relative to wetlands, through appropriate SOP's and these previously discussed safeguards and checks, WS has determined that MDM activities in Tennessee will have no adverse effect on wetlands.

5.1.1.6 Humaneness of Methods Used by WS

Regarding humaneness and animal welfare concerns, under this alternative, methods viewed by some persons as inhumane would be employed. Despite SOP's designed to maximize humaneness as described in Subsections 2.3.5 and 4.4, the perceived stress and trauma associated with being held in foothold traps or snares until the WS employee arrives at the trap or snare site to dispatch or release the animal, is unacceptable to some persons. In addition, these methods may be used in "drown sets" where the animal drowns shortly after being caught which is also considered inhumane by some persons. Other MDM methods used to take target animals including shooting and body-gripping traps (i.e., Conibear) result in a relatively humane death because the animals die instantly or within seconds to a few minutes. These methods however, are also considered inhumane by some individuals.

WS uses EPA registered and approved pesticides, such as zinc phosphide, aluminum phosphide, burrow and den fumigants, and anti-coagulants, to manage damage caused by some mammals, especially rodents, in Tennessee. Some individuals consider the use of such chemicals to be inhumane. Pesticide labels and Material Safety Data Sheets for chemicals used in the WS MDM program are provided in Appendix D.

WS personnel are experienced and professional in their use of management methods, and methods are applied as humanely as possible. Under this Alternative, mammals would be trapped as humanely as possible or shot by experienced WS personnel using the best and most appropriate method(s) available. Some animal rights activists may perceive these methods as inhumane because they oppose all lethal methods of damage management.

Wildlife Services has improved the selectivity and humaneness of management techniques through research and development. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some MDM methods are used in situations where nonlethal damage management methods are not practical or effective.

5.1.2 Alternative 2 - Nonlethal Required Before Lethal Control

5.1.2.1 Effects on Wildlife

Effects on Target Mammal Species Populations

Under this alternative, WS would be restricted to situations where nonlethal controls had been tried, in most cases by the requestor, but also by WS, without success. No preventive lethal control actions would

be taken by WS, under this alternative. For many individual damage situations, this alternative would be similar to the current program because many producers have tried one or more nonlethal methods such as habitat modifications, exclusion, or behavior modification of the offending species, without success, or have considered them and found them to be impractical in their particular situations prior to requesting WS's assistance. WS impacts to target mammal populations would be similar to the proposed action alternative. However, because non-lethal control must be applied before lethal control, damage may not be reduced in a timely and effective manner. In those situations, resource owners may be unwilling to accept further losses as all available non-lethal methods are applied. This could result in resource owners rejecting WS non-lethal methods and implement their own lethal control program resulting in impacts similar to Alternative 4.

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

Wildlife Services impacts to non-target wildlife populations are expected to be similar to the proposed action. However, because non-lethal control must be applied before lethal control, damage may not be reduced in a timely and effective manner. In those situations, resource owners may be unwilling to accept further losses as all available non-lethal methods are applied. This could result in resource owners rejecting WS non-lethal methods and implement their own lethal control program resulting in impacts similar to Alternative 4.

5.1.2.2 Effects of MDM Methods on Human Health and Safety

Safety and Efficacy of Chemical Control Methods Used in MDM

Impacts of WS chemical MDM methods on human health and safety would be similar to the proposed action alternative.

Effects on Human Health and Safety from Non-Chemical MDM Methods

Impacts of WS non-chemical MDM methods on human health and safety would be similar to the proposed action alternative.

Effects on Human Health and Safety from not Conducting MDM to Reduce Disease Threats or Outbreaks and Mammal Strike Hazards at Airports

Because non-lethal control must be applied before lethal control, damage may not be reduced in a timely and effective manner. Therefore, adverse impacts of this alternative on human health and safety could be greater than the proposed action alternative if nonlethal methods were ineffective at reducing disease and aircraft strike threats.

5.1.2.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

5.1.2.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species

Wildlife Services impacts on this issue would be similar to the proposed action. However, because non-lethal control must be applied before lethal control, damage may not be reduced in a timely and effective manner. In those situations, resource owners may be unwilling to accept further losses as all available non-lethal methods are applied. This could result in resource owners rejecting WS non-lethal methods and implementing their own lethal control program resulting in impacts similar to Alternative 4.

5.1.2.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Because non-lethal control must be applied before lethal control, damage may not be reduced in a timely and effective manner. Without the option of WS conducting lethal damage management

activities prior to implementation of nonlethal methods, damage could be expected to rise considerably before nonlethal means failed or could take effect. Therefore, impacts of this alternative on those persons adversely affected by mammal damage could be greater than the proposed action alternative if nonlethal methods were ineffective at reducing damage to acceptable levels.

5.1.2.4 Effects on Wetlands

Wildlife Services impacts on wetlands would be similar to the proposed action alternative.

5.1.2.5 Humaneness of Methods Used by WS

Wildlife Services impacts on humaneness would be similar to the proposed action alternative.

5.1.3 Alternative 3 - Technical Assistance Only

5.1.3.1 Effects on Wildlife

Effects on Target Mammal Species Populations

WS would have no impact on target mammal populations in Tennessee. Impacts to target mammals would be variable dependent upon actions taken by affected resource owners. WS would provide technical advice to those persons requesting assistance. Resource owners could use information provided by WS or implement their own damage reduction program without WS' technical assistance. Overall impacts would be similar to Alternative 4.

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

Under this alternative, WS would have no impact on nontarget wildlife populations. Wildlife Services would only provide technical advice to those persons requesting assistance. Mammal damage to native plant and wildlife species may increase under this alternative unless affected resource owners implement their own mammal damage management plan. Resource owners could use the information provided by WS or implement their own damage reduction program without WS technical assistance. Resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods which could lead to greater take of non-target wildlife than under the proposed action alternative. Negative impacts to plant and wildlife species should be less than Alternative 4 when WS technical advice is requested and followed.

One anticipated outcome of this alternative is a likely increase in damage and associated beaver created impoundments if resource owners did not remove beaver dams. These impoundments would likely have an impact on other wildlife and plant species. The extent and nature of the impacts would depend upon the size of the beaver created impoundment and the diversity of plant and animal species in the area. Some species would flourish in the newly created environment, while others would diminish.

5.1.3.2 Effects of MDM Methods on Human Health and Safety

Safety and Efficacy of Chemical Control Methods Used in MDM

Concerns about human health and safety risks from WS's use of chemical MDM methods would be alleviated because no such use would occur. WS would provide technical advice to those persons requesting assistance. Resource owners could use information provided by WS or implement their own damage reduction program without WS' technical assistance. Negative impacts to human health and safety resulting from the improper use of chemical control methods should be less than Alternative 4 when WS' technical advice is followed.

Effects on Human Health and Safety from Non-Chemical MDM Methods

Concerns about human health and safety risks from WS's use of non-chemical MDM methods would be alleviated because no such use would occur. WS would provide technical advice to those persons requesting assistance. Resource owners could use information provided by WS or implement their own damage reduction program without WS' technical assistance. Negative impacts to human health and safety resulting from the improper use of non-chemical control methods should be less than Alternative 4 when WS' technical advice is followed.

Effects on Human Health and Safety from not Conducting MDM to Reduce Disease Threats or Outbreaks and Mammal Strike Hazards at Airports

Resource owners could use the information provided by WS or implement their own damage reduction program without WS technical assistance. When WS technical advice is requested and followed, disease and mammal aircraft strike threats to human health and safety should be less than Alternative 4. However, resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, adverse impacts to human health and safety could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods.

5.1.3.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

5.1.3.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species

Wildlife Services would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS technical assistance. Overall impacts would be similar to Alternative 4.

5.1.3.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Wildlife Services would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS technical assistance. When WS technical advice is requested and followed, impacts on those persons adversely affected by mammal damage should be less than Alternative 4. However, resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, mammal damage could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods.

5.1.3.4 Effects on Wetlands

Wildlife Services would have no direct impact on wetlands. WS would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS technical assistance. Overall impacts to wetlands should be less than Alternative 4 when WS technical advice is requested and followed.

5.1.3.5 Humaneness of Methods Used by WS

The issue of humaneness as it relates to WS under this alternative is not applicable because resource owners or others would be responsible to implement the damage management methods. Wildlife Services would provide technical advice to those persons requesting assistance. Resource owners could use the information provided by WS or implement their own damage reduction program without WS technical assistance. Many of the methods considered inhumane by some individuals and groups might still be used by resource owners. Overall impacts should be less than Alternative 4 when WS technical advice is requested and followed.

5.1.4 Alternative 4 - No Federal WS MDM

5.1.4.1 Effects on Wildlife

Effects on Target Mammal Species Populations

Alternative 4 would not allow any WS MDM in Tennessee. There would be no effect on target mammal species by WS activities from this alternative. Wildlife Services would provide no assistance for MDM to any Local, State, or Federal government entities, industries, private businesses, or citizens in Tennessee. The TWRA and TDA, and representatives of private businesses and government entities could still conduct some level of MDM.

Some mammal populations would continue to increase where trapping and shooting pressure was low and may decline or stabilize where trapping and shooting pressure was adequate. Some resource owners experiencing damage may trap or shoot mammals, or hire private trappers, but would receive no guidance from WS regarding these options. Other resource owners experiencing damage may take illegal or unsafe action against local populations of mammals out of frustration of continued damage resulting in unknown impacts to these populations (USDA 1997). Overall impacts on statewide mammal populations may be similar to or greater than the proposed action alternative, since affected resource owners would likely lethally remove the damaging mammal that would no longer be removed by WS.

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

Alternative 4 would not allow any WS MDM in Tennessee. There would be no effect on nontarget or T&E species by WS activities from this alternative. Wildlife Services would provide no assistance for MDM to any Local, State, or Federal government entities, industries, private businesses, or citizens in Tennessee. The TWRA and TDA, and representatives of private businesses and government entities could still conduct some level of MDM.

In the absence of WS assistance, some resource owners may attempt to trap mammals or hire private trappers with little or no trapping experience. This could result in greater take and suffering of nontarget wildlife. Private individuals may trap mammals year round with the appropriate permits and would not be restricted to WS's self-imposed mitigation measures. Methods formerly used by WS when MDM programs were conducted, such as foothold and quick-kill traps, snares, and shooting, would probably increase as previously listed entities sought to reduce damage. This could result in less experienced persons implementing use of traps and snares without modifications to improve selectivity for target species, or to reduce animal stress. Furthermore, these resource owners or trappers would be more likely than WS personnel to trap non-target species and not report non-target take to regulatory authorities. Some resource owners experiencing damage may take illegal or unsafe action, including the illegal use of chemical toxicants, against local populations of mammals out of frustration from continued damage resulting in unknown impacts to plant and wildlife populations (USDA 1997).

One anticipated outcome of no WS mammal damage management program is a likely increase in damage and associated beaver created impoundments if resource owners did not remove beaver dams. These impoundments would likely have an impact on other wildlife and plant species. The extent and nature of the impacts would depend upon the size of the beaver created impoundment and the diversity of plant and animal species in the area. Some species would flourish in the newly created environment, while others would diminish.

5.1.4.2 Effects on Human Health and Safety

Safety and Efficacy of Chemical Control Methods Used in MDM

Concerns about human health and safety risks from WS's use of chemical MDM methods would be alleviated because no such use would occur. Resource owners could use any legal MDM chemical available to them, including EPA registered chemicals, rodenticides, and the use of explosives to remove

beaver dams. Without professional assistance or proper training in the use of chemical MDM methods, there is the potential for increased risks to public safety. Resource owners inexperienced in the safe and proper use of chemical MDM methods may attempt to resolve mammal damage problems.

The potential for illegal use of chemical toxicants under this alternative might pose threats to human health and safety if such chemicals were used indiscriminately in areas used by humans, or where such chemicals might be transported into the human food chain.

Effects on Human Health and Safety from Non-Chemical MDM Methods

Concerns about human health and safety risks from WS's use of non-chemical MDM methods would be alleviated because no such use would occur. Resource owners could use any legal MDM non-chemical available to them, including pyrotechnics, traps, snares, and firearms. Without professional assistance or proper training in the use of non-chemical MDM methods, there is the potential for increased risks to public safety. Resource owners inexperienced in the safe and proper use of non-chemical MDM methods may attempt to resolve mammal damage problems. These increased risks are associated with the improper or inexperienced use of damage management methods such as trapping and shooting.

Effects on Human Health and Safety from not Conducting MDM to Reduce Disease Threats or Outbreaks and Mammal Strike Hazards at Airports

Mammal damage would likely continue to increase unless resource owners implemented an effective MDM program in the absence of WS. Resource owners could implement their own damage reduction program without WS assistance. Resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, adverse impacts to human health and safety could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods.

5.1.4.3 Effects on the Socio-cultural Elements and Economics of the Human Environment

5.1.4.3.1 Effects on Human Affectionate-Bonds with Individual Mammals and on Aesthetic Values of Wild Mammal Species

The impacts of this alternative to stakeholders would be variable depending on their values towards wildlife and compassion for their neighbors. Animal activists and a minority of environmental activists would prefer this alternative because activists believe it is morally wrong to kill or use animals for any reason. Some people would support this alternative because they enjoy seeing mammals, or having mammals nearby. However, while WS would take no action under this alternative, other individuals or entities could, and likely would, conduct damage management activities resulting in impacts similar to Alternative 1.

5.1.4.3.2 Effects on Aesthetics and Value of Property Damaged by Mammals

Resource owners receiving damage from mammals would likely strongly oppose this alternative because they would bear the damage caused by mammals. Resource owners' efforts to reduce or prevent conflicts could result in less experienced persons implementing control methods. Therefore, mammal damage could be greater under this alternative than the proposed action alternative dependent upon the skills and abilities of the person implementing MDM control methods. Mammal damage would likely continue to increase unless an effective damage management program was implemented by non-WS personnel.

5.1.4.4 Effects on Wetlands

Wildlife Services would have no impact on wetlands. Under this alternative, beaver dam breaching/removal needs would be met by private, state, or local government entities. Some beaver impounded areas that WS would advise against draining might be drained under private or local

government management, which could have potential adverse effects on wetland habitats in limited circumstances.

5.1.4.5 Humaneness of Methods Used by WS

Wildlife Services would have no impact on this issue. This alternative would be considered humane by those people that believe WS should not be involved in MDM. However, even though WS would not be involved in MDM activities in Tennessee, resource owners could use any lethal and non-lethal method legally available to them to reduce mammal damage in the absence of WS assistance, with impacts on humaneness dependent upon the experience of the person implementing the control method. Some resource owners may take illegal action against localized populations of mammals out of frustration of continued damage. These illegal actions may be less humane than methods used by experienced WS personnel.

5.2 SUMMARY OF POTENTIAL IMPACTS

Each of the four analyzed Alternatives would have varying effects related to the 5 issues. Alternative 1 would probably have the overall lowest effects on the environment (Table 5.4). Alternative 4 would probably have the highest effects on the environment, followed closely by Alternative 3.

Table 5.4 Alternative Effects on Issues Compared

Issues/Alternatives	Alternative 1. Continue Current Federal MDM Program	Alternative 2. Nonlethal Required Before Lethal Control	Alternative 3. Technical Assistance Only	Alternative 4. No Federal WS MDM Program
Effects on Wildlife	*Low effect.* WS reductions in local target mammal population numbers; would not adversely affect state populations. No adverse affect on nontarget species by WS. Some species could be affected positively by MDM actions.	*Low to moderate effect.* WS impacts to target mammal populations and nontarget species similar to Alternative 1. Resource owners may reject WS program and implement their own lethal control program resulting in impacts to target and nontarget species similar to Alternative 4.	*Low to moderate effect.* No effect by WS on target mammal populations and nontarget species. If resource owners conduct their own MDM, impacts on target mammal populations could be similar or greater than the proposed action; increased possibility that non-targets species maybe taken, less likely than Alt. 4.	*Low to moderate effect.* No effect by WS on target mammal populations and nontarget species. If resource owners conduct their own MDM without WS, impacts on target mammal populations could be similar or greater than the proposed action; increased possibility that non-targets species maybe taken.
Effects on Human Health and Safety	***(Methods)*** *- Low effect.* Methods used by WS would be safe with no probable risk of human health and safety. ***(Mammal Threats)*** *- Moderate to high effect.* The proposed action has the greatest potential of	***(Methods)*** *- Low effect* WS impacts similar to Alternative 1. Resource owners may reject WS program and implement their own lethal control program resulting in impacts similar to Alternative 4. ***(Mammal Threats)*** *- Low to high effect.*	***(Methods)*** *– Low to moderate effect.* No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods. ***(Mammal Threats)*** *- Low to high effect.* Impacts would be variable dependent	***(Methods)*** *– Low to moderate effect.* No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods. ***(Mammal Threats)*** *- Low to high effect.* Impacts would be variable dependent upon

Issues/Alternatives	Alternative 1. Continue Current Federal MDM Program	Alternative 2. Nonlethal Required Before Lethal Control	Alternative 3. Technical Assistance Only	Alternative 4. No Federal WS MDM Program
	successfully reducing this risk.	This alternative less likely than Alt. 1 to reduce damage in an effective and timely manner.	upon experience and knowledge of person implementing methods.	experience and knowledge of person implementing methods.
Effects on Socio-Cultural Elements And Economics Of the Human Environment	Variable effects. Some would oppose this alternative, others would support it. Those people adversely affected by wildlife damage would likely favor this alternative.	Variable effects. Some would oppose this alternative, others would support it; Damage may not be reduced in a timely and effective manner for some projects.	Variable effects. Some would oppose this alternative, others would support it. No effect by WS. Resource owners would likely conduct MDM activities no longer conducted by WS resulting in impacts similar to the proposed program; Damage may not be reduced in a timely and effective manner for some projects.	Variable effects. Some would oppose this alternative, others would support it. No effect by WS. Resource owners would likely conduct MDM activities no longer conducted by WS resulting in impacts similar to the proposed program.
Effects on Wetlands	No probable effect by WS.	No probable effect by WS.	Low to Moderate effect. No effect by WS. Variable effects by non-WS personnel; impacts to wetlands should be less than Alternative 4 when WS technical advice is requested and followed.	Low to Moderate effect. No effect by WS. Variable effects by non-WS personnel; some beaver impoundments might be drained which WS would advise against.
Humaneness Of Methods Used by Wildlife Services	Variable effect. Methods viewed by some people as inhumane would be used.	Variable effect. Methods viewed by some people as inhumane would be used.	No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods.	No effect by WS. Resource owner's impacts would be variable dependent upon experience and knowledge of person implementing methods.

5.3 CUMULATIVE IMPACTS OF THE PROPOSED ALTERNATIVE BY ISSUE

Cumulative impacts, as defined by 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 Alternatives 1 and 2, WS would address damage associated with mammals in a number of situations throughout the State. The WS MDM program would be the primary federal program with MDM responsibilities; however, some state and local government agencies may conduct MDM activities in Tennessee as well. Through

ongoing coordination with these agencies, WS is aware of such MDM activities and may provide technical assistance in such efforts. WS does not normally conduct direct damage management activities concurrently with such agencies in the same area, but may conduct MDM activities at adjacent sites within the same time frame. In addition, commercial pest control companies may conduct MDM activities in the same area. The potential cumulative impacts analyzed below could occur either as a result of WS MDM program activities over time, or as a result of the aggregate effects of those activities combined with the activities of other agencies and individuals.

5.3.1 Cumulative Impacts on Wildlife Including Target and Non-target, and T&E Species

Evaluation of MDM program actions of the proposed alternative relative to target, non-target and T&E species in the previous portions of this EA indicated that no significant cumulative, immediate effects are expected. MDM program actions would be occurring simultaneously, over time, with other natural processes and human - generated changes that are currently taking place. These activities include, but are not limited to:

- Natural mortality of target, non-target, and T&E species
- Human-induced mortality of target and non-target species through hunting, MDM, and other activities
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

All these factors play a role in the dynamics of wildlife populations, and any or all may act to produce cumulative effects on those populations. Normally, MDM is necessary to reduce damage caused by a species when some or all of these elements have contrived to elevate target species populations on a local, regional, or national scale, or place target species populations at a juncture to cause damage to resources. WS actions taken to minimize or eliminate damage being caused by overabundant populations, or individuals of a species causing damage, is constrained as to scope, duration and intensity, for the purpose of minimizing or avoiding impacts to the environment, including wildlife. WS evaluates damage occurring, including other affected elements and the dynamics of the damaging species, determines appropriate strategies to minimize effects on environmental elements, applies damage management actions, and subsequently monitors and adjusts / ceases damage management actions (Slate et al. 1992). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative impacts to target, non-target, and T&E species.

No significant cumulative impacts on target and non-target wildlife are expected from WS MDM actions based on the following considerations:

1. Historical outcomes of WS MDM programs to address the target species identified in this EA

No significant cumulative effects have been identified in WS MDM programs addressing target species identified in this EA, nor for associated non-target species, including T&E, as a result of program activities or components implemented over time.

2. SOP's and mitigation strategies built into WS MDM program processes (Subsection 4.4)

These operational safeguards are designed to protect wildlife from negative effects of WS MDM actions, and are tailored to respond to changes in wildlife populations which could result from unforeseen environmental changes which might produce negative cumulative effects. This would include those changes occurring from sources other than WS conducted MDM programs. Alterations in MDM programs, which are appropriate to any changes that indicate important cumulative negative effects to wildlife, are defined through SOP's and mitigation measures, and implementation is insured through monitoring, in accordance with the ADC Decision Model (Slate et al. 1992).

3. Current status of potentially affected species, including target, non-target, and T&E

Natural and human-induced mortality patterns for target, non-target, and T&E species evaluated in this EA are expected to remain essentially unchanged in Tennessee. This is true for both elements outside WS MDM conducted programs, and the programs themselves. Evaluation in previous portions of this EA

determined that WS activities would not adversely affect target, non-target, and T&E species. As a result, no significant cumulative effects are expected from repetitive MDM programs over time in the fairly static set of conditions affecting wildlife currently in Tennessee.

5.3.2 Cumulative Impacts on Human Health and Safety

Non-Chemical Methods

All non-chemical MDM methods, such as trapping, snaring, shooting, harassment methods, etc. are used and expended within a limited time frame, are not residual, and do not possess properties capable of inducing significant cumulative impacts on human health and safety.

Chemical Methods
Lethal chemical MDM methods may include the use of zinc phosphide, aluminum phosphide, anti-coagulants, and gas cartridges. Zinc Phosphide (ZP), aluminum phosphide (AP), and anti-coagulant baits are used in MDM programs in Tennessee to manage damage caused by rodents. Gas cartridges (sodium nitrate) are used to manage damage being caused by groundhogs and coyotes. Therefore, consideration for their uses, properties, and fate as it will be applied in Tennessee is an important consideration.

Zinc Phosphide. ZP is a finely ground gray-black powder that is practically insoluble (solubility = 1 ppm) in water and alcohol, therefore it is unlikely to be mobile in soils. It breaks down to elemental zinc and phosphine gas when exposed to moisture or under acidic conditions. The decomposition rate of ZP in the soil depends on soil moisture and pH, with complete decomposition in 30 days in moderately moist soils. The residue of ZP is not expected to accumulate in the soils between applications, or in animal tissues. The phosphine gas produced during breakdown is a colorless gas with a high vapor pressure and so is generally prevented from accumulating in low areas. Ultimately the phosphine is transformed into inorganic phosphate (USDA 1997). These factors indicate that no significant cumulative effects to human health and safety are expected from the use of this chemical in WS MDM programs in Tennessee.

ZP is available to certified pesticide applicators in Tennessee and might be used by some. Any non-WS programs that might employ ZP for purposes specified on product labels would not collectively produce cumulative effects for the same reasons outlined for WS MDM programs. Therefore, no significant cumulative effects on human health and safety are expected from all combined activities involving ZP for the management of damage caused by species for which the product is registered for use.

Aluminum phosphide is available in tablet form, as a fumigant for rodent burrows, to manage damage being caused by such rodents as moles, ground squirrels, groundhogs, voles, and Norway rats. It is not soluble in water, but will react with moist air to produce phosphine gas. It is stable under dry conditions. It is not persistent in soil systems because it decomposes to phosphine gas rapidly on contact with moisture and soil. The rate of decomposition of the tablets varies from less than three and up to five days or more, depending on moisture and temperature (MSDS). Ultimately, phosphine gas is transformed into harmless inorganic phosphate. Phosphine gas is a colorless gas with a vapor pressure of 33.5 atm at 20°C, much higher than other fumigants. The high vapor pressure generally prevents the accumulation of this gas in low areas, in spite of a specific gravity of 1.17, compared to specific gravity for air of 1.0. Aluminum phosphide is insoluble in water and therefore not expected to be particularly mobile in soils. At the same time, accumulation in soils is not significant due to the decomposition of aluminum phosphide in the presence of moisture. Zinc phosphide does not accumulate in animal tissue, and similar metabolism may be expected of aluminum phosphide (USDA 1997). Based on properties and fate of aluminum phosphide when used as a fumigant in WS MDM programs in Tennessee, no significant cumulative effects to human health and safety are expected from its use.

Aluminum phosphide is available to certified pesticide applicators in Tennessee and might be used by some. However, because of properties and fate of this chemical, such use would not introduce any cumulative effects which might adversely impact human health and safety. Therefore, no significant cumulative effects on human health and safety are expected from all combined activities involving aluminum phosphide use for the management of damage caused by rodents.

Sodium nitrate is the principle active chemical in gas cartridges, 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). Burning sodium nitrate however, as in the use of a gas cartridge as a fumigant in a rodent burrow or coyote den, 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 (1986c). The gas along with other components of the cartridge, are likely to form oxides of nitrogen, carbon, phosphorus, and sulfur. These products are environmentally non-persistent because they are likely to be metabolized by soil microorganisms or enter their respective elemental cycles. In rodent cartridges, sodium nitrate is combined with seven additional ingredients; sulfur, charcoal, red phosphorus, mineral oil, sawdust, and two inert ingredients. Coyote gas cartridges contain sodium nitrate and charcoal. None of the additional ingredients in these two formulations are 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 (USEPA 1991g). No gas residues remain at the treatment site where either formulation is used, for any period of time (USDA 1997), and so, no significant cumulative effects from the presence of gases can be expected. Based on properties and fate of sodium nitrate and its components as used in gas cartridges as a fumigant in WS MDM programs in Tennessee, no significant cumulative effects to human health and safety are expected from its use in such programs.

Gas cartridges are available to the public in Tennessee and this method might be used by some. Any non-WS programs that might employ gas cartridges for purposes specified on product labels would not collectively produce cumulative effects for the same reasons outlined for WS MDM programs. Therefore, no significant cumulative effects on human health and safety are expected from all combined activities involving gas cartridge use for the management of damage caused by rodents and coyotes.

Non-lethal chemicals may also be used or recommended by the WS MDM program in Tennessee. Characteristics of these chemicals and use patterns indicate that no significant cumulative impacts related to environmental fate are expected from their use in WS MDM programs in Tennessee.

5.3.3 Cumulative Impacts on Socio-cultural Elements and Economics of the Human Environment

Five aspects of this issue have been identified in this EA (Subsection 2.2.3):

- possible disruption of human affectionate-bonds which some people develop with individual wild or feral mammals,
- possible decrease in aesthetic enjoyment which some people gain by feeding, and viewing wild or feral mammals,
- decrease in aesthetic enjoyment of feral or wild mammals experienced by some people as a result of overabundant species present, and
- degradation or loss of value of properties by some people as a result of the presence of too many individuals of a species.

This Subsection evaluates possible cumulative effects of each of these elements.

5.3.3.1 Cumulative Impacts on Human Affectionate-bonds

In the wild, few animals in the United States have life spans approaching that of humans. Species evaluated in this EA have life spans ranging from a few months for some small rodents, a maximum of 20-25 years for black bears, and over 100 years for some species of turtles. Most wild mammals viewed frequently by people, such as squirrels, raccoons, and white-tailed deer, live less than five years. Mortality is high among wildlife populations and specific individuals among a species may experience death early in life. This is a natural occurrence and humans 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, 1994, Marks and Koepke

1994, Zasloff 1996, Archer 1999, Ross and Baron-Sorensen 1998, Meyers, 2000) and observations made regarding this is probably applicable to close bonds which 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 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 which die or are no longer accessible, they usually find a similar meaningfulness by establishing an association with new individual animals or through other relational activities (Weisman 1991). Through this process of coping with the loss and establishing new affectionate bonds, people may avoid compounding emotional effects resulting from such losses (Parkes 1979, Lefrancois 1999).

Some mammals with which humans have established affectionate bonds may be removed from some project sites by WS MDM actions in Tennessee. Other individuals of the same species continue to be present in the area and people 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 which might be removed from a specific location by WS MDM actions. Therefore, no significant cumulative effects on human affectionate bonds are expected from WS MDM programs in Tennessee. Other non-WS actions which may disrupt human affectionate bonds with wildlife, such as natural wildlife mortality, hunter take, and other occurrences, in combination with the removal or dispersal of animals by WS, is not expected to collectively cumulatively affect this element of the human environment.

5.3.3.2 Cumulative Impacts on Aesthetic Enjoyment of Wildlife

Those who enjoy viewing wildlife may experience a temporary reduction in being able to view wildlife at some sites where WS MDM programs have removed animals. However, other animals may replace those removed, and other animals may be viewed and enjoyed at adjacent locations. Because effects on aesthetic enjoyment gained by viewing wildlife are temporary, no significant cumulative effects are expected as a result of WS MDM actions. Other non-WS actions which may temporarily and locally reduce the presence of wildlife for public viewing, such as natural wildlife mortality, hunter take, and other occurrences, combined with removal of animals by WS, is not expected to collectively or increasingly alter the current availability of wildlife, in the long-term, or on a statewide, regional, or national scale. Wildlife will still be available for aesthetic enjoyment, and so no overall significant cumulative effects are expected regarding this element of the human environment.

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 of those species or the continued presence of what is viewed as too many individuals could lead to further degradation of such people's enjoyment of any wildlife. The removal of some individuals among those species through WS MDM actions could positively affect their aesthetic enjoyment of remaining individuals and species, and might reduce the possibility of cumulative degradation of the public's attitude about a species, or wildlife in general. However, WS activities are not expected to have any significant cumulative effects on this element of the human environment.

5.3.3.3 Cumulative Impacts on Economic Loss Resulting From Overabundant Wildlife

Landowners, business owners, and managers of land in public trust are sometimes concerned with losses that occur as a result of excessive populations of a species, and, over time, such large populations have the ability to greatly affect the quality of such resources and increase anxiety and frustration of those landowners. Cumulative damage can occur over time, if no remedy is found. Removal of some individuals of such large populations of mammals could positively affect economic elements at these sites and reduce

the likelihood of cumulative effects, which could result from recurrent damage. However, WS activities are not expected to have any significant cumulative effects on this element of the human environment.

5.3.4 Cumulative Impacts on Wetlands

WS MDM programs that sometimes occur in wetlands or wetland-like habitat are beaver, nutria and muskrat damage management. In these activities WS programs do not result in net loss of established wetlands, nor do MDM activities result in progressive or cumulative reductions of established wetlands, or in cumulative damage or cumulative alterations of established wetlands. Therefore, WS MDM programs, considered collectively with all other MDM activities by other entities in Tennessee, are not expected to have any significant cumulative effects on wetlands in the state.

5.3.5 Cumulative Impacts on Concerns About Humaneness of MDM Methods

WS continues to seek other methods and to improve current technology to improve humaneness of methods in managing damage caused by mammals. Cooperation with individuals and organizations involved in animal welfare continues to be an agency priority for the purpose of evaluating WS strategies and defining research aimed at developing methods for MDM programs. Because WS continues to develop and implement more humane methods as technology advances, no significant cumulative effects from WS MDM actions in Tennessee are expected in relation to this element of the human environment. Combined MDM activities of other entities which have the potential to affect concerns about humaneness of MDM methods, coupled with all WS MDM activities, are not expected to have any significant cumulative effects on this element of the human environment.

5.4 SUMMARY OF CUMULATIVE IMPACTS

No significant cumulative environmental impacts are expected from any of the 4 alternatives including the Proposed Action. Under the Proposed Action, the lethal removal of mammals would not have a significant impact on overall mammal populations in Tennessee, but some local reductions may occur. Management activities will not negatively impact other protected flora and fauna in Tennessee. The Proposed Action is supported by the TWRA, the agency responsible for managing mammals and other flora and fauna in the State. No T&E species or critical habitat would be adversely impacted by the Proposed Action. Therefore, WS has determined that the Proposed Action would not likely adversely affect any species protected under the ESA or state wildlife laws. No risk to public or pet health and safety is expected by WS activities since only trained and experienced wildlife biologists and wildlife specialists would conduct and recommend management methods for mammal damage. There is a slight increased risk to public safety when control activities are conducted by persons that reject WS assistance and recommendations, but not to a significant extent. Although some persons will likely be opposed to WS participation in management activities to reduce mammal damage, the analysis in this EA indicates that WS Integrated Wildlife Damage Management program will not result in significant cumulative adverse impacts on the quality of the human environment.

6.0 CHAPTER 6: LIST OF PREPARERS AND PERSONS CONSULTED

6.1 List of Preparers

David Reinhold, USDA-WS-ERO, Environmental Coordinator
Brett Dunlap, USDA-WS, TN / KY State Director, Madison, TN
David Lingo, USDA-WS, District Supervisor, Jackson, TN

6.2 List of Persons and Agencies Consulted

U.S. Fish and Wildlife Service, Tennessee Field Office
Lee Barclay, Ph.D., Supervisor
Steve Alexander, Ecologist
Jim, Widlak, Fish & Wildlife Biologist

Tennessee Wildlife Resources Agency
Ed Warr, Wildlife Biologist
Alan Peterson, Wildlife Biologist
Randy Huskey, Wildlife Biologist

Tennessee Department of Environment and Conservation
Robert Baker, Assistant Manager, Permitting and Streams Section

U.S. National Park Service
Stones River National Battlefield

U.S. Tennessee Valley Authority

University of Tennessee – Martin
Dr. Eric Pelren, Associate Professor of Wildlife Biology

APPENDIX A

LITERATURE CITED

LITERATURE CITED

Andrews, E. J., B. T. Bennett, J. D. Clark, K. A. Houpt, P. J. Pascoe, G. W. Robinson, and J. R. Boyce. 1993. Report on the AVMA panel on euthanasia. *J. Amer. Vet. Med. Assoc.*, 202:229-249.

Archer, J. 1999. *The Nature of Grief: The Evolution and Psychology of Reactions to Loss*. Taylor & Francis/Routledge, Florence, KY. 317pp.

Arner, D.H., and G.R. Hepp. 1989. Beaver pond wetlands: a southern perspective. P 117-128 in L.M. Smith, R.L. Pederson, and R.M. Kaminski, Eds., *Habitat Management for Migrating and Wintering Waterfowl in North America*. Texas Tech University Press, Lubbock.

_____, and J.S. DuBose. 1980. The impact of the beaver on the environment and economics in the southeastern United States. In *Int. Wildl. Conf.*, 14:241-247.

AVMA (American Veterinary Medical Association). 1987. Panel report on the colloquium on recognition and alleviation of animal pain and distress. *Journal of the American Veterinary Medical Association.*, 191:1186-1189.

_____, (American Veterinary Medical Association). 2000. Report of the AVMA panel on euthanasia. *Journal American Veterinary Medical Association*, Vol.. 218, No. 5, March 1, 2001. pp. 669-696.

Avery, E. L. 1992. Effects of removing beaver dams upon a northern Wisconsin brook trout stream. Wisconsin Department of Natural Resources, Madison, Wisconsin.

Bailey, T. N. 1972. Ecology of bobcats with special reference to social organization. Ph.D. Thesis, Univ. Idaho, Moscow. 82pp.

Baker, R. H., and M. W. Baker. 1975. Montane habitat used by the spotted skunk (*Spilogale putorius*) in Mexico. *J. Mammal.*, 56: 671-673.

Balser, D. S., D. H. Dill, and H. K. Nelson. 1968. Effect of predator reduction on waterfowl nesting success. *J. Wildl. Manage.*, 32:669-682.

Barrett, R. H. and G. H. Birmingham. 1994. Wild pigs. Pp D65-70 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage*. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Beach, R., and W. F. McCulloch. 1985. Incidence and significance of giardia lamblia (Lambl) in Texas beaver populations. In *Proc. Great Plains Wildl. Damage Cont. Work.*, 7:152-164.

Beaver, B. V., W. Reed, S. Leary, B. McKieran, F. Bain, R. Schultz, B. T. Bennett, P. Pascoe, E. Shull, L. C. Cork, R. Francis-Floyd, K. D. Amass, R. Johnson, R. H. Schmidt, W. Underwood, G. W. Thorton, and B. Kohn. 2001. 2000 Report of the AVMA panel on euthanasia. *J. Am. Vet. Med. Assoc.*, 218:669-696.

Becker, S.E. and L.S. Katz. 1997. Gonadotropin-releasing hormone (GnRH) analogs or active immunization against GnRH to control fertility in wildlife. Pp. 11-19 in T.J. Kreeger, Ed., *Contraception in Wildlife Management*. U.S. Government Printing Office, Washington, DC.

_____, S. E., W. J. Enright, and L.S. Katz. 1999. Active immunization against gonadotropin-releasing hormone in female white-tailed deer. *Zoo Biology* 16:385-396.

Bekoff, M. 1982. Coyote. Pages 447–459 in J. A. Chapman and G. A. Feldhamer, Eds., *Wild mammals of North America: biology, management, and economics*. Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

Berryman, J. H. 1991. Animal damage management: responsibilities of various agencies and the need for coordination and support. In *Proc. East. Wildl. Damage Control Conf.* 5:12-14.

Bishop, R. C. 1987. Economic values defined. Pages 24 -33 in D. J. Decker and G. R. Goff, eds. Valuing wildlife: economic and social perspectives. Westview Press, Boulder, CO. 424 p.

Blundell, G.M., J.W. Kern, R.T. Bowyer, and L.K. Duffy. 1999. Capturing river otters: a comparison of Hancock and leg-hold traps. *Wildl. Soc. Bull.* 27(1):184-192.

Boggess, E. K. 1994a. Mink. Pp C89-92 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

_____. 1994b. Raccoons. Pp C101-107 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Bollengier, R. M. Jr. 1994. Woodchucks. Pp B-183-187 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Boutin, S. and D. E. Birkenholz. 1987. Muskrat and round-tailed muskrat. Pp 282-313 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock Eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Boyce, P. S. 1998. The social construction of bereavement: an application to pet loss. Dissertation Abstracts International Section A: *Humanities & Social Sciences.* Vol 59(4-A). US: University Microfilms International. 1348pp.

Bromley, P.T., J.F. Heisterberg, W.T. Sullivan, Jr., P. Sumner, J.C. Turner, R.D. Wickline, and D. K. Woodward. 1994. Wildlife Damage Management: Beavers. North Carolina Cooperative Extension Service. 8 pp.

Brown, R.G., W.D. Bowen, J.D. Eddington, W.C. Kimmins, M. Mezei, J.L. Parsons, and B.Pohajdak. 1997. Evidence for long-lasting single administration contraceptive vaccine in wild grey seals. *J. Repro. Immun.* 35(1997): 43-51.

Burt, W.H., and R.P. Grossendeider. 1976. A field guide to the mammals. Houghton Mifflin Col, Boston. 289 pp.

CDC (Centers For Disease Control and Prevention). 2001a. Rabies prevention and control. Information obtained at website : Http://www.cdc.gov/ncidod/dvrd/rabies

CDC (Centers For Disease Control and Prevention). 2001b. Mass treatment of humans who drank unpasteurized milk from rabid cows – Massachusetts, 1996 -1998. CDC – Morbidity and Mortality Weekly Report. Information obtained from website: http://www.cdc.gov/ncidod/dvrd/rabies/Professional/MMWRtext/mmwr4811.htm

CDC (Centers For Disease Control and Prevention). 2000. Notice to readers: Update: West Nile Virus isolated from mosquitos - New York, 2000. Morbidity and Mortality Weekly Report. 49(10):211.

CDC (Center for Disease Control and Prevention). 1990. Compendium of Rabies Control. Morbidity and Mortality Weekly Report. 39, No. RR-4:6.

CDFG (California Department of Fish and Game). 1991. California department of fish and game. Final environmental document - bear hunting. Sections 265, 365, 366, 367, 367.5. Title 14 Calif. Code of Regs. Calif. Dept. of Fish and Game, State of California, April 25, 1991. 13pp.

CEQ. 1981. Forty most asked questions concerning CEQ's National Environmental Policy Act regulations. (40 CFR 1500-1508) Fed. Reg. 46(55):18026-18038.

Churcher, P. B., and J. H. Lawton. 1987. Predation by domestic cats in an English village. *J. Zool.* (London) 212:439-455.

Clausen, G., and A. Ersland. 1970. Blood O_2 and acid-base changes in the beaver during submersion. *Respiration Physiology.* 11:104-112.

Cleary, E.C., S.E. Wright, and R.A. Dolbeer. 2000. Wildlife Strikes to civil aircraft in the United States 1990-1999 U.S. Dept. of Trans., Federal Aviation Admin. Ser. Rep. No.4. Washington, D.C. 61 pp.

Cole, R., and G. O. Batzli. 1979. Nutrition and population dynamics of the prairie vole *Microtus* ochrogaster in central Illinois. *Appl. Ecol.* 48:455-470.

Coleman, J. S., and S. A. Temple. 1989. Effects of free ranging cats on wildlife: a progress report. *In Proc. Eastern Wildl. Damage Contr. Conf.* 4:9-12.

Conover, M.R. 1982. Comparison of two behavioral techniques to reduce bird damage to blueberries: Methiocarb and hawk-kite predator model. *Wildl. Soc. Bull.*, 10,211-216.

Crabb, W. D. 1941. Food habits of the prairie spotted skunk in southeastern Iowa. *J. Mammal.* 22:349–364. 124.

_____. 1948. The ecology and management of the prairie spotted skunk in Iowa. *Ecol. Monogr.* 18:201–232.

Craven, S. R. 1994. Cottontail rabbits. Pp D-75-80 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

_____, and S. E. Hygnstrom. 1994. Deer. Pp D-25-40 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Crowe, D. M. 1975. A model for exploited bobcat populations in Wyoming. *J. Wildl. Manage.* 39:408-415.

Davidson, W. R. and V. F. Nettles. 1997. *Field manual of wildlife diseases in the southeastern United States.* 2nd ed. The Univ. of Georgia, Athens, Georgia. 417pp.

De Almeida, M. H. 1987. Nuisance furbearer damage control in urban and suburban areas. Pp 996-1006 in Novak, J. A. Baker, M. E. Obbard, and B. Malloch, Eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

DeBenedetti, S. H. 1986. Management of feral pigs at Pinnacles National Monument: Why and How. In *Proceedings of the conference on the conservation and management of rare and endangered plants.* California Native Plant Society. Sacramento, CA.

deCalesta, D.S. and G.W. Witmer 1994. Elk. Pp D-41-50 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Decker, D. J. and G. R. Goff. 1987. Valuing Wildlife: Economic and Social Perspectives. Westview Press. Boulder, Colorado, 424 p.

Dolbeer, R.A., N.R. Holler, and D.W. Hawthorne. 1994. Identification and control of wildlife damage. Pp 474-506 in T.A. Bookhout, ed., *Research and management techniques for wildlife and habitats.* The Wildlife Society; Bethesda, Maryland.

Dolbeer, R.A. 1998. Population dynamics: the foundation of wildlife damage management for the 21st century. Pp. 2-11 *in Proc. 18th Vertebr. Pest Conf.*, Davis, CA.

Dubey, J. P. 1973. Feline toxoplasmosis and coccidiosis: a survey of domiciled and stray cats. *J. Amer. Vet. Med. Assoc.* 162(10): 873-877.

Dubey, J.P. , R. M. Weigel, A. M. Siegel, P. Thulliez, U. D. Kitron, M. A. Mitchell, A. Mannelli, N. E. Mateus-Pinilla, S. K. Shen, O. C. H. Kwok, and K. S. Todd. 1995. Sources and reservoirs of *Toxoplasma gondii* infection on 47 swine farms in Illinois. *J. Parasitol.* 81(5): 723-729.

Eagle, T. C., and J. S. Whitman. 1987. Mink. Pp 614-625 in M. Novak, J. A. Baker, M. E. Obbard, B. Mallock, Eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Eng, T. R. and D. B. Fishbein. 1990. Epidemiologic factors, clinical findings, and vaccination status of rabies in cats and dogs in the United States in 1988. *J. Amer. Vet. Med. Assoc.* 197(2): 201-209.

EPA (Environmental Protection Agency). 1995. Facts about wetlands. USEPA. Office of water, Office of wetlands, oceans and watersheds (4502F). EPA 843-F-95-00le.

Errington, P. L. 1933. Bobwhite winter survival in an area heavily populated with grey foxes. Iowa State Coll. *J. Sci.* 8:127–130. Madison. 504pp.

_____. 1943. An analysis of mink predation upon muskrats in north-central United States. Iowa State Coll. Agric. Exp. Stn., *Res. Bull.* 320-798-924.

ExToxNet (Extension Toxicology Network). 2003a. Zinc phosphide fact sheet http://ace.orst.edu/info/extoxnet/pips/ghindex.html

_____. (Extension Toxicology Network). 2003b. Aluminum phosphide fact sheet. http://ace.orst.edu/info/extoxnet/pips/ghindex.html

Fitzgerald, B.M., W. B. Johnson, C. M. King, and P. J. Moors. 1984. Research on Mustelids and cats in New Zealand. WRLG Res. Review No. 3. Wildl. Res. Liaison Group, Wellington. 22 pp.

Fitzwater, W. D. 1994. Feral house cats. Pp C-45-50 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Flyger, V. and J.E. Gates. 1982. Moles pages 209-229 *in* Wild Mammals of North America; Biology, Management, and Economics. Edited by J.A. Chapman and G.A. Feldhamer. Johns Hopkins University Press. Baltimore and London.

Follmann, E. H. 1973. Comparative ecology and behavior of red and gray foxes. Ph.D. Thesis, Southern Illinois Univ., Carbondale. 152pp.

Fowler, M.E. and R.E. Miller. 1999. Zoo and Wild Animal Medicine. W.B. Saunders Co. Philadelphia, PA

Fraser, D., J. F. Gardner, G. B. Kolenosky, and S. M. Strathearn. 1982. Estimation of harvest rate of black bears from age and sex data. *Wildl. Soc. Bull.* 10:53-57.

Fritzell, E. K. 1987. Gray fox and island fox. Pp 408-420 in M. Novak, J. A. Baker, M. E. Obbard, B. Mallock. Eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Frost, C. C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. Pp 17-37 in S. M. Hermann, Ed., *The longleaf pine ecosystem: Ecology, restoration, and management.* Proceedings 18th Tall Timbers Fire Ecology Conference: Tallahassee, FL.

Fuller, T. K., W. E. Berg, and D. W. Kuehn. 1985. Survival rates and mortality factors of adult bobcats in north-central Minnesota. *J. Wildl. Manage.* 49:292-296.

Fur Institute of Canada. 2000. Traps meeting requirements of Agreement on International Humane Trapping Standards. Press Release. June 12, 2000.

Gardner, A. L. 1982. Virginia opossum. Pp 3-36 in J. A. Chapman and G. A. Feldhamer, Eds., *Wild mammals of North America: biology, management, and economics.* Johns Hopkins Univ. Press, Baltimore, Maryland. 1147 pp.

Gerell, R. 1971. Population studies on mink, *Mustela vison* (Schreber), in southern Sweden. *Viltrevy* 8:83-114.

Gerwolls, M. K. Labott, S. M. 1994. Adjustment to the death of a companion animal. *Anthrozoos* 7(3): 172-187.

Gier, H. T. 1948. Rabies in the wild. *J. Wildl. Manage.* 12:142–153.

_____. 1968. Coyotes in Kansas. Rev. ed. Kansas State Coll., Agric.Exp. Stn. Bull. 393. 118pp.

Gilbert, F.F., and N. Gofton. 1982. Terminal dives in mink, muskrat, and beaver. *Physiol.& Behav.* 28:835-840.

Gillespie, J. H. and F. W. Scott. 1973. Feline viral infections. Advances in Vet. Sci. and Comp. Med. 17: 163-200.

Gipson, P. S. 1983. Evaluations of behavior of feral dogs in interior Alaska, with control implications. *Vertebr. Pest Control Manage. Mater.* 4th Symp. Am. Soc. Testing Mater. 4:285-294.

Glueck, T.F., W.R. Clark, and R.D. Andrews. 1988. Raccoon movement and habitat use during the fur harvest season. *Wildl. Soc. Bull.* 16:6-11.

Godfrey, G., and P. Crowcroft. 1960. *The life of the mole.* London Museum Press, 152 pp.

Gore, J. A. and M. J. Kinnison. 1991. Hatching success in roof and ground colonies of least terns. *Condor* 93:759-762.

Gracely, R. H. and W. F. Sternberg. 1999. Athletes: Pain and Pain Inhibition. *American Pain Society.* 9:1-8

Greenwood, R. J. 1986. Influence of striped skunk removal on upland duck nest success in North Dakota. *Wildl. Soc. Bull.* 14:6-11.

Green, J. S., F. R. Henderson, and M. D. Collinge. 1994. Coyotes. Pp C-51-76 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

_____, and P. S. Gipson. 1994. Feral dogs. Pp C-77-82 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Greenhall, A. M. and S. C. Frantz. 1994. Bats. Pp D5-24 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. *Fur-bearing mammals of California.* 2 vols. Univ. California Press, Berkeley. 777pp.

Grover, P. B. 1979. Habitat requirements of Charadriiform birds nesting on salt flats at Salt Plains National Wildlife Refuge. M.S. Thesis, Oklahoma State Univ., Stillwater, OK.

_____, and F. L. Knopf. 1982. Habitat requirements and breeding success of Charadriiform birds nesting at Salt Plains National Wildlife Refuge, Oklahoma. *J. Field Ornithol.* 53:139-148.

Hall, E. R., and K. R. Kelson. 1959. *The mammals of North America.* Vol. 2. The Ronald Press Co., New York, N. Y. 616pp.

Hallberg, D. L., And G. R. Trapp. 1984. Gray fox temporal and spatial activity in a riparian–agricultural zone in California's Central Valley. Pp 920–928 in R. E. Warner and K. M. Hendrix, Eds., *Proc.Calif. Riparian Systems Conf.*, Univ. California Press, Berkeley.

Hamilton, D. A. 1982. Ecology of the bobcat in Missouri. M. S. Thesis, Univ. Missouri, Columbia. 132pp.

Harris, S. 1977. Distribution, habitat utilization and age structure of a suburban fox (*Vulpes vulpes*) population. *Mammal Rev.* 7: 25-39.

_____. 1979. Age related fertility and productivity in red foxes, *Vulpe vulpes*, in suburban London. *J. Zool.* (London) 187:195-199.

_____, and J. M. V. Rayner. 1986. Urban fox *(Vulpes vulpes)* population estimates and habitat requirements in several British cities. *J. Anim. Ecol.* 55:575–591.

Haroldson, K. J., and E. K. Fritzell. 1984. Home ranges, activity, and habitat use by gray foxes in an oak–hickory forest. *J. Wildl. Manage.* 48:222–227.

Hasbrouck, J.J., W.R. Clark, and R.D. Andrews. 1992. Factors associated with raccoon mortality in Iowa. *J. Wildl. Manage.* 56(4):693-699

Hatler, D. F. 1976. The coastal mink on Vancouver Island, British Columbia. Ph.D. Thesis, Univ. British Columbia, Vancouver. 296pp.

Hefner, J.M., B.O. Wilen, T.E. Dahl, and W.E. Frayer. 1994. Southeast Wetlands: Status and Trends, Mid 1970's to mid 1980's. United States Department of Interior, Fish and Wildlife Service. Southeast Region. Atlanta, GA.

Henderson, F. R. 1994. Moles. Pp D-51-58 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Herrero, S. 1982. Aspects of evolution and adaptation in American black bears (Ursus americanus Pallas) and brown and grizzly bears (U. Arctos Linne) of North America. *Int. Conf. Bear Res. And Manage. 2:221-231.*

_____, 1985. *Bear attacks: their causes and avoidance.* New Century Publ. Piscataway, New Jersey. 288pp.

Hickman, C.P., C.P. Hickman, Jr., and F.M. Hickman. 1978. *Biology of animals.* The C.V. Mosby Company, St. Louis. 640pp.

Hill, E. P. 1976. Control methods for nuisance beaver in the southeastern United States. In *Proc. Vertebr. Pest Control Conf.* 7:85-98.

_____. 1982. Beaver. Pages 256-281 *in* J.A. Chapman and G.A. Feldhamer, Eds., *Wild Mammals of North America.* Johns Hopkins University Press, Baltimore, Maryland. 1147 pp.

Hoagland, J.W. 1993. Nuisance Beaver Damage Control Proposal. Okla. Dept. Wildl. Cons. Internal Document. 20 pp.

Holbrook, H. T., and R. M. Timm. 1986. *Moles and their control.* NebGuide G86-777. Univ. Nebraska. Coop. Ext. Lincoln. 4 pp.

Honacki, J. H., K. E. Kinman, and J. W. Koeppl, editors. 1982. *Mammal species of the world: a taxonomic and geographic reference.* Allen Press, Inc., and Assoc. Systematics Collections, Lawrence, Kans. 694pp.

Horstman, L. P., and J. R. Gunson. 1982. Black bear predation on livestock in Alberta. *Wildl. Soc. Bull.*, 10:34-39.

Howard, W. E., and R. E. Marsh. 1982. Spotted and hog-nosed skunks. Pp 664–673 in J. A. Chapman and G. A. Feldhamer, Ed.,. *Wild mammals of North America: biology, management, and economics.* Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

Howard, R., L. Berchielli, G. Parsons, and M. Brown. 1980. *Trapping furbearers: Student manual.* Dept. of Conservation, New York. 59 pp.

Humphrey, S.R. Bats. Pp 52–70 in J. A. Chapman and G. A. Feldhamer, Eds., *Wild mammals of North America: biology, management, and economics.* Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

Jackson, J. J. 1994a. Opossums. Pp D59-64 in S.E. Hygnstrom, R.M. Timm and G.E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

_____. 1994b. Tree squirrels. Pp B-171-175 in S.E. Hygnstrom, R.M. Timm and G.E. Larson, Eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Johnson, A. S. 1970. *Biology of the raccoon in Alabama.* Auburn Univ. Exper. Stn. Bull. 402. 148 pp.

Jones, J. K. Jr., R. S. Hoffman, D. W. Rice, C. Jones, R. F. Baker, and M. G. Engstrom 1992. *Revised checklist of North American mammals north of Mexico, 1991.* Occasional Paper # 146. Texas Tech. Univ. Press. 23pp.

KDFWR (Kentucky Department of Fish and Wildlife Resources). 2002. Kentucky Mammals, Kentucky Species Information, KFWIS Life History Database. Http://www.kfwis.state.ky.us/KFWIS/SpeciesInfo7/ lifehistory/lifehistory.asp.

Kennedy, M.L., J.P. Nelson, Jr., F.W. Weckerly, D.W. Sugg, and J.C. Stroh. 1991. An assessment of selected forest factors and lake level in raccoon management. Wildl. Soc. Bull. 19:151-154.

Kennely, J. J., and B. E. Johns. 1976. The estrous cycle of coyotes. J. Wildl.Manage. 40:272–277.

Kern, W.H., Jr. 2002. Raccoons. WEC-34. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Kirkpatrick, J.F., I.K.M. Liu, and J.W. Turner. 1990. Remotely-delivered immunocontraception in feral horses. *Wildl. Soc. Bull.* 18:326-330.

Kirsch, E. M. 1996. Habitat selection and productivity of least terns on the lower Platte River, Nebraska. *Wildl. Monogr.* 132:1-48.

Knowlton, F. F. 1972. Preliminary interpretations of coyote population mechanics with some management implications. *J. Wildl. Manage.* 36:369–382.

Kolenosky, G. B., and S. M. Strathearn. 1987. Black Bear. Pp 442-454 in M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, Eds., *Wild furbearer management and conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Kolz, A.L. and R.E. Johnson. 1997. In-water electro-shock techniques to repel aquatic mammals and birds. In J.R. Mason, Ed., *Repellents in Wildlife Management* Symp. Proc. Aug. 8-10, 1995 Denver & Ft. Collins , CO. USDA, APHIS, WS, Nat. Wildl. Res. Cen.:203-215.

Krebs, J.W., C.E., Rupprecht, and J.E. Childs. 2000. Rabies surveillance in the United States during 1999. *J. Amer. Vet. Med. Assoc.* 217:1799-1811.

_____, J.S. Smith, C.E. Rupprecht, and J.E. Childs. 1998. Rabies surveillance in the United States during 1997. *J. Amer. Vet. Med. Assoc.* 213:1713-1672.

_____, J. W., T. W. Strine, J. S. Smith, D. L. Noah, C. E. Rupprecht, and J. E. Childs. 1996. Rabies surveillance in the United States during 1995. *J. Amer. Vet. Med. Assoc.* 209(12): 2031-2044.

Latham, R.M. 1960. Bounties Are Bunk. *Nat. Wildl. Federation,* Wash., D.C. 10 pp.

Lefrancois, G. R. 1999. Bereavement and grieving, pp. 552-554. in *The Lifespan.* 6th ed. Wadsworth. 556pp.

Lembeck, M. 1978. Bobcat study, San Diego County, California. Calif. Dep. Fish and Game, Fed. Aid Nongame Wildl. Invest. Proj. E-W-2, Rep. 22pp.

Leopold, A. S. 1933. *Game Management.* Charles Scribner & Sons, NY, NY. 481 pp.

Lewis, J. W. 1979. Significance of beaver and beaver ponds in the Tombigbee Resource Conservation and Development Area Alabama-1978. Ala. Coop. Ext. Serv., Auburn Univ., Circ. CRD-7. 10 pp.

Linscombe, G., N. Kinler, and R. J. Aulerich. 1982. Mink. Pp 629-643 in J. A. Chapman and G. A. Feldhamer, Eds., *Wild mammals of North America: biology, management, and economics.* John Hopkins Univ. Press, Baltimore, Md. 1147 pp.

Linzey, D. W. 1998. *The mammals of Virginia.* McDonald and Woodward Pub. Blacksburg, VA. 459 p.

Lipscomb, D. J. 1989. Impacts of feral hogs on longleaf pine regeneration. *Southern J. of Applied Forestry* 13(4):177-181.

Loeb, B. F., Jr. 1994. The beaver of the old north state. *Pop. Govern.*:18-23.

Loker, C.A., D.J. Decker, and S.J. Schwager. 1999. Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. *Wildl. Soc. Bull.* 27:152-159.

Lord, R. D., Jr. 1961. A population study of the gray fox. *Am. Midl. Nat.* 66:87–109. Sci. 38.79–82.

Lowery, M.D., J.W. Glidden, and D.E. Riehlman. 1993. *Options for the management of locally overabundant and nuisance deer populations: a technical review.* New York State Department of Environmental Conservation, Division of Fish and Wildlife. 26 pp.

Lowry, D. A. 1978. Domestic dogs as predators on deer. *Wildl. Soc. Bull.* 6:38-39.

Ludders, J.W., R.H. Schmidt, F.J. Dein, and P.N. Klein. 1999. Drowning is not euthanasia. *Wildl. Soc. Bull.* 27:666-670.

Lynch, J. J., T. O'Neil, and D. W. Lay. 1947. Management significance of damage by geese and muskrats to gulf coasts marshes. *J. Wildl. Manage.* 1:50-76.

Macdonald, D. W., and M. T. Newdick. 1982. The distribution and ecology of foxes, *Vulpes vulpes* (L.), in urban areas. Pages 123–135 in R. Bornkamm, J. A. Lee, and M. R. D. Seaward, Eds., *Urban ecology*. Blackwell Sci. Publ., Oxford, U.K.

MacIvor, L. H., S. M. Melvin, and C. R. Griffin. 1990. Effects of research activity on piping plover nest predation. *J. Wildl. Manage.* 54:443-447.

Mallis, A. 1982. *Handbook of pest control, 6th ed.* Franzak & Foster Co., Cleveland. 1101 pp.

Marks, S. G., and J. E. Koepke. 1994. Pet attachment and generativity among young adults. *J. Psychology* 128(6): 641.

Marshall, W. H. 1936. A study of the winter activities of the mink. *J. Mammal.* 17:382-392.

Massey, B. W. 1971. A breeding study of the California least tern, 1971. Admin. Rep. 71-9, Wildl. Manage. Branch, Calif. Dept. Fish and Game, Helen, MT.

_____, and J. L. Atwood. 1979. Application of ecological information to habitat management for the California least tern. Prog. Rep. 1, U. S. Fish and Wildlife Serv., Laguna Niguel, CA.

Matschke, G.H. 1976. Oral acceptance and antifertility effects of microencapsulated diethylstilbestrol on white-tailed does. In *Proceedings of the Southeast Assoc. of Game and Fish Comm.* 29:646-651.

_____. 1977a. Antifertility action of two synthetic progestins in female white-tailed deer. *J. Wildl. Manage.* 41:194-196.

_____. 1977b. Fertility control in white-tailed deer by steroid implants. *J. Wildl. Manage.* 41:731-735.

_____. 1977c. Microencapsulated diethystilbestrol as an oral contraceptive in white-tailed deer. J. *Wildl. Manage.* 41:87-91.

Mayer, J. J., and I. L. Brisbin, Jr. 1991. *Wild pigs of the United States; their history, morphology and current status.* Univ. Press, Athens, Georgia. 313pp.

McCabe, R. A. 1949. Notes on live-trapping mink. *J. Mammal.* 30:416-423.

McCord, C.M., and J.E. Cardoza. 1982. Pp 728-766 *in* J. A. Chapman and G. A. Feldhamer, Eds., *Wild mammals of North America: biology, management, and economics.* Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

McKnight, T. 1964. Feral livestock in Anglo-America. Univ. Calif. Publ. Geogr., Vol. 16. Univ. Calif. Press, Berkeley.

McVey, M., K. Hall, P. Trenham, A. Soast, L. Frymier, and A. Hirst. 1993. Wildlife Exposure Factors Handbook, Volume I. U.S. Environmental Protection Agency, Washington D.C., EPA/600/R-93/187a.

Means, D. B. 1999. *Desmognathus* auriculatus. Pp 10-11 in Michael Lanoo, Ed., *Status and Conservation of U.S. Amphibians.* Declining Amphibians Task Force Publ. No. 1.

Melquist, W.E. and A. E. Dronkert. 1987. River otter. pp. 626-641 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, Eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Meltzer, M.I. 1996. Assessing the costs and benefits of an oral vaccine for raccoon rabies: a possible model. *Emerging Infectious Diseases* 2(4):343-349.

Meyers, B. 2000. Anticipatory mourning and the human-animal bond. Pp 537-564 in Rando, Therese A. Ed., *Clinical dimensions of anticipatory mourning: Theory and practice in working with the dying, their loved ones, and their caregivers.* Champaign, IL, US: Research Press. xiii, 601 pp.

Miller, J. E. 1994. Muskrats. pp B-61 to B-70 *in* S. E. Hygnstrom, R. M. Timm and G. E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebraska and USDA-APHIS-WS and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

_____. 1983. Control of beaver damage. In *Proc. East. Wildl. Damage Control Conf.* 1:177-183.

_____, and G.K. Yarrow. 1994. Beavers. pp. B1-B11. *in* S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Miller, L. A., B.E. Johns, and G.J. Killian. 2000. Long-term effects of PZP immunization on reproduction of white-tailed deer. *Vaccine* (2000):568-574.

Minsky, D. 1980. Preventing fox predation at a least tern colony with an electric fence. *J. Field Ornithol.* 51:180-181.

Mitchell, J. L. 1961. Mink movements and populations on a Montana river. *J. Wildl. Manage.* 25:48-54.

Mosillo, M., J.E. Heske, and J.D. Thompson. 1999. Survival and movements of translocated raccoons in northcentral Illinois. *J. Wildl. Manage.*; 63(1): 278-286.

Muller, L.I., R.J. Warren, and D.L. Evans. 1997. Theory and Practice of immunocontraception in wild animals. *Wildl. Soc. Bull.* 25(2):504-514.

NASS (National Agricultural Statistics Service). 2000. Sheep and goats predator loss. U.S. Dept. Agric., Natl. Agric. Statistics Serv., Washington, DC.

NASS (National Agricultural Statistics Service). 2001. Cattle predator loss. U.S. Dept. Agric., Natl. Agric. Statistics Serv., Washington, DC.

National Audubon Society. 2000. *Field guide to North American mammals.* J. O. Whitaker, Jr., ed. Indiana State Univ. Alfred A. Knopf, New York, N.Y. 937pp.

NatureServe Explorer. 2002. An online encyclopedia of life [web application]. Version 1.6 . Arlington, Virginia, USA: NatureServe. Available: http://www.natureserve.org/explorer. (Accessed: August 20, 2003).

Nesbitt, W. H. 1975. Ecology of a feral dog pack on a wildlife refuge. Pp 391-396 in M. W. Fox, ed., *The Wild Canids.* Van Nostrand Reinhold Co., New York.

Neves, R. J., and M.C. Odom. 1989. Muskrat predation on endangered freshwater mussels in Virginia. *J. Wildl. Manage.* 53:934-941.

Nicholson, W. S. 1982. An ecological study of the gray fox in east central Alabama. M.S. Thesis, Auburn Univ., Auburn, Ala. 93pp.

Noah, D.L., M.G. Smith, J.C. Gotthardt, J. W. Krebs, D. Green, and J.E. Childs. 1995. Mass human exposure to rabies in New Hampshire: Exposures, Treatment, and cost. Public Health Briefs, National Center for Infectious Diseases, 1600 Clifton Rd. Mailstop G-13, Atlanta, GA 30333. 3 pp.

Noonan, B. 1998. The Canadian terminal dive study. *Wildl. Control Tech.* May - June. pp. 24-26.

Novak, M., J. A. Baker, M.E. Obbard, B. Mallock.. 1987. *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

_____. 1987. Beaver. Pp. 282-313 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

O'Brien, J. M. 1994. Voles. Pp B-13-16 in S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

O'Neil, T. 1949. The muskrat in the Louisiana coastal marshes. Louisiana Dept. Wildlife and Fish., New Orleans. 152 p.

Parkes, C. M. 1979. Grief: the painful reaction to the loss of a loved one. Monograph. University of California, San Diego.

Patterson, D. 1951. Beaver - trout relationships. Investigational Report 822. Wisconsin Conservation Department, Madison, Wisconsin.

Patton, S., S. L. Johnson, D. G. Loeffler, B. G. Wright, J. M. Jensen. 1986. Epizootic of toxoplasmosis in kangaroos, Wallabies, and potaroos: possible transmission via domestic cats. *J. Amer. Vet. Med. Assoc.* 189(9): 1166-1169.

Pearson, O. P. 1985. Predation. Pp 535-566 in R. A. Tamarin, ed., *Biology of new world Microtus*. Amer. Soc. Mammal. Shippensburg, Pennsylvania.

Pelton, M.R. 1982. Black Bear. Pp 504 -514 in J. A. Chapman and G. A. Feldhamer, eds., *Wild mammals of North America: biology, management, and economics.* Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

Perry, H. R. 1982. Muskrats. Pp 282 - 325 in J. A. Chapman and G. A. Feldhamer, eds., *Wild mammals of North America: biology, management, and economics.* John Hopkins Univ. Press. Baltimore, Md. 1147 pp.

Phillips, R. L., and R. H. Schmidt. 1994. Foxes. Pp C-83-88 in S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Randolph, J. P. 1988. *Virginia trapper's manual.* Dept. of Game and Inland Fisheries, Richmond, VA. 48 pp.

Reif, J. S. 1976. Seasonality, natality, and herd immunity in feline panleukopenia. *Am.. J. Epidemiology* 103(1):81-87.

Ritcey, R. W., and R. Y. Edwards. 1956. Live trapping mink in British Columbia. *J. Mammal.* 37:114-116.

Roblee, K.J. 1983. A wire mesh culvert for use in controlling water levels at nuisance beaver sites. In *Proc. East. Wildl. Damage Control Conf.* 1:167-168.

_____. 1987. The use of T-culvert guard to protect road culverts from plugging damage by beavers. In *Proc. East. Wildl. Damage Control Conf.* 3:25-33.

Rosatte, R.C. 1987. Skunks. Pp. 599-613 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Ross, C. B., and J. Baron-Sorensen. 1998. *Pet loss and human emotion: guiding clients through grief.* Accelerated Development, Inc. Philadelphia, PA. 166 pp.

Roughton, R.D. 1979. Effects of oral melengestrol acetate on reproduction in captive white-tailed deer. *J. Wildl. Manage.* 43:428-436.

Sanderson, G.C. and G.F. Huber, Jr. 1982. Selected demographic characteristics of Illinois (U.S.A) raccoons (*Procyon lotor*). Pp 487-513 in J.A. Chapman and D. Pursely, eds., *Worldwide furbearer conference proceedings.* MD Wildl. Admin., Annapolis, MD.

_____. Raccoons. Pp. 486-499 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Schmidt, G. D., and L. S. Roberts. 1989. *Foundations of parasitology, 4th ed.* Times Mirror / Mosby College Publishing, St Louis, Mo. 750pp.

Schmidt, R. 1989. Wildlife management and animal welfare. In *Trans. N.Amer. Wildl. And Nat. Res. Conf.* 54:468-475.

Schwartz, C. W., and E. R. Schwartz. 1959. *The wild mammals of Missouri.* Univ. Missouri Press and Missouri Conserv. Comm., Columbia . 341 p.

Scott, M. D., and K. Causey. 1973. Ecology of feral dogs in Alabama. *J. Wildl. Manage.* 37:253-265.

Seidensticker, J., M. A. O'Connel, and A. J. T. Hohnsingh. 1987. Virginia Opossum. Pp 246-263 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

Singer, F. J., W. T. Swank, and E. E. C. Clebsch. 1982. Some ecosystem responses to European wild boar rooting in a deciduous forest. Research/Resources Management Report No. 54. USDI, National Park Serv.: Atlanta, GA.

Skinner, Q. D., J. E. Speck Jr., M. Smith, and J. C. Adams. 1984. Stream water quality as influenced by beaver within grazing systems in Wyoming. *J. Range. Manage.* 37:142-146.

Slate, D. 1980. A study of New Jersey raccoon populations— determination of the densities, dynamics and incidence of disease in raccoon populations in New Jersey. N.J. Div. Fish, Game, and Wildl., Pittman-Robertson Proj. W-52-R-8, Final Rep. 67pp.

Slate, D.A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. In *Trans. N. A. Wildl. Nat. Res. Conf* 57:51-62.

Speake, D. W., L. H. Barwick, H. O. Hillestad, and W. Stickney. 1969. Some characteristics of an expanding turkey population. In *Proc. Annu. Conf. SE Assoc. Fish and Wildl. Agencies* 23:46-58.

_____. 1980. Predation on wild turkeys in Alabama. In *Proc. Fourth Natl. Wild Turkey Symp.* 4:86-101.

_____, R. Metzler, and J. McGlincy. 1985. Mortality of wild turkey poults in Northern Alabama. *J. Wildl. Manage.* 49:472-474.

Stephens, D. L. and R. P. Hill. 1996. The loss of animal companions: A humanistic and consumption perspective. *Society & Animals.* Vol 4(2): 189-210.

TASS (Tennessee Agricultural Statistics Service) 2002. Tennessee Agriculture 2002. Bulletin No. 37. State of Tennessee. 14 pp.

TDA (Tennessee Department of Agriculture). 2003. Tennessee Forest Facts. http://www.state.tn.us/agriculture/forestry/tdfff.html

TWRC (Tennessee Wildlife Resources Commission). 2003. Controlling Coyotes in Tennessee. Tennessee Wildlife Resources Commission. http://www.state.tn.us/twra/coyote.pdf

Teutsch, S. M., D. D. Juranek, A. Sulzer, J. P. Dubey, R. K. Sikes. 1979. Epidemic toxoplasmosis associated with infected cats. *N. Engl. J. Med.* 300(13): 695-699.

Thompson, R. L. 1977. Feral hogs on National Wildlife Refuges. Pp 11-16 in G. W. Wood, ed., *Research and management of wild hog populations: Proceedings of a Symposium.* Georgetown, S. C. 113 pp.

Till J. A., and F. F. Knowlton. 1983. Efficacy of denning in alleviating coyote depredations upon domestic sheep. *J. Wildl. Manage.* 47:1018-1025.

_____. 1992. Behavioral effects of removal of coyote pups from dens. In *Proc. Vertebr. Pest Conf.* 15:396-399.

Timm, R. M. 1994. Norway rats. Pp B105-120 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

_____, and W. E. Howard. 1994. White-footed and deer mice. Pp B 47-51 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, eds., Prevention and Control of Wildlife Damage. Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Trapp, G. R. 1978. Comparative behavioral ecology of the ringtail *(Bassariscus astutus*) and gray fox *(Urocyon cinereoargenteus*) in southwestern Utah. *Carnivore* 1(2):3–32.

Trautman, C. G., L. F. Fredrickson, and A. V. Carter. 1974. Relationship of red foxes and other predators to populations of ring-necked pheasants and other prey, South Dakota. In *Trans. North Am. Wildl. Nat. Resour. Conf.* 39:241-252.

Turner, J.W. and J.F. Kirkpatrick. 1991. New developments in feral horse contraception and their potential application to wildlife. *Wildl. Soc. Bull.* 19:350-359.

_____, I.K.M. Liu, and J.F. Kirkpatrick. 1992. Remotely-delivered immunocontraception in captive white-tailed deer. *J. Wildl. Manage.* 56:154-157.

_____, J.F. Kirkpatrick, and I.K.M. Liu. 1993. Immunocontraception in white-tailed deer. Pages 147-159 in T.J. Kreeger, Technical Coordinator, *Contraception in Wildlife Management.* USDA APHIS Technical Bulletin No. 1853.

_____, J.F. Kirkpatrick, and I.K.M. Liu. 1996. Effectiveness, reversibility, and serum antibody titers associated with immunocontraception in captive white-tailed deer. *J. Wildl. Manage.* 60:873-880.

Twichell, A. R., and H. H. Dill. 1949. One hundred raccoons from one hundred and two acres. *J. Mammal.* 30:130–133.

TWRA (Tennessee Wildlife Resources Agency). 2001. Tennessee Furbearer Report 1998/98-1998/99. Technical Report No. 99-14. State of Tennessee.

_____. 2002. 2002 Tennessee Hunting & Trapping Guide. State of Tennessee.

_____. 2003. Tennessee elk reintroduction questions and answers. Information found at website: http://www.state.tn.us/twra/elkques1/html

Underwood, H.B. and F.D. Verret. 1998. Pp 41-52. From fertility control to population control: improving efficacy of deer immunocontraceptive programs. In *A Workshop on the Status and Future of Wildlife Fertility Control.* TWS Annual Meeting, Buffalo, NY.

Urban, D. 1970. Raccoon populations, movement patterns, and predation on a managed waterfowl marsh. *J. Wildl. Manage.* 34:372–382.

USACE (U.S. Army Corps of Engineers). 2002. Final notice. Issuance of nationwide permits. Department of Defense, Department of the Army, Corps of Engineers. U. S. Army Corps of Engineers Regulatory Home Page: http://www.usace.army.mil/inet/functions/cw/cecwo/reg/

US Census Bureau. 1999. Statistical Abstract of the United States. U.S. Department of Commerce, Economics and Statistics Administration. Washington DC. 1005pp.

USDA (United States Department of Agriculture). 1997. Final Environmental Impact Statement (Revised). USDA, APHIS, ADC (*WS*) Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

_____. 1989. USDA, Animal and Plant Health Inspection Service, Animal Damage Control Strategic Plan. USDA, APHIS, ADC (*WS*), Operational Support Staff, 4700 River Road, Unit 87, Room 2D05, Riverdale, MD 20782.

_____. 2001. Environmental Assessment Oral Vaccination To Control Specific Rabies Virus Variants in Raccoons, Gray Foxes, and Coyotes in the United States. USDA, APHIS, WS, 4700 River Road, Unit 87, Room 2D05, Riverdale, MD 20782.

USDOT (United States Department of Transportation), FAA (Federal Aviation Administration). 1997. Advisory circular No. 150/5200-33. subject: hazardous wildlife attractants on or near airports. 10pp.

_____. 2000. Wildlife strikes to civil aircraft in the United States 1990-1999. Federal Aviation Admin. Wildl. Aircraft Strike Database, Ser. Rpt No.6. Sept, 2000.

USDI, FWS (United States Department of the Interior, Fish and Wildlife Service), U.S. Department of Commerce, U.S. census Bureau. 2002. *2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.*

U.S. Fish and Wildlife Service. 2001. Bog Turtle (*Clemmys muhlenbergii*), Northern Population, Recovery Plan. Hadley, Massachusetts. 103 pp.

USFWS. 2001. Tennessee Partners for Fish and Wildlife. Cookeville, TN. http://partners.fws.gov/pdfs/TN-needs.pdf

USFWS (U.S. Department of Fish and Wildlife Service). 2003. U.S. Fish and Wildlife Service, Species Information, Threatened and Endangered Animals and Plants, Laws, Policies and Federal Register Notices, Our Listing Program, Interagency Policy Regarding Recognition of Distinct Vertebrate Population Segments Under the ESA. Information found at website: http://endangered.fws.gov/wildlife.html#

USFWS, 2005. Species Profile for Slackwater Darter. Information found at website: http://ecos.fws.gov/docs/life_histories/E01B.html

Vaughn, J. B. 1976. Cat rabies. Pp 139-154 in G. M. Baer, ed., *The natural history of rabies.* Vol. II. Academic Press New York.

Vaughan, M.R. and M.R. Pelton. 2003. Black Bears of North America. National Biological Service, Virginia Coop. Fish and Wildlife Research Unit. VA Polytechnic Institute and State Univ. http://biology.usgs.gov/s+t/frame/c286.htm

Virchow, Dallas, and Denny Hogeland. 1994. Bobcats. Pp. C35-45 in S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Voigt, D. R.. 1987. Red fox. Pp 378-392 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150 pp.

_____, and R. L. Tinline. 1980. Strategies for analyzing radio tracking data. Pp 387–404 in C. J. Amlaner, Jr., and D. W. Macdonald, eds., *A handbook on biotelemetry and radio tracking.* Pergamon Press, Oxford, U.K.

_____, and B. D. Earle. 1983. Avoidance of coyotes by red fox families. *J. Wildl. Manage.* 47:852–857.

_____, and D. W. MacDonald. 1984. Variation in the spatial and social behavior of the red fox, *Vulpes vulpes. Acta Zool. Fenn.* 171:261-265

_____, and W. E. Berg. 1987. Coyote. Pp 345-357 in M. Novak, J. A. Baker, M.E. Obbard, B. Mallock, eds., *Wild Furbearer Management and Conservation in North America.* Ministry of Natural Resources, Ontario, Canada. 1150pp.

Wade, D. E. and C. W. Ramsey. 1986. *Identifying and managing mammals in Texas: beaver, nutria and muskrat.* Texas Agri. Ext. Serv. and TX Agri. Exp. Sta. Texas A&M Univ. in coop. with USDI-USFWS (Fish and Wildl. Serv.) Pub. B-1556. 46 pp.

Weisman, A. D. 1991. Bereavement and companion animals. *Omega: Journal of Death & Dying.* 22(4): 241-248.

Whitaker, J.O., Jr. and WLJ. Hamilton, Jr. 1998. *Mammals of the Eastern United States.* Cornell University Press, Ithaca, NY. 583 pp.

Wildlife Services. 1999. Environmental Assessment for Predator damage management in Nebraska for the protection of livestock, wildlife, property and public health and safety. USDA, APHIS, WS. Nebraska..

Wildlife Society, The, 1990. *Conservation Policies of the Wildlife Society.* The Wildl. Soc., Wash., D.C. 20 pp.

Williams, D. E., and R. M. Corrigan. 1994. Chipmunks. Pp B-13-16 in S.E. Hygnstrom, R.M. Timm and G.E. Larson, eds., *Prevention and Control of Wildlife Damage.* Univ. Nebr. Coop. Ext., USDA-APHIS-ADC, and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Wood, C. W., and R. Barrett. 1979. Status of wild pigs in the United States. *Wildl. Soc. Bull.* 7:237-246.

Woodward, D. K., R. B. Hazel, and B. P. Gaffney. 1985. Economic and environmental impacts of beaver in North Carolina. In *Proc. East. Wildl. Damage Contr. Conf.* 2:89-96.

_____. 1983. Beaver management in the southeastern United States: a review and update. In *Proc. East. Wildl. Damage Contr. Conf.* 1:163-165.

Yates, T.L. and R.J. Pedersen. 1982. Moles pages 37-51 *in* Wild Mammals of North America; Biology, Management, and Economics. Edited by J.A. Chapman and G.A. Feldhamer. Johns Hopkins University Press. Baltimore and London.

Yeager, L. E., and R. G. Rennels. 1943. Fur yield and autumn foods of the raccoon in Illinois river bottom lands. *J. Wildl. Manage.* 7:45–60.

Zasloff, R. L. 1996. Human-animal interactions. Special Issue. *Applied Animal Behaviour Science.* 47(1-2): 43-48.

APPENDIX B

MAMMAL DAMAGE MANAGEMENT (MDM) METHODS AVAILABLE FOR USE OR RECOMMENDATION BY THE TENNESSEE WILDLIFE SERVICES PROGRAM

Appendix B

Mammal Damage Management Methods

Resource owners and government agencies have used a variety of techniques to reduce mammal damage. However, all lethal and non-lethal methods developed to date have limitations based on costs, logistics, or effectiveness. Below is a discussion of mammal damage management methods currently available to the Tennessee WS program. If other methods are proven effective and legal to use in Tennessee, they could be incorporated into the TN WS program, based upon NEPA compliance.

Nonchemical Wildlife Damage Management Methods

Nonchemical management methods consist primarily of tools or devices used to repel, capture or kill a particular animal or local population of wildlife to alleviate resource damage. Methods may be non-lethal (e.g., fencing, frightening devices, etc.) or lethal (e.g., firearms, Conibear traps, snares, etc.). If WS personnel apply these methods on private lands, an *Agreement for Control on Private Property* must be signed by the landowner or administrator authorizing the use of each damage management method. Nonchemical methods used by WS include:

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing of small critical areas can sometimes prevent animals which cannot climb from entering areas of protected resources. Fencing of culverts, drain pipes, and other water control structures can sometimes prevent beavers from building dams which plug these devices. In those applications, however, consideration must be given for water flow so that the fence does not act to catch and hold water-borne debris. Fencing, especially if it is installed with an underground skirt, can prevent access to areas for many mammal species which dig, including coyotes, foxes, woodchucks, beaver, nutria, and muskrat. Areas such as airports, yards or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and gnawing of valuable trees and to prevent the entry of mammals into buildings through existing holes or gaps. Construction of concrete spillways may reduce or prevent damage to dams by burrowing aquatic rodent species. Riprap can also be used on dams or levies at times, especially to deter muskrat, woodchucks, and other burrowing rodents. Electrical water barriers have proven effective in limited situations for beaver; an electrical field through the water in a ditch or other narrow channel, or hot-wire suspended just above the water level in areas protected from public access, have been effective at keeping beaver out. The effectiveness of an electrical barrier is extended when used in conjunction with an odor or taste cue that is emitted because beaver will avoid the area even if the electrical field is discontinued (Kolz and Johnson 1997). Similarly, electric fences of various constructions have been used effectively to reduce damage to various crops by deer, raccoons, and other species (Craven and Hygnstrom 1994, Boggess 1994b).

Cultural Methods and Habitat Management includes the application of practices which 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, removing trees along stream banks to discourage the presence of beavers, or planting lure crops on fringes of protected crops. Continual destruction of beaver dams and removal of dam construction materials on a daily basis will sometimes cause beavers to move to other locations, although this strategy can be far more expensive than removing beavers in conjunction with dam removal. Water control devices such as the 3-log drain (Roblee 1983), the T-culvert guard (Roblee 1987), wire mesh culvert (Roblee 1983), and the Clemson beaver pond leveler (Miller and Yarrow 1994) can sometimes be used to control the water in beaver ponds to desirable levels that do not cause damage. Such methods have variable results and rarely provide acceptable levels of control unless used in an integrated program with other strategies.

Removal of trees from around buildings can sometimes reduce damage associated with tree squirrels and raccoons. However, squirrels are able to climb a variety of surfaces and have been observed gaining access to the roofs of homes in urban environments by climbing brick and stone siding and by traveling from roof to roof along power lines (B. Dunlap, WS, Pers. comm., 2003).

Some mammals which cause damage in urban environments are attracted to homes by the presence of garbage or pet food left outside and unprotected. Removal or sealing of garbage in tight trash receptacles, and

elimination of all pet foods from outside areas can reduce the presence of unwanted mammals. If raccoons and opossums are a problem, making trash and garbage unavailable and removing all pet food from outside during nighttime hours can reduce their presence. If tree squirrels or chipmunks are damaging property or causing a nuisance, care in preventing them from obtaining bird seed left in bird feeders can often greatly reduce their presence. This may mean hanging bird feeders by thin wire from tree limbs, or constructing mounting poles which cannot be climbed by these animals.

Removal of Beaver Dams That Cause Flooding Damage is generally conducted to maintain existing stream channels and drainage patterns, and reduce flood waters that have affected established silviculture, agriculture, and ranching activities or drainage structures such as culverts. Beaver dams are made from natural debris such as logs, sticks, and mud that beaver take from the immediate area. It is this portion that is dislodged during a beaver dam removal operation. The impoundments that WS removes are normally from recent beaver activity and have not been in place long enough to take on the qualities of a true wetland (i.e. hydric soils, aquatic vegetation, preexisting function). Unwanted beaver dams can be removed by hand with a rake or power tools (e.g., a winch), or with explosives. Explosives are used only by WS personnel specially trained and certified to conduct such activities, and only binary explosives are used (i.e., they are comprised of two parts that must be mixed at the site before they can be detonated as an explosive material). Beaver dam removal by hand or with binary explosives does not affect the substrate or the natural course of the stream and returns the area back to its preexisting condition with similar flows and circulations. Because beaver dams involve waters of the United States, removal is regulated under Section 404 of the Clean Water Act.

Wetlands are recognized by three characteristics: hydric soils, hydrophytic vegetation, and general hydrology. Hydric soils are either composed of, or have a thick surface layer of, decomposed plant materials (muck); sandy soils have dark stains or streaks from organic material in the upper layer where plant material has attached to soil particles. In addition, hydric soils may be bluish gray or gray below the surface or brownish black to black and have the smell of rotten eggs. Wetlands also have hydrophytic vegetation present such as cattails, bulrushes, willows, sedges, and water plantains. The final indicator is general hydrology which includes standing and flowing water or waterlogged soils during the growing season; high water marks are present on trees and drift lines of small piles of debris are usually present. Beaver dams usually will develop a layer of organic material at the surface because siltation can occur rapidly, but aquatic vegetation and high water marks (a new high water mark is created by the beaver dam) are usually not present. However, cattails and willows can show up rapidly if they are in the vicinity, but most hydrophytic vegetation takes time to establish.

When a dam is removed, debris is discharged into the water. The debris that ends up in the water is considered "incidental fallback" or discharge fill. However, in most beaver dam removal operations, the material that is displaced., if considered to be discharge, is exempt from permit requirements under 33 CFR 323 or 330. A permit would be required if the impoundment caused by a beaver dam was considered a true wetland. WS personnel survey the beaver dam site and impoundment and determine whether conditions exist suggesting that the area may be a wetland as defined above. If such conditions exist, the landowner is asked the age of the dam or how long he/she has known of its presence to determine whether Swampbuster, Section 404 permit exemptions or NWPs allow removal of the dam. If not, the landowner is required to obtain a Section 404 permit before the dam will be removed by WS personnel.

The following information explains Section 404 exemptions and conditions that pertain to the removal of beaver dams.

33 CFR 323 - Permits For Discharges of Dredged or Fill Material into Waters of the United States. This regulation provides guidance to determine whether certain activities require permits under Section 404.

Part 323.4 Discharges not requiring permits. This section establishes exemptions for discharging certain types of fill into waters of the United States without a permit. Certain minor drainage activities connected with normal farming, ranching, and silviculture activities where they have been established do not require a permit as long as these drainages do not include the immediate or gradual conversion of a wetland (i.e. beaver ponds greater than 5 years old) to a non-wetland. Specifically part (a)(1)(iii)(C)(i) states, "*...fill material incidental to connecting upland*

drainage facilities [e.g., drainage ditches] *to waters of the United States, adequate to effect the removal of excess soil moisture from upland croplands...*". This indicates that beaver dams that block ditches, canals, or other structures designed to drain water from upland crop fields can be removed without a permit.

Moreover, (a)(1)(iii)(C)(iv) states the following types of activities do not require a permit "*The discharges of dredged or fill materials incidental to the emergency removal of sandbars, gravel bars, or other similar blockages which are formed during flood flows or other events, where such blockages close or constrict previously existing drainageways and, if not promptly removed., would result in damage to or loss of existing crops or would impair or prevent the plowing, seeding, harvesting or cultivating of crops on land in established use for crop production. Such removal does not include enlarging or extending the dimensions of, or changing the bottom elevations of, the affected drainageway as it existed prior to the formation of the blockage. Removal must be accomplished within one year of discovery of such blockages in order to be eligible for exemption.*"; this allows the removal of beaver dams in natural streams to restore drainage of agricultural lands within one year of discovery.

Part 323.4 (a) (2) allows "*Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption.*"; this allows beaver dams to be removed without a permit where they have resulted in damage to roads, culverts, bridges, or levees if it is done in a reasonable amount of time.

Tennessee regulates discharges into the waters of the state through the Tennessee Department of Environment and Conservation and grants exemptions from permitting for discharges based on guidelines and exemptions provided by the Corps. TDEC does not consider removal of beaver dams by WS in the state to require permits in those situations exempted by the Corps (R. Baker, TDEC, pers. comm., 2003).

33 CFR 330 - Nationwide Permit (NWP) Program. The Corps Chief of Engineers is authorized to grant certain dredge and fill activities on a nationwide basis if they have minimal impact on the environment. The NWPs are listed in Appendix A of 33 CFR 330 and permittees must satisfy all terms and conditions established in order to qualify for their use. Individual beaver dam removal activities by WS may be covered by any of the following NWPs if not already exempted from permit requirements by the regulations discussed above. WS complies with all conditions and restrictions placed on NWPs for any instance of beaver dam removal done under a specific NWP.

The Corps reevaluated its NWP during 2001-02 and presented revised guidelines in 2002 (USACE, 2002). Based on those guidelines, NWPs can be used **except** in any component of the National Wild and Scenic River System (16 U.S.C. §§ 1271 -1287 as amended) such as the designated reaches of the Obed River in Tennessee and any other rivers or reaches and their corridors in Tennessee which have been designated as part of the Wild Rivers system authorized by The Tennessee Scenic Rivers Act. Any beaver dam removal in these designated areas which might be contemplated by WS may require consultation with the Corps and TDEC to obtain permits for any such activities.

NWP 3 authorizes the rehabilitation of those structures, such as culverts, homes, and bridges, destroyed by floods and "discrete events" such as beaver dams provided that the activity is commenced within 2 years of the date when the beaver dam was established.

NWP 18 allows minor discharges of dredged and fill material, including the removal of beaver dams, into all waters of the United States provided that the quantity of discharge and the volume of excavated area does not exceed 25 cubic yards below the plane of the ordinary high water mark (this is normally well below the level of the beaver dam) and will not cause the loss of more than 1/10 acre of special aquatic site including wetlands. The District Engineer must be "notified"

(general conditions for notification apply), if the discharge is between 10-25 cubic yards for a single project or the project is in a special aquatic site or if the discharge is in a special aquatic site, including wetlands. Beaver dams rarely would exceed 2 or 3 cubic yards of backfill into the waters and probably no more than 5 cubic yards would ever be exceeded. Therefore, this stipulation is not restrictive. Beaver dams periodically may be removed in a special aquatic area, but in most instances the aquatic site will be returned to normal. However, if a true wetland exists, and beaver dam removal is not allowed under another permit, then a permit must be obtained from the District Engineer.

NWP 27 provides for the discharge of dredge and fill for activities associated with the restoration of wetland and riparian areas with certain restrictions. On non-federal public and private lands, the owner must have: a binding agreement with USFWS or NRCS to conduct restoration; a voluntary wetland restoration project documented by NRCS; or notified the District Engineer according to "notification" procedures. On Federal lands, including Corps and USFWS, wetland restoration can take place without any contract or notification. This NWP "*...applies to restoration projects that serve the purpose of restoring "natural" wetland hydrology, vegetation, and function to altered and degraded non-tidal wetlands and "natural" functions of riparian areas. This NWP does not authorize the conversion of natural wetlands to another aquatic use...*" If operating under this permit, the removal of a beaver dam would be allowed as long as it was not a true wetland (i.e., 5 or more years old), and for non-federal public and private lands the appropriate agreement, project documentation, or notification is in place.

A quick response without delays resulting from permitting requirements can be critical to the success of minimizing or preventing damage. Exemptions contained in the above regulations or NWPs provide for the removal of the majority of beaver dams that WS in Tennessee encounters. The primary determination that must be made by WS personnel is whether a beaver impounded area has become a true wetland or is just a flooded area. The flexibility allowed by these exemptions and NWPs is important for the efficient and effective resolution of many beaver damage problems because damage escalates rapidly in many cases the longer an area remains flooded.

Lure crops/alternate foods are crops planted or other food resources provided to mitigate the potential loss of higher value crops

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. These 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
- harassment / shooting into groups or herds

Live Capture and Relocation can be accomplished through the use of cage traps, snares, and foothold traps to capture some species of mammals for the purpose of translocating them for release to wild sites. WS sometimes uses these methods to conduct MDM programs in Tennessee when the target animal(s) can legally be relocated or can be captured and handled with relative safety by WS personnel. Live capture and handling of wild mammals poses an additional level of human health and safety threat if target animals are aggressive, large, or extremely sensitive to the close proximity of humans. For that reason, WS may limit this method to specific situations and certain species. Excessive populations may make this a poor wildlife management strategy for some 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. The American Veterinary Medical Association, 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 (Center for Disease Control 1990). Although relocation is not necessarily precluded in all cases, it would in many cases be logistically impractical and biologically unwise in Tennessee, and is evaluated by WS on a case-by-case basis.

Trapping can utilize a number of devices, including footholds, cage-type traps, and Conibear (body-gripping) traps, foot snares, and neck/body snares. For a description of these methods the reader is referred to the FEIS, Appendix J (USDA 1997). These techniques are usually implemented by WS personnel because of the technical training required to use such devices. A formal risk assessment of all mechanical devices used by the WS MDM program in Tennessee is in the FEIS, Appendix P (USDA 1997). Below is a brief summary of leg-hold trap and snare usage.

Foothold (Leghold) Traps can be effectively used to capture a variety of mammals. Foothold traps are either placed beside, or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target animals. Effective trap placement and adjustment and the use and placement of appropriate baits and lures by trained WS personnel also contribute to the foothold trap's selectivity. An additional advantage is that foothold traps can allow for the on-site release of non-target animals. The use of foothold traps requires more skill than some methods, but they are indispensable in resolving many damage problems.

Snares are capture devices comprised of a cable formed in a loop with a locking device and placed in travel ways. Most snares are also equipped with a swivel to minimize cable twisting and breakage. Snares are also easier than foothold traps to keep operational during periods of inclement weather. Snares set to catch an animal around the body or legs are usually a live-capture method.

Cage traps are live capture traps used to trap a variety of small to medium sized mammals. Cage traps come in a variety of sizes and are made of galvanized wire mesh, and consists of a treadle in the middle of the cage that triggers the door to close behind the animal being trapped.

Hancock/Bailey Traps (suitcase/basket type cage traps) are designed to live-capture beaver. The trap is constructed of a metal frame that is hinged with springs attached and covered with chain-link fence. The trap's appearance is similar to a large clam when closed. When set, the trap is opened to allow an animal to enter the *clam shells*, when tripped the *clam shells* close around the animal. One advantage of using the Hancock or Bailey trap is the ease of release of beaver or non-target animals. Beaver caught in Hancock or Bailey traps could also be humanely euthanized. Disadvantages are that these traps are very expensive (>$300 per trap), cumbersome, and difficult to set (Miller and Yarrow 1994). The trap weighs about 25 pounds and is relatively bulky to carry and maneuver. Hancock and Bailey traps can also be dangerous to set (i.e., hardhats are recommended when setting suitcase traps), are less cost and time-efficient than snares, footholds, or body-grip traps, and may cause serious and debilitating injury to river otters (Blundell et al. 1999).

Body-grip (e.g., Conibear-type) Traps are designed to cause the quick death of the animal that activates the trap. The size 330 Conibear trap is generally used for beaver exclusively in aquatic habitats, with placement depths varying from a few inches to several feet below the water surface. Placement is in travel ways or at lodge or burrow entrances created or used by the target species. The animal captured as it travels through the trap and activates the triggering mechanism. Safety hazards and risks to humans are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to non-target animals because of the placement in aquatic habitats and below the water surface.

Shooting is selective for target species and may involve the use of spotlights and either a handgun, shotgun or rifle. Shooting is an effective method to remove a small number of mammals in damage situations, especially where trapping is not feasible. Removal of specific animals in the problem area can sometimes provide immediate relief from a problem. Shooting is sometimes utilized as one of the first lethal damage management options because it offers the potential of resolving a problem more quickly and selectively than some other

methods, but it is not always effective. Shooting may sometimes be one of the only damage management options available if other factors preclude setting of damage management equipment. WS personnel receive firearms safety training to use firearms that are necessary for performing their duties.

Denning is the practice of finding coyote dens and eliminating the young, adults, or both to stop an ongoing predation problem or prevent future depredation on livestock. Till and Knowlton (1983) documented denning's cost-effectiveness and high degree of efficacy in resolving predation problems due to coyotes killing lambs. 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 (see discussion of gas cartridge under *Chemical Management Methods*).

Hunting/Trapping: WS sometimes recommends that resource owners consider legal hunting and trapping as an option for reducing mammal damage. Although legal hunting/trapping is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some populations of mammals.

Aerial Shooting or aerial hunting (shooting from an aircraft) is a commonly used coyote damage management method; it especially can be effective in removing offending coyotes that have become "bait-shy" to trap sets or are not susceptible to calling and shooting. WS uses aerial hunting to remove coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, and other permitted animals. Aerial hunting is mostly species-selective (there is a slight potential for misidentification - i.e., small wolf and coyote) 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 aerial hunting for disease surveillance (i.e., 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.

Chemical Wildlife Damage Management Methods

All pesticides used by WS are registered under the FIFRA and administered by the EPA and TDA. All WS personnel in Tennessee who apply restricted - use pesticides are certified pesticide applicators by TDA and have specific training by WS for wildlife damage management pesticide application. The EPA and TDA requires pesticide applicators to adhere to all certification requirements set forth in the FIFRA. No chemicals are 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 for which each pesticide is registered for use. Specifics related to these chemicals and a summary of their use in Tennessee is provided below.

Zinc phosphide (ZP) is a rodenticide which is registered as a Restricted Use Pesticide (RUP) because of its hazard to non-target organisms and its acute oral toxicity (ExToxNet, 2003a). RUPs may be purchased and used only by certified applicators. Some formulations of this rodenticide are classified as highly toxic and require the Signal Word DANGER - POISON on the label. Others are either moderately toxic or only slightly toxic, and thus require the Signal Words WARNING or CAUTION, respectively. Trade names for commercial products containing ZP include Arrex, Commando, Denkarin Grains, Gopha-Rid, Phosvin, Pollux, Ridall, Ratol, Rodenticide AG, Zinc-Tox and ZP.

ZP is an inorganic compound that is used to control rats, mice, voles, ground squirrels, prairie dogs, nutria, muskrats, feral rabbits, and gophers. It is also used as a tracking powder for the control of house mice. It is applied to crop areas and non-crop areas including lawns, golf courses, highway medians, and areas adjacent to wetlands. It may be formulated as a grain based bait, as scrap bait, or as a paste. Rodenticide baits usually contain 0.5 to 2.07% ZP, pastes approximately 5 to 10%.

ZP ingested orally reacts with water and acid in the stomach and produces phosphine gas, which may account in a large part for observed toxicity. In rats, the LD50 for the technical product (80 to 90% pure) is 40 mg/kg, while the LD50 values for lower concentration formulations are slightly higher, indicating lower acute toxicity [160]. In sheep the LD50 ranges from 60 to 70 mg/kg [160]. The compound is nonirritating to the skin and eyes [160]. Rats fed ZP over a wide range of doses experienced toxic effects. Increased liver, brain, and kidney weights, and lesions on these organs, were noted in rats exposed to around 14 mg/kg/day. Body hair loss, reduction in body weight, and reduction of food intake were all noted at 3.5 mg/kg/day. The study was conducted over 13 weeks. There have been no observed symptoms of chronic poisoning due to ZP exposure in humans. However, it has been suggested that chronic exposure to sublethal concentrations for extended periods of time may produce toxic symptoms.

Small amounts of the rodenticide fed to experimental animals may have produced an 80% absorption of zinc as well. Zinc in sufficient concentrations may have an emetic effect. Hypophosphite may be excreted in the urine as a metabolite of ZP. There is little tendency for the compound to concentrate in living tissue, as it is readily converted to phosphine.

ZP is highly toxic to wild birds. The most sensitive birds are geese (LD50 of 7.5 mg/kg for the white-fronted goose). Pheasants, mourning doves, quail, mallard ducks, and the horned lark are also very susceptible to this compound. Blackbirds are less sensitive.

ZP is highly toxic to freshwater fish. The fish species which have been evaluated include bluegill sunfish (LC50 of 0.8 mg/L) and rainbow trout (LC50 of 0.5 mg/L) [1]. Carp were also found to be susceptible to ZP, especially in weakly acidic water.

ZP is also toxic to non-target mammals when ingested directly. Nearly 60 studies have been conducted on the toxicity of this rodenticide to wild animals. Secondary toxicity to mammalian predators (animals eating other animals that had been exposed to the compound) from ZP is rather low, primarily because the compound does not significantly accumulate in the muscles of target species. Some of the toxic effects to predators have been due to the ingestion of ZP that was in the digestive tract of the target organism. Studies on secondary organisms have focused on coyotes, fox, mink, weasels, and birds of prey. Under field conditions, most of the toxic effects to non-target wildlife are due to direct exposures resulting from misuse or misapplication of this rodenticide.

ZP is used in WS MDM programs in Tennessee in accordance with label restrictions in a manner defined by application guidelines on the label. Application procedures and baits used are determined by formulations allowed by labeling and the species targeted. Most ZP applications in Tennessee are for vole damage management, although some applications for Norway rats and other species are conducted.

Aluminum phosphide (ExToxNet 2003b) is a Restricted Use Pesticide so may be purchased and used only by certified applicators. It is in EPA Toxicity Class I and products containing it must bear the signal word DANGER. Aluminum Phosphide was first registered for use in the United States in the late 1950s. Current trade or other names include Fastphos, Fumitoxin, Gastoxin, Max-Kill, Phosfume, Phostoxin and Weevilcide. Al-phos, Celphide, Celphine, Celphos, Detia-Gas-Ex, and Quick Tox may have been used in previous formulations.

Aluminum phosphide is an inorganic phosphide used to control insects and rodents in a variety of settings. It is mainly used as an indoor fumigant at crop transport, storage or processing facilities (or in shipholds, railcars, etc.) for both food and non-food crops. It may also be used as an outdoor fumigant for burrowing rodent and mole control, or in baits for rodent control in crops. Aluminum Phosphide is available in pellet and tablet form, and is also available in porous blister packs, sachets or as dusts. As in the case of Phostoxin, it may be formulated as 55% active ingredient along with ammonium carbamate and inert ingredients.

Phostoxin and aluminum phosphide can cause acute toxicity. Neither are absorbed dermally; rather main routes of exposure are through ingestion and inhalation. They are highly toxic via both these routes. The reported rodent oral LD50 is 11.5 mg/kg for Phostoxin, with that for the technical compound presumably lower. Aluminum phosphide ingested orally reacts with water and stomach acids to produce phosphine gas, which may

account in a large part for observed toxicity. Phosphine generated in the gastrointestinal tract is readily absorbed in to the bloodstream, and it is readily absorbed through the lung epithelium.

In chronic toxicity studies, rats fed aluminum phosphide-fumigated chow averaging 0.51 ppm phosphine residues (approximately 0.43 mg/kg/day) showed no differences from the control animals with respect to blood or urine chemistry and no observable differences in tissue structure. It was reported that workers had probably encountered similar exposures on an intermittent basis (in some cases over as long as a 20 year period) and had yet to show signs of toxicity, which suggests that chronic effects may be minor or have a very long latency period. Inhalation studies were conducted on the effects of phosphine gas on male and female rats exposed at levels of 0.5, 1.5, and 4.5 mg/meters cubed for six hours per day over a 13 week period. Higher exposure groups (7.5 and 15 mg/meters cubed) were added following preliminary acute test results. Results indicated that 15 mg/meters cubed was lethal to 4 out of ten female rats following three days of exposure. Significant treatment-related effects on body weight and decreased food consumption were seen across all treatment groups and sexes, but were reversible. Decreases in red-blood cell counts, hemoglobin, hematocrit and increased platelet counts were seen in male rats of the 4.5 mg/meters cubed group. Dose-related changes in blood urea nitrogen and other clinical parameters were also seen across exposure groups. Post-mortem examination of test animals revealed microscopic lesions in the outer cortex of the kidneys of rats exposed to 15 mg/meters cubed, but not at lower exposure levels. All of these effects were apparently reversible following a four-week recovery period.

Aluminum phosphide is used in Tennessee MDM programs primarily as a small field rodent and mole fumigant for burrows. It is used in accordance with label restrictions in a manner defined by application guidelines on the label. Use in Tennessee is infrequent and amounts used are very small.

Warfarin and Diphacinone. Several anticoagulant rodenticides are used to control commensal rodents and some field rodents around building and other structures. Common anticoagulants include warfarin and diphacinone. Anticoagulants are normally classified as multiple-dose toxicants. For the materials to be effective, animals must feed on the bait more than once. However, some newer formulations only require a single feeding to be effective. Bait for rats and mice must be continuously available for 2 to 3 weeks for effective population control.

Ketamine (Ketamine HCl) is a dissociative anesthetic that is used to capture wildlife, primarily mammals, birds, and reptiles. It is used to eliminate pain, calms fear, and allay anxiety. Ketamine is possibly the most versatile drug for chemical capture, and it has a wide safety margin (Fowler and Miller 1999). When used alone, this drug may produce muscle tension, resulting in shaking, staring, increased body heat, and, on occasion, seizures. Usually, ketamine is combined with other drugs such as xylazine. The combination of such drugs is used to control an animal, maximize the reduction of stress and pain, and increase human and animal safety.

Telazol (tiletamine) is another anesthetic used in wildlife capture. It is 2.5 to 5 times more potent than ketamine; therefore, it generally works faster and lasts longer. Currently, tiletamine can only be purchased as Telazol, which is a mixture of two drugs: tiletamine and zolazepam (a tranquilizer). Muscle tension varies with species. Telazol produces extensive muscle tension in dogs, but produces a more relaxed anesthesia in coyotes, wolves, and bears. It is often the drug of choice for these wild species (Fowler and Miller 1999). This drug is sold in a powder form and must be reconstituted with sterile water before use. Once mixed with sterile water, the shelf life is four days at room temperature and 14 days if refrigerated.

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

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. There are DEA restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified WS personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with DEA and state regulations.

The **Gas Cartridge** is registered as a fumigant by the EPA (Reg. No. 56228-21) and is used in conjunction with denning operations. 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 den. Carbon monoxide euthanasia is recognized by the AVMA as an approved and humane method to kill animals (AVMA 1987).

CO_2 is sometimes used to euthanize mammals which are captured in live traps and when relocation is not a feasible option. Live mammals are placed in a chamber and sealed shut. CO_2 gas is released into the chamber and the animal quickly die after inhaling the gas. This method is approved as a euthanizing agent by the American Veterinary Medical Association. CO_2 gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is also the gas released by dry ice. The use of CO_2 by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

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 are not available for many species which may present damage problems, such as some predators or furbearing species. Repellents are variably effective and depend to a great extent on resource to be protected, time and length of application, and sensitivity of the species causing damage. Table 5-6 below lists some species which may respond to repellents and some repellents which have been registered or determined to be useful in attempting to reduce damage. Again, acceptable levels of damage control are usually not realized unless repellents are used in conjunction with other techniques.

Table B.1. List of Common Mammal Species and Repellents Available

Species (common name)	Repellent*
Chipmunks	Napthalene (in confined spaces); Thiram, bitrax, or ammonium soap applied to flowers, bulbs, seeds., vegetation
House Mice	Napthalene (in confined spaces) Ropel ®
Field Mice	Napthalene
Norway Rats	Ropel ®
Tree Squirrels	Ropel ®, Napthalene, Capsaicin, Registered Polybutenes
Black Bears	Capsaicin Spray
Feral Dogs	Capsaicin and Anise Oil
Bats	Napthalene (limited efficacy); Illumination, Air drafts / ventilation, Sticky deterrents (limited efficacy)
Cottontail Rabbits	Wide variety of taste repellents, mostly thiram based

* All repellents listed may be variably effective in reducing damage and may have other effects on surfaces where applied. and on other animals or plants. Read labels carefully.

APPENDIX C

MEMORANDUM OF UNDERSTANDING AMONG ENTITIES COLLABORATING WITH WILDLIFE SERVICES IN THE MDM PROGRAM IN TENNESSEE

MEMORANDUM OF UNDERSTANDING
AMONG
UNIVERSITY OF TENNESSEE (AGRICULTURAL EXTENSION SERVICE) (UT)
TENNESSEE DEPARTMENT OF AGRICULTURE (TDA)
TENNESSEE DEPARTMENT OF HEALTH (TDH)
TENNESSEE WILDLIFE RESOURCES AGENCY (TWRA)
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC)
AND
UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES (USDA/APHIS/WS)
TO ESTABLISH A COOPERATIVE WILDLIFE DAMAGE MANAGEMENT PROGRAM

ARTICLE 1

The purposes of this Memorandum of Understanding (MOU) are to: 1) establish a cooperative relationship among the UT,TDA,TDH,TWRA,TDEC, and USDA/APHIS/WS for planning, coordinating, and implementing of wildlife damage management policies developed to prevent or minimize damage caused by wild animal species, including threatened and endangered species, to agriculture, horticulture, animal husbandry, forestry, wildlife, natural resources, property, and human health and safety, and 2) facilitate an exchange of information.

ARTICLE 2

Program authorities that allow the cooperators and USDA/APHIS/WS to jointly participate are included under State statutes and the Animal Damage Control Act of March 2, 1931 (7 USC 426, as amended by the Agriculture Appropriations Act of FY2001) respectively. These authorities assign wildlife damage management program direction and coordination of effort among various government and private entities.

ARTICLE 3

UT, TDA, TDH, TWRA, TDEC, and USDA/APHIS/WS agree to:

I. To meet at least annually in order to discuss mutual wildlife damage management program concerns, accomplishments, resource needs, available technology, and procedures. USDA/APHIS/WS will coordinate the annual meetings and any special wildlife damage management meetings related to this agreement.

II. The State Director of USDA/APHIS/WS and their employees, after consultation, will be authorized by the Director of the TWRA to reduce or control wildlife species detrimental to human health and safety, or property under the provision of TCA-70-4-113 and TCA-70-4-115.

III. Requests for wildlife damage management assistance will be referred by the agency receiving the request to TWRA or to USDA/APHIS/WS under the following guidelines:

1. Problems that can be easily and knowledgeably answered by the receiving agency or individual through technical assistance;

2. Damage complaints involving all migratory bird (waterfowl, blackbirds, raptors etc.) and feral bird species (pigeons, starlings, house sparrows) problems should be directly referred to USDA/APHIS/WS;

3. Problems involving wildlife at airports should be directly referred to USDA/APHIS/WS;

4. Situations involving public health threats from wildlife including, but not limited to rabies should be directed to either TDH, or USDA/APHIS/WS.

5. Wildlife Disease management programs for wildlife, particularly rabies monitoring, surveillance, and oral rabies vaccination programs may be conducted by WS and/or in cooperation/conjunction with TWRA, TDH, TDEC, and TDA.

ARTICLE 4

All wildlife damage management control activities will be conducted in accordance with applicable Federal, State, and local laws and regulations.

ARTICLE 5

Signature of this MOU does not constitute a financial obligation on the part of APHIS. Each signatory party is to use its own funds in carrying out the purpose of this MOU.

ARTICLE 6

Pursuant to Section 22, Title 41, United States Code, no member of or delegate to Congress shall be admitted to any share or part of this MOU or to any benefit to arise there from.

ARTICLE 7

This MOU will be in effect upon the date of final signature and shall continue until July 2008. This MOU may be amended at any time by mutual agreement of the parties involved in writing. It may be terminated by any of the parties upon 60 days written notice to the other parties.

ARTICLE 8

This Agreement and any continuation thereof shall be contingent upon the availability of funds appropriated by the Congress of the United States. It is understood and agreed that any monies allocated for the purpose o f this agreement shall be expended in accordance with its terms and in the manner prescribed by the fiscal regulations and/or administrative policies of the entity making the funds available. If fiscal resources are to transfer, a separate agreement must be developed by the parties.

(Date)	Dean University of Tennessee (Agricultural Extension Service)
(Date)	Commissioner Tennessee Department of Agriculture
(Date)	Commissioner Tennessee Department of Health
(Date)	Director Tennessee Wildlife Resources Agency
(Date)	Commissioner Tennessee Department of Environment and Conservation
(Date)	State Director, TN/KY USDA/Animal and Plant Health Inspection Service/Wildlife Services
(Date)	Regional Director, AERO, USDA/Animal and Plant Health Inspection Service/Wildlife Services

APPENDIX D

MATERIAL SAFETY DATA SHEETS AND PESTICIDE LABELS FOR PESTICIDES USED IN THE TENNESSEE WILDLIFE SERVICES MDM PROGRAM

~t~~ '--C'..' ;1) 1!/

MATERIAL SAFETY DATA SHEET GAS CARTRIDGE EPA REGISTRATION NUMBER 56228-2

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: A fused cartridge, that when ignited in a confined woodchuck, ground squirrel, or prairie dog den, produces toxic carbon monoxide gas.

Trade Name: Gas cartridge
Synonyms: Woodchuck Cartridge

MANUFACTURER: united states Department of Agriculture
Animal and Plant Health Inspection Service wildlife Services
Riverdale, MD 20737
Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053 SECTION II. INGREDIENTS AND HAZARDS
Active Ingredients:

Sodium Nitrate 53%
Charcoal ~ Total 81%

Inert Ingredients:

Fullers Earth 10% Borax 9%
Total 19%

Total Ingredients: 100%

Hazards: After fuse ignites cartridge, toxic carbon monoxide gas is produced.

SECTION III. PHYSICAL DATA

Water Solubility: Negligible Specific Gravity: Unknown
Appearance and Odor: Gray-colorEd., hard-compacted granular material in a cardboard tube; practically odorless.

Carbon monoxide, a highly poisonous, odorless, and tasteless gas, is produced after the cartridge is ignited by the fuse.

. P ~~

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point No Data Autoignition Temperature No Data Flammability Limits No Data

Extinguish b¥ covering with water, dry chemical, or soil to exclude alr. Firefighters should wear a self-contained breathing apparatus.

SECTION V. REACTIVE DATA

Gas cartridges are relatively stable; they react with oxidizing agents.

SECTION VI. HEALTH HAZARD INFORMATION

Gas cartridges produce toxic fumes, when burned. Fumes may be harmful if inhaled. Inhalation overexposure can cause headache, nausea, dizziness, weakness, unconsciousness, and death.

FIRST AID: Call 9 physician immediately. If inhaled, and person has poisoning symptoms, transfer victim to fresh air. Have victim lie down and keep warm. If respiration has stopped, use artificial respiration. If available, pure oxygen should be given.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: pick up spilled gas cartridge and replace in original container.

DISPOSAL: Check with local, state, and federal regulations; if acceptable, soak in water, crush, and dispose of in approved landfill; or, bury in at least six inches of loose soil.

SECTION VIII. SPECIAL PROTECTION INFORMATION

In cases of fire in storage areas, self-contained breathing apparatus is necessary for firefighters.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Once ignited by the fuse, the cartridge will burn vigorously until completely spent, and is capable of causing severe burns to exposed skin and clothes. High temperatures and flame can ignite dry grass, leaves, and other flammable materials. **Do not use cartridges in burrows that extend under porches or buildings**. Fuses are very flammable. Store in areas that protect them against contact with materials that may cause ignition.

(I)

MATERIAL SAFETY DATA SHEET LARGE GAS CARTRIDGE EPA REGISTRATION NUMBER 56228-21

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: A fused cartridge, that when ignited in a confined coyote, red fox, or striped skunk den, produces toxic carbon monoxide gas.

Trade Name: Large Gas Cartridge Synonym: Denning Cartridge

MANUFACTURER: United States Department of Agriculture
Animal and Plant Health Inspection Service wildlife Services
Riverdale, MD 20737
Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053 SECTION II. INGREDIENTS AND HAZARDS
Active Ingredients:

Sodium Nitrate 53%
Charcoal 28% Total 81%

Inert Ingredients:

Fullers Earth 10% Borax ~
" Total 19%

Total Ingredients 100%

Hazards: After fuse ignites cartridge, toxic carbon monoxide gas is produced.

SECTION III. PHYSICAL DATA

Water Solubility: Negligible Specific Gravity: Unknown
Appearance and Odor: Gray-colored., hard-compacted :
granular material in a cardboard --;~ tube; practically odorless. :

Carbon monoxide, a highly poisonous, odorless, and tasteless gas, is produced after the cartridge is ignited by the fuse.

SECTION IV. FIRE AND EXPLOSION DATA -Page 1 of 2-

~i

@

Flash Point No Data Autoignition Temperature No Data Flammability Limits No Data

Extinguish b¥ covering with water, dry chemical, or soil to exclude a~r. Firefighters should wear a self-contained breathing apparatus.

SECTION V. REACTIVE DATA

Gas cartridges are relatively stable; react with oxidizing agents.

SEC~ION VI. HEALTH HAZARD DATA

Gas cartridges ~roduce toxic fumes, when burned. Fumes may be harmful ~f inhaled. Inhalation overexposure can cause headache, nausea, dizziness, weakness, unconsciousness, and death.

FIRST AID: Call ~ Dh¥sician immediately. If inhaled., and person has poisoning symptoms, transfer victim tb fresh air. Have victim lie down and keep warm. If respiration has stopped, use artificial respiration. If available, pure oxygen should be given.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Pick up spilled gas cartridge and replace in original container.

DISPOSAL: Check with local, state, and federal regulations; if acceptable, soak in water, crush, and dispose of in approved landfill; or, bury in at least six inches of loose soil.

SECTION VIII. SPECIAL PROTECTION INFORMATION

In cases of fire in storage areas, self-contained breathing apparatus is necessary for firefighters.

SECTION IX. SPECIAL PRECAUTIONS AND 'COMMENTS

Once ignited b¥ the fuse, the cartridge will burn vigorously unt~l completely spent, and is capable of causing severe burns to exposed skin and clothes. High temperatures and flame can ignite dry grass, leaves, and other flammable materials. Do not use cartridges in burrows that extend under porches or buildings. Fuses are very flammable. Store in areas that protect them against contact with materials that may cause ignition.

↑ **LIFT AND PEEL TO ACCESS FULL LABEL** ↑

GAS CARTRIDGE

For control of woodchucks, yellow-bellied marmots ground squirrels, and prairie dogs.

NOT FOR SALE TO PERSONS UNDER 16 YEARS OLD

ACTIVE INGREDIENTS:

Sodium Nitrate	53.0%
Charcoal	28.0%
Total	**81.0%**
INERT INGREDIENTS	**19.0%**
TOTAL	**100.0%**

ENVIRONMENTAL HAZARDS

This product is highly toxic to wildlife. Check all burrows for signs of nontarget species. If present, do not treat burrows.

ENDANGERED SPECIES CONSIDERATIONS

General Considerations

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.

The killing of a member of an endangered species due to use of gas cartridges may result in a fine and/or imprisonment-under the Endangered Species Act. All users of this product must determine whether endangered species are known to occur or might occur in the intended use areas.

Consult the nearest U.S. Fish and Wildlife Service regional office or the appropriate State agency for current information on habitats occupied by endangered species.

Use this product according to the enclosed "Endangered Species Considerations" on the back of this label to protect endangered species.

KEEP OUT OF REACH OF CHILDREN

WARNING

STATEMENT OF PRACTICAL TREATMENT
CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY

If inhaled and person has poisoning symptoms (headache, nausea, dizziness, weakness), transfer victim to fresh air. Have victim lie down and keep warm. If respiration is adequate, recovery will be rapid. If breathing has stopped, use artificial respiration. If available, pure oxygen should be given.

SEE RIGHT PANEL & BACK OF LABEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in cool, dry place away from fire, heat and direct sunlight.

PESTICIDE DISPOSAL: To dispose of unused cartridges, soak in water, crush and bury at least 6" deep in loose soil.

CONTAINER DISPOSAL: Place in trash collection.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

This product may be used to control woodchucks *(Marmota monax)*, yellow-bellied marmots *(M. flaviventris)*, ground squirrels *(Spermophilus spp.)*, black-tailed prairie dogs *(Cynomys ludovicianus)*, white-tailed prairie dogs *(C. leucurus)*, and Gunnison prairie dogs *(C. gunnisoni)* in open fields, non-crop areas, rangelands, reforested areas, lawns, and golf courses. This product may only be used underground in burrow systems. It may not be used to fumigate buildings or other man-made structures. **Do not use in or under buildings or near flammable material, or when either the soil or the vegetation in the area to be treated are in extremely dry conditions.** USE THIS PRODUCT ONLY IN BURROW SYSTEMS KNOWN TO BE IN ACTIVE USE BY THE TARGET SPECIES.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Riverdale, MD 20737
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-2
Net Weight 5.1 oz. (144.6 grams) 2/98

PRECAUTIONARY STATEMENTS HAZARD TO HUMANS AND DOMESTIC ANIMALS

WARNING

After ignition, cartridge produces toxic gases. Fumes may be harmful if inhaled.

CHEMICAL HAZARDS

Once ignited by the fuse, this cartridge will burn vigorously until completely spent and is capable of causing severe burns to exposed skin and clothes, and of igniting dry grass, leaves and other combustible material. **DO NOT USE IN OR UNDER BUILDINGS.**

DIRECTIONS FOR USE (CON'T)

APPLICATION DIRECTIONS

GENERAL PROCEDURES

Locate and plug all entrances to the burrow system except the entrance selected for treatment. Obtain material needed to plug the entrance once the cartridge is applied.

Using a nail at least 1/8" in diameter, puncture the fuse-end cap of the cartridge at the points marked on it. Insert fuse in the center hole into the cartridge. Insure that there is a minimum of 3 inches of exposed fuse.

NOTE: The minimum burn time for these fuses is 5 seconds.

Hold cartridge away from face and body, then light fuse. Place cartridge, fuse-end first, as far into the burrow as possible. Close entrance to burrow immediately. Cover all cracks in soil where smoke escapes.

TARGET-SPECIFIC DIRECTIONS

Woodchucks and yellow-bellied marmots: Consult state wildlife agency before using this product for woodchuck or marmot control. Examine burrows to be sure they are in active use by woodchucks or rockchucks. Burrows are 25 to 30 cm (10 to 12 inches) in diameter. Active burrows have a mound of fresh soil at the main entrance and trails leading to feeding areas. Do not gas if nontarget species are observed entering or using the borrow. It is preferable to control woodchucks or marmots in February and March before young are born and leave the burrows. Fewer nontarget species use the burrows in the spring. Use extra caution when treating woodchuck or marmot burrows in October through January when the burrows may be inhabited by cottontail rabbits. DO NOT treat unoccupied burrows.

Locate all burrow entrances if possible. Select one for treatment and close all others with rock and soil. Light fuse and insert cartridge fuse-end first as far as possible into burrow. Immediately cover opening with rock and soil, being careful not to smother cartridge.

Ground Squirrels and Prairie Dogs: Ground squirrel burrow design varies with the species, soil type, habitat, and climate. Burrows may be as deep as 3 m (9 feet). Diameter varies with the body size of the species and may range from 5 to 25 cm (2 to 10 inches). Prairie dog burrows have large holes and cone shaped mounds and may extend to 5 m (15 feet) below the surface. It is preferable to treat burrows of either genus during the spring breeding season. Observe the area in early morning and late evening during 24 hours before treating burrows to confirm that prairie dogs or ground squirrels are actively using the site. DO NOT treat unoccupied burrows. DO NOT treat burrows with evidence that a snake or weasel has entered in pursuit of prey.

Burrowing owls occasionally use prairie dog burrows for breeding from May through July. Check with the local wildlife agency before using this product to determine the possible presence of burrowing owls in the area to be treated and inspect the colony for signs of burrowing owls. The presence of owls is indicated by the presence of guano or shredded cow and horse dung around the burrow from May through mid-June. If burrowing owls are known or suspected to be present in a colony, DO NOT use the gas cartridge in the colony from May to July.

Collect soil and other material to close burrow openings. Treat each burrow opening by lighting fuse and inserting cartridge into burrow, fuse-end first (make sure burrow is large enough for easy insertion of cartridge before lighting fuse). Cover burrow immediately, taking care not to smother cartridge with loose soil. Immediately cover all nearby cracks in soil or openings from which smoke escapes. Proceed to nearest open burrow and follow same procedure.

OVER

ENDANGERED SPECIES CONSIDERATIONS

(GAS CARTRIDGE, EPA REG. NO. 56228-2)

Use this product according to these instructions to protect endangered species.

Black-footed ferret ***(Mustela nigripes).*** To limit risks to the black-footed ferret and to avoid destruction of it prey base, do not use this product within 4.3 miles (7 kilometers) of any prairie dog town unless the colony is an isolated black-tailed prairie dog town less than 80 acres in size or an isolated white-tailed or Gunnison prairie dog town less then 200 acres in size, or unless the town has been appropriately surveyed, using methods acceptable to the U.S. Fish and Wildlife Service, and found not to contain black-footed ferrets and found by the FWS not to be a suitable site for ferret reintroduction

---

Use of this product within the occupied habitats of the organisms listed immediately below is limited to qualified individuals who have been trained to distinguish dens and burrows of target species from those of nontarget species. Such individuals may be wildlife biologists, certified applicators, representatives of California State or Federal agencies, or agents of county agricultural offices or university extension offices.

Fresno kangaroo rat ***(Dipodomys nitratoides exilis)*** in Fresno and Merced Counties, California;

Giant Kangaroo rat ***(D. ingens)*** in Merced, Fresno, Kings, Tulare, Kern, San Luis Obispo, and Santa Barbara Counties, California;

Stephen's kangaroo rat ***(D. stephensi)*** in Riverside, San Diego, and San Bernardino Counties, California;

Tipton kangaroo rat ***(D. n. nitratoides)*** in Kings, Tulare, Kern, and Fresno Counties, California;

Point Arena mountain beaver ***(Aplodontia rufa nigra)*** in Mendocino County, California;

San Joaquin kit fox ***(Vulpes macrotis mutica),*** unless authorized by the U.S. Fish and Wildlife Service (FWS), in Alameda, Contra Costa, Fresno, Kern, Kings, Merced, Monterey, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Stanislaus, or Tulare counties, California;

Desert Tortoise ***(Gopherus agassizii)*** in Arizona, southern California, southern Nevada, and southern Utah.

Do not use this product within the occupied habitats of the endangered animal types listed immediately below:

Hualapi Mexican vole ***(M. Mexicanus hualapaiensis)*** in Mohave County, Arizona;

Morro Bay kangaroo rat ***(D. heermanni morroensis)*** in San Luis Obispo County, California;

Utah prairie dog ***(Cynomys parvidens)*** in Garfield, Iron, Kane, Piute, Sevier, and Wayne Counties, Utah;

Coachella Valley fringe-toed lizard ***(Uma inornata)*** in the Coachella Valley area of southern California;

Island night lizard ***(Xantusia riversiana)*** on Santa Barbara, San Clemente, and San Nicholas Islands, California.

Blunt-nosed leopard lizard ***(Gambelia silus).*** Do not use this product within the occupied habitat of the blunt-nosed leopard lizard in Fresno, Kern , Kings, Merced, Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, and Stanislaus Counties, California, from October 1 to April 15, unless a specific blunt-nosed leopard lizard protection program for this period is approved by the U.S. Fish and Wildlife Service and fully implemented. Use of this product in occupied habitat of this species from April 15 through September 30 is limited to daylight hours when air temperatures are 77-95° F (20-30°C).

San Francisco garter snake ***(Thamnophis sirtalis tetrataenia).*** Do not use this product within the occupied habitat of the San Francisco garter snake in San Mateo, San Francisco, Santa Clara, And Santa Cruz Counties, California, from November 1 to March 30, unless a specific San Francisco garter snake protection program for this period is approved by the U.S. Fish and Wildlife Service and fully implemented. Use of this product in occupied habitat of this species under such approved programs or from April 1 through October 31 is limited to qualified individuals who have been trained to distinguish dens and burrows of target species from those of nontarget species. Such individuals may be wildlife biologists, certified applicators, representatives of California State or Federal agencies, or agents of county agricultural offices or university extension offices.

Eastern indigo snake ***(Drymarchan corais couperi).*** Do not use this product within habitat types and locales known to support the eastern indigo snake throughout Florida and the coastal plain of Georgia.

Gopher tortoise ***(Gopherus polyphemus).*** Do not use this product in or adjacent to known gopher tortoise occupied habitat west of the Mobile and Tombigbee Rivers in Alabama.

LARGE GAS CARTRIDGE

For control of coyotes (Canis latrans), red foxes (Vulpes vulpes fulva), and striped skunks (Mephitis mephitis) in dens only.

NOT FOR SALE TO PERSONS UNDER 16 YEARS OLD

ACTIVE INGREDIENTS:

Sodium Nitrate	53.0%
Charcoal	28.0%
INERT INGREDIENTS..19.0%	
TOTAL	100.00%

KEEP OUT OF REACH OF CHILDREN

WARNING

STATEMENT OF PRACTICAL TREATMENT

CALL A PHYSICIAN OR POISON CONTROL CENTER IMMEDIATELY!

If inhaled and person has poisoning symptoms (headache, nausea, dizziness, weakness), transfer victim to fresh air. Have victim lie down and keep warm. If respiration is adequate, recovery will be rapid. If breathing has stopped, use artificial respiration. If available, pure oxygen should be given.

SEE LEFT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

WARNING

After ignition, cartridge produces the toxic gas, carbon monoxide. Fumes may be harmful if inhaled.

CHEMICAL HAZARDS

Once ignited by the fuse, this cartridge will burn vigorously until completely spent and is capable of causing severe burns to exposed skin and clothes, and of igniting dry grass, leaves and other combustible materials.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in cool, dry place away from fire, heat and direct sunlight.

PESTICIDE DISPOSAL: To dispose of unused cartridges, soak in water, crush and bury at least 6" deep in loose soil.

CONTAINER DISPOSAL: Place in trash collection.

ENVIRONMENTAL HAZARDS

This product is highly toxic to wildlife. Check all burrows for signs of nontarget species. If present, do not treat burrows.

ENDANGERED SPECIES CONSIDERATIONS

General Considerations

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species.

The killing of a member of an endangered species due to use of gas cartridges may result in a fine and/or imprisonment under the Endangered Species Act. All users of this product must determine whether endangered species are known to occur or might occur in the intended use areas.

Consult the nearest U.S. Fish and Wildlife Service regional office or the appropriate State agency for current information on habitats occupied by endangered species.

Use this product according to thespecific endangered species considerations on the carton insert.

SEE BACKPANEL FOR DIRECTIONS FOR USE

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Hyattsville, MD 20782
EPA Est. No. 56228-ID-1
EPA Reg. Nol 56228-21

Net Weight 10.2 ozs (289.2 grams)

Specimen Label
Not For Reproduction

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS

For control of coyotes *(Canis latrans)*, red foxes *(Vulpes vulpes fulva)*, and striped skunks *(Mephitis mephitis)* in dens only on rangelands, crop and non-crop areas. Do not use near flammable material or inside Buildings. USE ONLY IN DENS IN ACTIVE USE BY THE TARGET SPECIES.

DEN SELECTION

COYOTES First select a den in active use by coyotes for treatment. Coyote dens are normally found in steep embankments or draws and may be concealed in brush. These dens can easily be distinguished from nontarget animal dens (such as badger and fox) by the large size of the den and coyote sign around its entrance. Coyote dens range in size from 9 to 12 inches in width and 12 to 18 inches in height. Typical coyote sign around the entrance includes tracks of the adults before the pups are active outside the den. After the pups become active, their tracks will also be present as well as their scat and the vegetation around the den will be laid flat due to the pups' activity. Active dens may be identified by these signs being fresh and the pups may sometimes be heard upon approaching the entrance. DO NOT use unless the den is occupied by coyotes.

RED FOXES Determine the den location of particular foxes which are preying on livestock or causing other damage. Such predation occurs during rearing of kits. Fox tracks and dung marks of prey lead to the den site usually located in mixed farmlands and woodlots, the brushy fringe of forests, or along marshes or tilled fields. The dens will be marked by remains of prey in addition to tracks and observations. Active dens may be identified by these signs being fresh and the kits may sometimes be heard upon approaching the entrance.

SKUNKS Track individual skunks creating health or safety hazards or depredating endangered or threatened species. Treat a den which the target skunk has entered based on tracking evidence. Do not treat dens under inhabited structures or buildings where toxic gases could reach humans, pets, or domestic animals including livestock.

APPLICATION DIRECTIONS

Make sure cartridge will pass easily into opening. Close any openings to den other than the one to be treated. Obtain material to plug entrance. Then, with a nail at least 1/8" in diameter, puncture cap at end of cartridge at points marked. Insert fuse in one of the center holes. Insure that there is a minimum of 7 inches of exposed fuse. Hold cartridge away from face and body, then light.

NOTE: The minimum burn time for these fuses is 5 seconds.

Place cartridge, fuse-end first, as far into the burrow as possible. Close entrance to burrow immediately. (If burrow is steep, contents of cartridge may flow out of lighter end. If so, place cartridge as deep in burrow as possible with fuse-end up, light, and close burrow.)

Specimen Label
Not For Reproduction

ENDANGERED SPECIES CONSIDERATIONS INSERT

LARGE GAS CARTRIDGE

EPA Reg. No. 56228-21

Use of this product is subject to limitations set forth below for the purpose of protecting endangered species.

Black-footed ferret (*Mustela nigripes*).

To limit risks to the black-footed ferret and to avoid destruction of its prey base, do not use this product within 4.3 miles (7 kilometers) of any prairie dog town unless the colony is an isolated black-tailed prairie dog town less than 80 acres in size or an isolated white-tailed or Gunnison prairie dog town less than 200 acres in size, or unless the town has been appropriately surveyed, using methods acceptable to the U.S. Fish and Wildlife Service, and found not to contain black-footed ferrets and found by the FWS not to be a suitable site for ferret reintroductions.

Fresno kangaroo rat (*Dipodomys nitratoides exilis*) in Fresno and Merced Counties, California;

Giant kangaroo rat (*D. ingens*) in Merced, Fresno, Kings, Tulare, Kern, San Luis Obispo, and Santa Barbara Counties, California;

Stephen's kangaroo rat (*D. stephensi*) in Riverside, San Diego, and San Bernardino Counties, California;

Tipton kangaroo rat (*D. n. nitratoides*) in Kings, Tulare, Kern, and Fresno Counties, California;

Point Arena mountain beaver (*Aplodontia rufa nigra*) in Mendocino County, California;

San Joaquin kit fox (*Vulpes macrotis mutica*), as determined by the U.S. Fish and Wildlife Service (FWS), in Alameda, Contra Costa, Fresno, Kern, Kings, Merced, Monterey, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Stanislaus, or Tulare Counties, California;

Desert tortoise (*Gopherus agassizii*) in Arizona, southern California, southern Nevada, and southern Utah.

Use of this product within the occupied habitats of the organisms listed above is limited to qualified individuals who have been trained to distinguish dens and burrows of target species from those of nontarget species. Such individuals may be wildlife biologists, certified applicators, representatives of California State or Federal agencies, or agents of county agricultural offices or university extension offices.

Hualapai Mexican vole (*M. Mexicanus hualapaiensis*) in Mohave County, Arizona;

Morro Bay kangaroo rat (*D. heermanni morroensis*) in San Luis Obispo County, California;

Utah prairie dog (*Cynomys parvidens*) in Garfield, Iron, Kane, Piute, Sevier, and Wayne Counties, Utah;

(Continued On Back)

10/95

Specimen Label
Not For Reproduction

Coachella Valley fringe-toed lizard (*Uma inornata*) in the Coachella Valley area of southern California;

Island night lizard (*Xantusia riversiana*) on Santa Barbara, San Clemente, and San Nicolas Islands, California.

Do not use this product within the occupied habitats of the above endangered animals:

Blunt-nosed leopard lizard (*Gambelia silus*).

Do not use this product within the occupied habitat of the blunt-nosed leopard lizard in Fresno, Kern, Kings, Merced, Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, and Stanislaus Counties, California, from October 1 to April 15, unless a specific blunt-nosed leopard lizard protection program for this period is approved by the U.S. Fish and Wildlife Service and fully implemented. Use of this product in occupied habitat of this species from April 15 through September 30 is limited to daylight hours when air temperatures are 77-95°F (20-30°C).

San Francisco garter snake (*Thamnophis sirtalis tetrataenia*).

Do not use this product within the occupied habitat of the San Francisco garter snake in San Mateo, San Francisco, Santa Clara, and Santa Cruz Counties, California, from November 1 to March 30, unless a specific San Francisco garter snake protection program for this period is approved by the U.S. Fish and Wildlife Service and fully implemented. Use of this product in occupied habitat of this species under such approved programs or from April 1 through October 31 is limited to qualified individuals who have been trained to distinguish dens and burrows of target species from those of nontarget species. Such individuals may be wildlife biologists, certified applicators, representatives of California State or Federal agencies, or agents of county agricultural offices or university extension offices.

Eastern indigo snake (*Drymarchan corais couperi*).

Do not use this product within habitat types and locales known to support the eastern indigo snake throughout Florida and the coastal plain of Georgia.

Gopher tortoise (*Gopherus polyphemus*).

Do not use this product in or adjacent to known gopher tortoise occupied habitat west of the Mobile and Tombigbee Rivers in Alabama."

Red Wolf (*Canis rufus*);

Gray Wolf (*Canis lupus*).

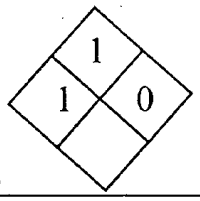
Unless authorized by the U.S. Fish and Wildlife Service, DO NOT use in areas where the above endangered species may have dens.

10/95

Specimen Label
Not For Reproduction

MATERIAL SAFETY DATA SHEET

GAS CARTRIDGE
EPA REGISTRATION NUMBER: 56228-2



Health	1
Fire	1
Reactivity	0

SECTION I. IDENTIFICATION

EFFECTIVE DATE: 02-10-2004

DESCRIPTION: A fused cartridge, that when ignited in a confined woodchuck, Ground squirrel, or prairie dog den, produces toxic carbon monoxide gas

REGISTRANT:
United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services
Riverdale, MD 20737
T: 301-734-7921

MANUFACTURER:
Pocatello Supply Depot
238 E. Dillon Street
Pocatello, ID 83201-6623
T: 208-236-6920

EMERGENCY CONTACT NUMBER: 1-800-535-5053 INFOTRAC

Revised: February 9, 2004

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredients:

Product Name: Sodium Nitrate (53%)
Common Name: sodium niter, Chile saltpeter
Chemical Formula: $NaNO_3$
CAS Number: 7631-99-4

Product Name: Carbon (28%)
Common Name: Charcoal
Chemical Formula: C
CAS Number: 7440-44-0
Total: (81%):

Inert Ingredients (19%):

Hazards: After fuse ignites cartridge, toxic carbon monoxide gas is produced.

SECTION III. PHYSICAL DATA (Combined Active Ingredients)

Appearance and Odor:	Gray-colored, hard-compacted granular material in a cardboard tube; practically odorless.
Boiling Point (760 mm Hg):	n/a
Vapor Pressure (mm Hg):	n/a
Specific Gravity (Water = 1):	Unknown
Solubility in water (By Weight):	Negligible
Melting Point:	n/a
Volatility:	n/a
Vapor Density:	n/a

SECTION IV. FIRE AND EXPLOSION DATA

Flammability:	Combustible
Flash Point:	No data
Flammable Limit:	No data
Extinguishing Media:	Extinguish by covering with water, dry chemical, or soil to exclude air.
Special Firefighter procedures:	Wear self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

Reactivity Data:	Stable
Conditions to avoid:	Heat
Incompatibilities:	Oxidizing agents
Hazardous Decomposition or Byproducts:	carbon monoxides
Corrosivity:	n/a
Hazardous Polymerization:	no

SECTION VI. HEALTH HAZARD INFORMATION

Permissible Exposure Limit (PEL):	No PEL has been established for this product, its active ingredients, or its combustion product (carbon monoxide).
Toxicity: Oral LD_{50} (rat)	None specified for the combined active ingredients.
NTP Carcinogen:	Known: No Anticipated: No

Gas cartridges produce toxic fumes, when burned. Carbon monoxide is the highly poisonous gas, odorless and tasteless. Fumes may be harmful if inhaled. Inhalation overexposure can cause headaches, nausea, dizziness, weakness, unconsciousness, and death.

FIRST AID:	Call a physician immediately.
Eyes:	No known effect if any.
Skin:	No known effect if any.
Inhalation:	If inhaled, and person has poisoning symptoms, transfer victim to fresh air. Have victim lie down and keep warm. If respiration has stopped, use artificial respiration. If available, pure oxygen should be given.
Ingestion:	No known effect if any.

SECTION VII. SPILL, LEAK AND DISPOSAL PROCEDURES

Spill or Leak: Pick up spilled gas cartridge and replace in original container.

Disposal: Check with local, state, and federal regulations; if acceptable, soak in water, crush, and dispose of in approved landfill; or, bury in at least six inches of loose soil.

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

Once ignited by the fuse, the cartridge will burn vigorously until completely spent, and is capable of causing severe burns to exposed skin and clothes. High temperatures and flame can ignite dry grass, leaves, and other flammable materials. **Do not use cartridges in burrow that extend under porches or buildings**. Fuses are very flammable. Store in areas that protect them against contact with materials that may cause ignition.

SECTION IX. SPECIAL PROTECTION INFORMATION

Ventilation:	n/a
Eye Protection:	n/a
Protective Gloves:	n/a
Respiratory Protection:	In case of fire in storage areas, self-contained breathing apparatus is necessary for firefighters.

SECTION X. TRANSPORT INFORMATION

DOT Classification:	Oxidizing solid, n.o.s. (contains sodium nitrite, charcoal) 5.1, UN1479, PG III, OXIDIZER 5.1, Placard all quantities.

SECTION XI. REGULATORY INFORMATION

National Fire Protection Association	Health (Blue):	1 (may be irritating)
	Flammability (Red):	1 (combustible if heated)
	Reactivity (Yellow):	0 (stable)
	Special Hazard (White):	n/a

SECTION XII. OTHER INFORMATION

The above information is believed to be accurate to the best of our knowledge. However, since data, safety standards and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, the United States Department of Agriculture, Animal Plant Health Inspection Service makes no warranty, either expressed or implied, with respect to completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. User should satisfy himself that he has all current data relevant to his particular use.

MATERIAL SAFETY DATA SHEET
LARGE GAS CARTRIDGE
EPA REGISTRATION NUMBER 56228-21

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: A fused cartridge, that when ignited in a confined coyote, red fox, or striped skunk den, produces toxic carbon monoxide gas.

Trade Name: Large Gas Cartridge
Synonym: Denning Cartridge

MANUFACTURER:

United States Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control
(301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredients:

Sodium Nitrate		53%
Charcoal		28%
	Total	81%

Inert Ingredients:

Fullers Earth		10%
Borax		9%
	Total	19%

Total Ingredients 100%

Hazards: After fuse ignites cartridge, toxic carbon monoxide gas is produced.

SECTION III. PHYSICAL DATA

Water Solubility: Negligible
Specific Gravity: Unknown
Appearance and Odor: Gray-colored, hard-compacted granular material in a cardboard tube; practically odorless.

Carbon monoxide, a highly poisonous, odorless, and tasteless gas, is produced after the cartridge is ignited by the fuse.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point	No Data
Autoignition Temperature	No Data
Flammability Limits	No Data

Extinguish by covering with water, dry chemical, or soil to exclude air. Firefighters should wear a self-contained breathing apparatus.

SECTION V. REACTIVE DATA

Gas cartridges are relatively stable; react with oxidizing agents.

SECTION VI. HEALTH HAZARD DATA

Gas cartridges produce toxic fumes, when burned. Fumes may be harmful if inhaled. Inhalation overexposure can cause headache, nausea, dizziness, weakness, unconsciousness, and death.

FIRST AID: Call a physician immediately. If inhaled, and person has poisoning symptoms, transfer victim to fresh air. Have victim lie down and keep warm. If respiration has stopped, use artificial respiration. If available, pure oxygen should be given.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Pick up spilled gas cartridge and replace in original container.

DISPOSAL: Check with local, state, and federal regulations; if acceptable, soak in water, crush, and dispose of in approved landfill; or, bury in at least six inches of loose soil.

SECTION VIII. SPECIAL PROTECTION INFORMATION

In cases of fire in storage areas, self-contained breathing apparatus is necessary for firefighters.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Once ignited by the fuse, the cartridge will burn vigorously until completely spent, and is capable of causing severe burns to exposed skin and clothes. High temperatures and flame can ignite dry grass, leaves, and other flammable materials. Do not use cartridges in burrows that extend under porches or buildings. Fuses are very flammable. Store in areas that protect them against contact with materials that may cause ignition.

-~-

(!)

MATERIAL SAFETY DATA SHEET

GRAIN BAIT CONTAINING ZINC PHOSPHIDE EPA REGISTRATION NUMBERS: 56228-3,14

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: Zinc Phosphide-coated grain for controlling rodent populations.

Trade Name: zinc Phosphide-treated grain bait Synonyms: Grain bait

MANUFACTURER: united states Department of Agriculture
Animal and Plant Health Inspection Service Wildlife Services
Riverdale, MD 20737
Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Zinc Phosphide (Active ingredient) 2.0% or less
Inert ingredients 98.0% or more

Rat Oral LD50: 56228-3: 1.82% ZnP 911 mg/kg 56228-14: 2.0% ZnP 888 mg/kg

No personal exposure limit (PEL) has been established for these products. Normal exposure may be created by dust released while handling; under abnormal conditions decomposition of products
could create a more hazardous situation. If ingested., poisoning willoccur.

SECTION III. PHYSICAL DATA (Active Ingredient)

Specific Gravity (H20=1) Close to 1.0 (depends on coating

densit':()
Volatiles Negligl1ble Solubility in Water Negligible
Appearance and Odor Gray, free-flowing granular powder
with no particular distinctive odor; dust leaves a slight metallic taste in mouth. .

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point Not Applicable Autoignition Tem~. No Data Flammability Lim1ts No Data

Contact with strong oxidizers may cause heat/explosion. Like
every grain product, this can reach self-ignition temperature in storage because of fermentation induced by moisture and warm conditions; finely dispersed dust particles in the air can be a fire or explosion hazard.

Extinguishing Media: Dry chemical: carbon dioxide: powder or foam. Avoid contact with water.

(!) SECTION V. REACTIVE DATA

This is a stable material at room tem~erature, when dry and kept in closed containers. Moisture reacts w~th zinc phosphide to produce phosphine, a highly-toxic and spontaneously-flammable 9as. In contact with acids, the release of phosphine is more rapid, wh~le in contact with oxidizers, the essentially organic nature of the product creates a high risk of fire. Upon burning, it forms zinc oxide and phosphorus oxides. Full protective equipment is required for all clean-up activities if this product is reacting to water or acids.

SECTION VI. HEALTH HAZARD INFORMATION

There is no established PEL for this product or its active ingredient. Inhalation of dust released by this product can be irritating; in large quantities, the zinc phosphide presents a potential risk because of phosphine exposure. Pulmonary symptoms may be produced which could include delayed onset of severe pulmonary edema; treating-physician should be made aware of the presence of zinc phosphide and surveillance maintained for sufficient time in cases of serious exposure.

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

FIRST AID: Call a physician OR Poison Control Center IMMEDIATELY.

IF SWALLOWED: Immediately call a Poison Control Center or physician, or transport the patient to the nearest hospital. Do not drink water. Do not administer anything by mouth or make the patient vomit unless advised to do so by a physician.
IF INHALED: Remove victim to fresh air. Applyartificial respiration if necessary.
IF ON SKIN OR IN EYES: Flush with plenty amounts of water. Remove contaminated clothing and wash affected areas with soap and water. Get medical attention if irritation persists.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Use dust respirator and rubber gloves when cleaning up any spills. Return to the original container, if possible, or a similar-type container. If WET, collect in plastic bags for disposal; maintain good ventilation around collected material to reduce risk of exposure to phosphine. Flush contaminated area with copious amount of water. Neutralize any acid with sodium carbonate.

DISPOSAL: For waste disposable purposes, this product will be considered an acute hazardous waste. Scrap material can be burned in an approved incinerator or buried in an approved landfill in accordance with existing EPA and/or state regulations. Consult with state and local agencies for applicable disposal methods and techniques. If ap~roved by a~propriate agencies, the empty grain bag may be burned or dlsposed of In sanitary landfill.

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

In using this material, follow suitable precautions to control dust, thus preventing fire and health hazards. Use good personal hygiene

--

r::JJ

practices and keep product away from food, beverages, cosmetics, or tobacco products. Users should refrain from smoklng while handling this product.

SECTION IX. SPECIAL PROTECTION INFORMATION

Store in a dry and well ventilated area, away from oxidizing agents and sources of heat or ignition. If handling produces dust, wear dust respirator and goggles or face shield, together with gloves. Follow good housekeeping practices where this material is used or stored to prevent any accumulation or contamination.

MATERIAL SAFETY DATA SHEET

ZINC PHOSPHIDE CONCENTRATE
EPA REGISTRATION NUMBER 56228-6

SECTION I. MATERIAL IDENTIFICATION

DESCRIPTION: Zinc Phosphide Concentrate, 63% active ingredient. SYNONYMS: Zinc Phosphide Rodenticide

MANUFACTURER: United States Department of Agriculture
Animal and Plant Health Inspection Service Wildlife Services, Riverdale, MD 20737 Phone: (301) 734-7921

EMERGENCY CONTACT NUMBER: 1-800-535-5053

SECTION II. INGREDIENTS AND HAZARDS

Zinc Phosphide, powder, (Active Ingredient) 63.20%
(93% technical) , CAS #1314-84-7 Impurities (in technical) 4.72% Magnesium Carbonate, powder (Inert Ingredient) 32.08%
CAS# 546-93-0 100.00% SECTION III. PHYSICAL DATA (Active Ingredient) Specific Gravity (H2O=1) 4.7
Volatiles Negligible Solubility in Water Insoluble
Ap~earance and Odor Grey powder with garlic-like odor Bolling Point 20120 C Melting Point 4200 C

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point Not Applicable Autoignition Tem~. No Data Flammability Limlts No Data

Extinguishing Media: Carbon dioxide, dry sand, or foam.
Special Fire-Fighting Procedures: wear a self-contained breathing apparatus and protective clothing.

Unusual Fire and Explosion Hazards: DO NOT use water. Reaction produces toxic and flammable phosphine gas and forms zinc and phosphorous oxides upon burning.

SECTION V. REACTIVITY DATA

Avoid contact with oxidizing materials, acids, and water. Hazardous decomposition or byproducts produce zinc and phosphorous oxides, and phosphine gas. Hazardous polymerization will not occur.

1/) **SECTION VI. HEALTH HAZARD INFORMATION**

There is no established PEL for this product or its active ingredient. Inhalation of dust released by this product can be irritating; in large quantities, the zinc phosphide presents a potential risk because of phosphine gas exposure. Pulmonary symptoms may be produced which could include delayed onset of severe pulmonary edema; treating physician should be made aware of the presence of zinc phos~hide and surveillance maintained for sufficient time in cases of serlous exposure.

LD-50 Orally in rats: 40.5-46.7 mg/kg

Normal exposure may be created by dust released while handling; under abnormal conditions decom~osition of ~roducts could create a more hazardous situation. If lngestEd., polsoning will occur.

Any person applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

Summary of Risks: this product is classified as an acute rodenticide. Its mode of action involves the evolution of phosphine gas in the stomach which is toxic.

Emergency and First Aid Procedures:

IF SWALLOWED: (primary route of entry) Contact a physician or Poison Control Center, immediately, or transport the patient to the nearest hospital. DO NOT DRINK WATER. DO NOT administer anything by mouth or make the patient vomit unless advised to do so by a physician.

IF INHALED: (lesser primary route of entry) Move person to fresh air; may produce nausea, chills, vomiting, diarrhea, and abdominal pain in extreme cases. May lead to respiratory irritation. Apply artificial respiration and/or administer oxygen, as needed.

SKIN CONTACT: Immediately flush area with large amounts of water; then wash with soap and water for a minimum of 10 minutes.

EYE CONTACT: flush with water for a minimum of 10 minutes. Get medical attention if irritation persists.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL OR LEAK: Restrict access to spill area. Use vinyl or rubber gloves, a NIOSH approved respirator, chemical safety glasses, and protective clothin9. If DRY, return to the original container, i~ possible, or a sim1lar-type container. If WET, collect in plast1c bags for disposal; maintain good ventilation around collected materia~ to reduce risk of exposure to phosphine gas.

DISPOSAL: For waste disposable purposes, this product will be considered an acute hazardous waste. Scrap material can be burned in an approved incinerator or buried in an approved landfill in accordance with existing EPA and/or state and local regulations. Consult with state and local agencies for applicable disposal methods and techniques.

(f) ~

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

In using this material follow suitable precautions to control dust, this ~reventing fire and health hazards. Use good personal,hygiene practlce and keep product away from food, beverages, cosmetlc or
tobacco products. Users should refrain from smoking while handling this product.

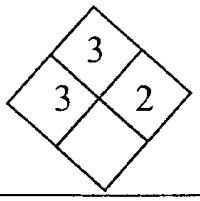
SECTION IX. SPECIAL PROTECTION INFORMATION

Store in dry and well ventilated area, away form oxidizing agents and sources of heat or ignition. If handling produces dust, wear dust
mask and goggles/face shield, and gloves. Follow good housekeeping practices where this material is used or stored to prevent any accumulation or contamination.

Revised 7-18-97, Reviewed 3-8-00

MATERIAL SAFETY DATA SHEET

ZINC PHOSPHIDE CONCENTRATE
EPA REGISTRATION NUMBER: 56228-6



Health	3
Fire	3
Reactivity	2

SECTION I. IDENTIFICATION

EFFECTIVE DATE: 02-1-2004

DESCRIPTION: Zinc Phosphide Concentrate
Synonyms: Zinc Phosphide Rodenticide

REGISTRANT: United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services
Riverdale, MD 20737
T: 301-734-7921

MANUFACTURER: Pocatello Supply Depot
238 E. Dillon Street
Pocatello, ID 83201-6623
T: 208-236-6920

EMERGENCY CONTACT NUMBER: 1-800-535-5053 INFOTRAC
Revised: January 30, 2004

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredient (63.2%):

Product Name:	Zinc Phosphide
Chemical Name:	Zinc Phosphide
Chemical Formula:	P_2Zn_3
CAS Number:	1314-84-7

Normal exposure may be created by dust released while handling; under abnormal conditions decomposition of products could create a more hazardous situation. If ingested, poisoning will occur.

Inert Ingredients (36.8%):

SECTION III. PHYSICAL DATA (Active Ingredient)

Appearance and Odor:	Dark gray, free-flowing granular powder with garlic-like odor
Boiling Point:	2012°C
Vapor Pressure (mm Hg):	No data
Specific Gravity (Water = 1):	4.7
Solubility in water:	Insoluble
Melting Point:	420°C
Volatility:	Negligible
Vapor Density (air = 1):	Phosphine = 1.17

SECTION IV. FIRE AND EXPLOSION DATA

Flammability:	Not Applicable
Flash Point:	n/a
Flammable Limit:	No data
Extinguishing Media:	Use dry chemicals, dry sand, or CO_2.
Unusual Fire and Explosion Hazards:	**Avoid** contact with water or foam. Emits toxic and flammable fumes (phosphine gas) under fire conditions.
Special Firefighter procedures:	Wear self-contained breathing apparatus and full protective clothing to prevent contact with skin and eyes.

SECTION V. REACTIVITY DATA

Reactivity Data:	Normally stable
Conditions to avoid:	Avoid contact with oxidizing materials, acids, and water
Incompatibilities:	Oxidizing agents, acids, and water
Corrosivity:	n/a
Hazardous Polymerization:	Will not occur

SECTION VI. HEALTH HAZARD INFORMATION

Toxicity: Oral LD_{50} (rat):	40.5 - 46.7 mg/kg
Permissible Exposure Limit (PEL):	No PEL has been established for this product or its active ingredient.
NTP Carcinogen:	Known: No Anticipated: No

Inhalation of dust released by this product can be irritating. In large quantities, the zinc phosphide presents a potential risk because of phosphine gas exposure. Any person applying this product and experiences signs or symptoms such as: abdominal pain, nausea, tightness in the chest, or weakness, should be seen by a physician immediately. Pulmonary symptoms may be produced which could include delayed onset of severe pulmonary edema; treating physician should be made aware of the presence of zinc phosphide and surveillance maintained for sufficient time in cases of serious exposure.

FIRST AID

Eyes:	Flush with water for a minimum of 10 minutes. If irritation persists after flushing, get medical attention.
Skin:	Remove contaminated clothing and promptly wash contaminated skin using soap or mild detergent and water for a minimum of 10 minutes. If irritation persists after washing, get medical attention.
Inhalation:	(Lesser primary route of entry) - Remove victim to fresh air. May produce nausea, chills, vomiting, diarrhea, and abdominal pain in extreme cases. May lead to respiratory irritation. Apply artificial respiration and/or oxygen as needed. Get medical attention.
Ingestion:	(Primary route of entry) - Contact a physician or Poison Control Center, immediately, or transport the patient to the nearest hospital. **DO NOT DRINK WATER.** DO NOT administer anything by mouth or make the patient vomit unless advised to do so by a physician.

Summary of Risks: This product is classified as an acute rodenticide. Its mode of action involves the evolution of phosphine, a toxic gas, in the stomach or intestinal tract.

SECTION VII. SPILL, LEAK AND DISPOSAL PROCEDURES

Spill or Leak: Restrict access to spill area. Use vinyl or rubber gloves, a NIOSH approved respirator, chemical safety glasses, and protective clothing. If DRY, return to the original container, if possible, or a similar-type container. If WET, collect in plastic bags for disposal; maintain good ventilation around collected material to reduce risk of exposure to phosphine gas.

Disposal: For waste disposal purposes, this product will be considered as acute hazardous waste. Scrap material can be burned in an approved incinerator or buried in an approved landfill in accordance with existing EPA and/or state and local regulations. Consult with the state and local agencies for applicable disposal methods and techniques.

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

In using this material follow suitable precautions to control dust, this helps to prevent fire and health hazards. Use good personal hygiene practices and keep product away from food, beverages, cosmetic or tobacco products. Users should refrain from smoking while handling this product.

SECTION IX. SPECIAL PROTECTION INFORMATION

Ventilation:	Store in a dry and well-ventilated area, away from oxidizing agents and sources of heat or ignition.
Eye Protection:	dust mask and goggles/face shield
Protective Gloves:	vinyl or rubber
Other Protective Gear:	Long-sleeved garment

SECTION X. TRANSPORT INFORMATION

DOT Classification: RQ, Zinc Phosphide 4.3, UN1714, PG 1, DANGEROUS WHEN WET, POISON, ERG Guide 139, Placard all quantities.

SECTION XI. REGULATORY INFORMATION

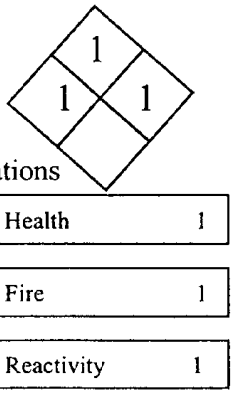
National Fire Protection Association	Health (Blue):	3 (highly toxic combustion products)
	Flammability (Red):	3 (warning, slight explosion hazard)
	Reactivity (Yellow):	2 (unstable, reacts violently with water)
	Special Hazard (White):	n/a

SECTION XII. OTHER INFORMATION

The above information is believed to be accurate to the best of our knowledge. However, since data, safety standards and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, the United States Department of Agriculture, Animal Plant Health Inspection Service makes no warranty, either expressed or implied, with respect to completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. User should satisfy himself that he has all current data relevant to his particular use.

MATERIAL SAFETY DATA SHEET

GRAIN BAIT CONTAING ZINC PHOSPHIDE
EPA REGISTRATION NUMBERS: 56228-3, 14



SECTION I. IDENTIFICATION

EFFECTIVE DATE: 02-1-2004

DESCRIPTION: Zinc Phosphide-coated grain for controlling rodent populations
Synonyms: Grain bait

REGISTRANT: United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services
Riverdale, MD 20737
T: 301-734-7921

MANUFACTURER: Pocatello Supply Depot
238 E. Dillon Street
Pocatello, ID 83201-6623
T: 208-236-6920

EMERGENCY CONTACT NUMBER: 1-800-535-5053 INFOTRAC

Revised: January 30, 2004

SECTION II. INGREDIENTS AND HAZARDS

Active Ingredient (2.0% or less):

Product Name:	Zinc Phosphide
Chemical Name:	Zinc Phosphide
Chemical Formula:	P_2Zn_3
CAS Number:	1314-84-7

No personal exposure limit (PEL) has been established for these grain products. Normal exposure may be created by dust released while handling; under abnormal conditions decomposition of products could create a more hazardous situation. If ingested, poisoning will occur.

Inert Ingredients (98.0% or more):

SECTION III. PHYSICAL DATA (Active Ingredient)

Appearance and Odor:	Gray, free-flowing granular powder with no particular distinctive odor, dust leaves a slight metallic taste in mouth.
Boiling Point:	[Technical] 2012°C
Vapor Pressure (mm Hg):	No data
Specific Gravity (Water = 1):	[Technical] 4.7 [Grain bait] Close to1.0 (depends on coating density)
Solubility in water:	Practically insoluble
Melting Point:	[Technical] 420°C
Volatility:	n/a
Vapor Density (air = 1):	Phosphine = 1.17

SECTION IV. FIRE AND EXPLOSION DATA

Flammability:	Not Applicable
Flash Point:	No data
Flammable Limit:	n/a
Extinguishing Media:	Use dry chemicals, lime, sand, or CO_2. Avoid contact with water.
Unusual Fire and Explosion Hazards:	Contact with strong oxidizers may cause heat/explosion. Like every grain product, this can reach self-ignition temperature in storage due to fermentation induced by moisture and warm conditions. Finely dispersed dust particles in the air can be a fire or explosion hazard.
Special Firefighter procedures:	Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

SECTION V. REACTIVITY DATA

Reactivity Data:	This is a stable material at room temperature, when dry and kept in closed containers. Moisture reacts with zinc phosphide to produce phosphine, a highly-toxic and spontaneously-flammable gas. In contact with acids, the release of phosphine is more rapid, while in contact with oxidizers, the essentially organic nature of the product creates a high risk of fire.
Conditions to avoid:	Heat
Incompatibilities:	Oxidizing agents
Corrosivity:	n/a
Hazardous Polymerization:	Will not occur

SECTION VI. HEALTH HAZARD INFORMATION

Toxicity: Oral LD_{50} (rat):	911 mg/kg (EPA Reg. No. 56228-3: 1.82% ZnP)
Oral LD_{50} (rat):	888 mg/kg (EPA Reg. No. 56228-14: 2.0% ZnP)
Permissible Exposure Limit (PEL):	No PEL has been established for grain bait products. No PEL or other limits recommended for zinc phosphide
NTP Carcinogen:	Known: No Anticipated: No

Inhalation of dust released by this product can be irritating. In large quantities, the zinc phosphide presents a potential risk because of phosphine gas exposure. Any person applying this product and experiences signs or symptoms such as: abdominal pain, nausea, tightness in the chest, or weakness, should be seen by a physician immediately. Pulmonary symptoms may be produced which could include delayed onset of severe pulmonary edema; treating physician should be made aware of the presence of zinc phosphide and surveillance maintained for sufficient time in cases of serious exposure.

FIRST AID:	Call a physician or Poison Control Center IMMEDIATELY.
Eyes or Skin:	Flush with plenty of water. Remove contaminated clothing and promptly wash contaminated skin using soap or mild detergent and water. If irritation is present after flushing or washing, get medical attention.
Inhalation:	Remove victim to fresh air. Apply artificial respiration if necessary. Get medical attention.

Ingestion: Contact a physician or Poison Control Center, immediately, or transport the patient to the nearest hospital. **DO NOT DRINK WATER**. DO NOT administer anything by mouth or make the patient vomit unless advised to do so by a physician.

Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SECTION VII. SPILL, LEAK AND DISPOSAL PROCEDURES

Spill or Leak: Use a dust respirator and rubber gloves when cleaning up any spills. Return to the original container, if possible, or to a similar-type container. If WET, collect in plastic gags for disposal, maintain good ventilation around collected materials to reduce risk of exposure to phosphine. Flush contaminated area with copious amounts of water. Neutralize any acid with sodium carbonate.

Disposal: For waste disposal purposes, this product will be considered as acute hazardous waste. Scrap material can be burned in an approved incinerator or buried in an approved landfill in accordance with existing EPA and/or state regulations. Consult with the state and local agencies for applicable disposal methods and techniques. If approved by appropriate agencies, the empty grain bag may be burned or disposed of in sanitary landfill.

SECTION VIII. SPECIAL PRECAUTIONS AND COMMENTS

In using this material follow suitable precautions to control dust, this helps to prevent fire and health hazards. Use good personal hygiene practices and keep product away from food, beverages, cosmetic or tobacco products. Users should refrain from smoking while handling this product.

SECTION IX. SPECIAL PROTECTION INFORMATION

Ventilation:	Store in a dry and well-ventilated area, away from oxidizing agents and sources of heat or ignition.
Eye Protection:	dust respirator and goggles/face shield
Protective Gloves:	vinyl or rubber
Other Protective Gear:	Long-sleeved garment

SECTION X. TRANSPORT INFORMATION

DOT Classification: Not a DOT regulated material.

SECTION XI. REGULATORY INFORMATION

National Fire Protection Association	Health (Blue):	1 (may be irritating)
	Flammability (Red):	1 (must preheat before ignition)
	Reactivity (Yellow):	1 (normally stable – may react with water)
	Special Hazard (White):	n/a

SECTION XII. OTHER INFORMATION

The above information is believed to be accurate to the best of our knowledge. However, since data, safety standards and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, the United States Department of Agriculture, Animal Plant Health Inspection Service makes no warranty, either expressed or implied, with respect to completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. User should satisfy himself that he has all current data relevant to his particular use.

PRECAUT \RY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. When mixing baits wear an approved respirator. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wear rubber gloves when handling bait. Keep products away from irresponsible individuals, domestic animals, pets, and poultry. Wash hands thoroughly with soap and water after use.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply in a manner where livestock may consume bait. Do not apply in areas where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

IOTICE; The killing of a member of an endangered pecies during Zinc Phosphide baiting operations may esult in a fine and/or imprisonment under the ndangered Species Act. All users of this product must etermine whether endangered species are known to ccur or might occur in the intended use areas. Consult e nearest U.S. Fish and Wildlife Service regional fice or the appropriate State agency for current formation on habitats occupied by endangered ecies. **Use of this product is subject to nitations set forth on the endangered species nsiderations attached to this label for the rpose of protecting endangered species.**

RESTRICTED (.E PESTICIDE

Due to hazards to nontarget species

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE CONCENTRATE

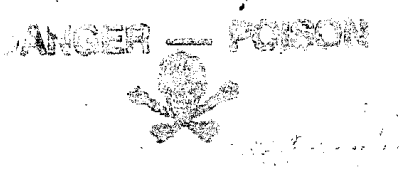
FOR RODENT AND LAGOMORPH CONTROL

For the control of voles, house mice, white-footed mice, Norway rats, roof rats, Polynesian rats, rice rats, Florida water rats, cotton rats, pocket gophers, muskrats, nutria, prairie dogs, wood rats, ground squirrels, marmots and woodchucks, and black-tailed jackrabbits at sites noted in directions for use.

ACTIVE INGREDIENT:

Zinc Phosphide	63.2%
INACTIVE INGREDIENTS:	36.8%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN



STATEMENT OF PRACTICAL TREATMENT

Any persons applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

IF SWALLOWED: Immediately call a Poison Control Center or physician, or transport the patient to the nearest hospital. Do not drink water. Do not administer anything by mouth or make the patient vomit unless advised to do so by a physician.

IF IN EYES: Flush with plenty of water. Get medical attention if irritation persists.

IF ON SKIN: Remove contaminated clothing and wash affected areas with soap and water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
RIVERDALE, MD 20737-1237
EPA Reg. No. 56228-6
EPA Est. No. 56228-ID-1

Net Weight oz.

STORAGE AND DI' .AL

Do not contaminate water, food, or ... by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance

CONTAINER DISPOSAL: Triple rinse (or equivalent) Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Do not apply bait on roads, or over water. Wear rubber gloves when handling bait. Due to compaction, can should be shaken before opening.

READ THIS LABEL Read this entire label and follow all use directions and use precautions.

IMPORTANT

Do not expose children, pets, or other nontarget animals to rodenticides. To help prevent accidents.

1. Store product not in use in a location out of reach of children and pets.
2. Apply bait used in and around buildings in locations out of reach of children, pets, domestic animals, and nontarget wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and by children under six years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining bait. If bait can be shaken from stations when they are lifted units must be secured or otherwise immobilized Even stronger bait stations are needed in areas open to hooted livestock, raccoons, bears, or other potentially destructive animals, or in areas prone to vandalism.
3. Dispose of product container, and unused, spoiled, and unconsumed bait as specified on this label.

4/96

MIXING DIRECTIONS

GRAIN BAITS (wheat, oats, barley, rye, milo, or millet): Mix 1.1 pounds of heated lecithin into 2.3 pounds of heated mineral oil. Slowly blend 3.25 pounds **ZINC PHOSPHIDE CONCENTRATE** into this mixture until evenly blended. Pour new mixture over 93.4 pounds of whole, rolled, or hulled grain and mix thoroughly.

SUNFLOWER SEED BAITS: Mix 1.1 pounds of heated lecithin into 2.3 pounds of heated mineral oil. Slowly blend 3.25 pounds **ZINC PHOSPHIDE CONCENTRATE** into this mixture until evenly blended. Pour new mixture over 93.4 pounds of sunflower seed and mix thoroughly.

MEAT BAITS (ground meat, canned dog or cat food, and/or dry meat-based pet food): Slowly blend 1 ounce of **ZINC PHOSPHIDE CONCENTRATE** into 2 pounds of meat.

FRUIT OR VEGETABLE BAITS (carrots, sweet potatoes, alfalfa, beet tops, cabbage, potato, apples, or pears): Cut root vegetables and fruits into 1/2-inch cubes except when treating muskrat, nutria or jackrabbits. For muskrat, nutria or rabbit control work, cut carrots or sweet potatoes into 2-inch lengths. Cut leafy vegetables into 3 to 6-inch lengths. Drain fluids or juices from bait material. Place 10 pounds of cut up bait material in a 5 gallon container. For prebaiting, mix bait material with vegetable oil at a rate of 1 oz/10 lbs of bait material. Tumble or stir until consistent coverage is attained. For preparation of treated bait, add 7 1/2 level tablespoons (40 grams) of **ZINC PHOSPHIDE CONCENTRATE** per each ounce of oil before mixing the oil with bait material at a rate of 1 oz/10 pounds bait material. Mix bait thoroughly by manual stirring or use of a mechanical tumbling type mixer. Well-mixed bait should display a consistent coverage.

Bait materials resembling human foods must be altered in form by cubing, crushing, balling, or pelletizing so that they are not readily recognizable as food. Also care should be taken to offer the bait in size and form that is the most effective in controlling the pest species and less attractive to nontarget animals.

RODENTS IN AND AROUND BUILDINGS

USE RESTRICTIONS: For control of Norway rats (Rattus norvegicus), root rats (R. rattus), house mice (Mus musculus), whited-footed mice (Peromyscus leucopus), meadow voles (Microtus pennsylvanicus), prairie voles, (M. ochrogaster), mountain voles (M. montanus), California voles (M. californicus), and pine voles (M. pinetorum) in and around homes, and industrial, commercial, agricultural, and public buildings. Do not place bait in areas where there is a possibility of contaminating food or surface that come into direct contact with food. Do not broadcast bait.

Apply bait in locations out of reach of children, pets, domestic animals and nontarget wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and by children under six years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining bait. If bait can be shaken from stations when they are lifted, units must be secured or otherwise immobilized. Even stronger bait stations are needed in areas open to hoofed livestock, raccoons, bears, other potentially destructive animals, or in areas prone to vandalism. Dogs, cats, and other nontarget animals may activiely search for bait, especially when meat-based baits are used.

SELECTION OF TREATMENT AREAS: Determine areas where rats or mice will most likely find and consume the bait. Generally, these are along walls, by gnawed openings, in or beside burrows, in corners and concealed places, between floors and walls, or in locations where rodents or their signs have been seen. Protect bait from rain or snow. Remove as much alternative food as possible.

APPLICATION DIRECTIONS:

Rats: Apply 1 to 2 teaspoons of bait per placement. Grain, fruit or vegetable, and meat-based baits may be used.

Mice and Voles: Apply 1 teaspoon of bait per placement. Space placements at 8- to 12-foot intervals. Grain and fruit or vegetable baits may be used for mice and voles. Meat-based baits may be used for house mice but not for voles or white-footed mice.

Collect and properly dispose of uneaten bait and dead rodents after completion of the baiting program.

VOLES AND WHITE-FOOTED MICE IN ORCHAI GROVES, NURSERIES, VINEYARDS, A NONBEARING FRUIT TREES

USE RESTRICTIONS: For control of meadow, pr California, mountain, and pine voles and white-fc mice in orchards, groves, nurseries, vineyards, ornam plantings, highway medians, and plantings of nonbe fruit trees. In orchards and vineyards, apply only harvest while crop is in a nonbearing phase. Do not a bait to bare ground.

Use baits made from wheat, oats, barley, rye, m sunflower seeds, or fruit baits.

APPLICATION DIRECTIONS:

HAND BAITING:

Fruit Baits: Place 1 or 2 cubes at intervals of 2 fe more in active trails under the cover of gras artificial cover near the bases of infested trees.

Grain or Sunflower Seed Baits: Near the bas each infested tree place teaspoonful quantities of at 2-4 locations, either on surface or at the mouth holes leading directly to underground burrow syste Cover bait artificially (e.g., by using mats or boa or by pulling overhanging grass back into place. not disturb the runway system. Apply bait at rate 3-5 pounds per acre of infested trees.

TRAIL BUILDER BAITING (grain or sunflower-seed l only): Follow manufacturer's instructions for the typ equipment used. Drop teaspoonful quantities of bait a to 5-foot intervals in the artificial trail made by the mac just inside the dripline of both sides of the trees. A bait at rates of 2-3 pounds per acre.

GROUND BROADCAST BAITING (grain or sunflo seed baits only): Under infested trees, broadcast evenly by cyclone seeder or by (rubber-gloved) h Concentrate baiting in areas with the the greatest de of vegetative cover. Apply bait at rates of 6-10 po per acre.

AERIAL APPLICATION (grain baits only): Broadcast at rates of 6-10 pounds per acre. Apply bait immedia after harvest and before leaf fall, when the grass is not matted. Do not apply bait by aerial application to gr vineyards or to any actively growing crop.

VOLES WHITE-FOOTED MICE IN BERRY PRODUCTION AREAS

USE RESTRICTIONS: For control of meadow, prairie, California, mountain, and pine voles and white-footed mice in blueberry, blackberry, gooseberry, boysenberry, raspberry, and strawberry production areas. Apply bait in fair weather after harvest while crop is in a nonbearing phase. Do not apply bait to bare ground unless bait is artificially covered (e.g., by using mats or boards). Do not apply bait by air.

Use baits made from wheat, oats, barley, rye, or millet.

APPLICATION DIRECTIONS:

HAND BAITING: Near the base of each infested vine or bush, place teaspoonful quantities of bait at 2-4 locations, either on the surface or at the mouths of holes leading directly to underground burrow systems. Cover bait artificially (e.g., by using mats or boards) or by pulling overhanging grass back into place. Do not disturb the runway system. Apply bait at rates of 3-5 pounds per acre of infested vines and bushes.

TRAIL BUILDER BAITING: Follow manufacturer's instructions for the type of equipment used. Drop teaspoon quantities of bait at 4- to 5-foot intervals in the artificial trail made by the machine just inside the dripline on both sides of the plants. Apply bait at rates of 3-4 pounds per acre.

GROUND BROADCAST BAITING: Under infested plants broadcast bait evenly by cyclone seeder or by (rubber-gloved) hand. Concentrate baiting in areas with the greatest degree of vegetative cover. Apply bait at rates of 6-10 pounds per acre.

VOLES AND E-FOOTED MICE IN PASTURES, RANGELANDS, AND REFORESTATION AREAS

USE RESTRICTIONS: For control of meadow, prairie, California, mountain, and pine voles, and white-footed mice in pasture, rangeland, and reforestation areas. Fall treatments should occur prior to seed fall or seeding efforts. Spring treatments may be needed to protect emergent seedlings.

Use baits made from wheat, oats, barley, rye or millet.

APPLICATION DIRECTIONS:

HAND BAITING: Place teaspoonful quantities of bait in surface runways or at the mouths of holes leading to underground burrow systems. Apply bait at rates of 3-5 pounds per acre of infested areas.

TRAIL BUILDER BAITING: Follow manufacturer's instructions for the type of equipment used. Drop teaspoonful quantities of bait at 4- to 5-foot intervals in the artificial trail made by the machine. Apply bait at rates of 2-3 pounds per acre.

GROUND BROADCAST BAITING: Apply bait in 20-foot swaths by cyclone seeder or by (rubber-gloved) hand. Apply bait at rates of 6-10 pounds per acre.

AERIAL APPLICATION: Apply bait evenly at rates of 6-10 pounds per acre in infested areas.

VOLES AND WHITE-FOO ICE IN LAWNS GOLF COURSES, NURSERIES, AND NONCRO AREAS

USE RESTRICTIONS: For control of meadow, prairi California, mountain, and pine voles, and white-foote mice in rights-of-way, noncrop areas, lawns, parks, tu and grass fields, nurseries, and golf courses whe significant damage and/or heavy infestations occur. D not apply bait to bare ground. Do not apply bait by air.

Use baits made from wheat, oats, barley, rye or millet.

PREBAITING: Prebaiting with untreated grain of th type to be used for treated baiting may lead to mor consistent acceptance of treated bait. Prebaits shoul be applied, at rates appropriate for treated baiting, 2-: days before toxic baits are to be used.

APPLICATION DIRECTIONS:

HAND BAITING: Place teaspoonful quantities of bai in surface runways or at the mouths of holes leading tc underground burrow systems. Apply bait at rates of 3- 5 pounds per acre of infested area.

TRAIL BUILDER BAITING: Follow manufacturer's instructions for the type of equipment used. Place teaspoonful quantities of bait at 4- to 5-foot intervals in the artificial trail made by the machine. Apply bait a rates of 2-3 pounds per acre.

GROUND BROADCAST BAITING: Apply bait evenly by cyclone seeder or by (rubber-gloved) hand. Apply bait at rates of 6-10 pounds per acre.

CAL. . AND MOUNTAIN VOLES IN SUGAR BEETS *(California only)*

USE RESTRICTIONS: For control of California voles and mountain voles in sugar beets. Grazing of sugar beets tops by livestock is prohibited. Do not apply bait within 30 days of harvest. Use baits made from wheat, oats, barley, rye, or millet.

PREBAITING: Prebaiting with untreated grain if the type to be used for treated baiting may lead to more consistent acceptance of treated baiting, 2-3 days before treated baits are to be used.

APPLICATION DIRECTIONS:

BAITING: Apply bait by mechanical spreader or aircraft through infested areas at rates of 5-10 pounds per acre, depending on the density of the infestation. If the field was prebaited, delay baiting until prebait has been accepted by the target species. Do not make more than two applications of zinc phosphide baits to the same field in one crop cycle.

RATS . ARCANE FIELDS

USE RESTRICTIONS: For control of Polynesian rats (Rattus exulans), Norway rats, roof rats, rice rats (Oryzomys palustris), Florida water rats (Neofiber alleni) and cotton rats (Sigmodon hispidus), in sugarcane fields. Do not apply bait more than four (4) times to any one area during the entire crop cycle. Do not apply bait within 30 days of harvest. Use baits made from wheat, oats, barley, rye, milo, or millet.

APPLICATION DIRECTIONS:

PREBAITING: Prebaiting with untreated grain of the type to be used for treated baiting usually is recommended to enhance acceptance of treated bait by rats. Prebaits should be applied, at a rate of 3 pounds per acre, 1-2 weeks before treated baits are to be used.

BAITING: Broadcast bait by aircraft, ground-driven equipment, or by (rubber-gloved) hand at a rate of 5 pounds per acre. The total rate of application to any one area may not exceed 20 pounds of bait for an entire crop cycle.

ROOF AND NORWAY F MACADAMIA ORCHARDS *(Hawaii only)*

USE RESTRICTIONS: For control of roof rats Norway rats in Macadamia nut orchards. Do not a bait more than four times to any orchard area in one year. Except for burrow baiting (see below), do apply bait within 30 days of any harvesting round. not apply bait by air. Use baits made from wh oats, barley, rye, or millet.

APPLICATION DIRECTIONS:

BAIT STATIONS: Baits may be placed in bait sta located in trees or on the ground at the bases of tr Place 1-2 teaspoons (4-8 grams) of bait in each station. Uneaten bait must be removed from trees to shaker harvest of from ground prior to mechan harvest.

BURROW TREATMENT: Place 1-2 teaspoons grams) of bait in each burrow entrance. No prehar interval is required if nuts are not retrieved from ground. If nuts are to be retrieved from the ground, 30-day preharvest interval applies.

BROADCAST BAITING: Broadcast bait by gro driven equipment or by (rubber-gloved) hand at a of 5 pounds per acre. The total rate of applicatio any one area may not exceed 20 pounds of bait acre for an entire crop cycle.

WOODRATS

USE RESTRICTIONS: For use to control eastern woodrats (Neotoma floridana), southern plains woodrats (N. micropus), whitethroat woodrats (N. albigula), desert woodrats (N. lepida), Mexican woodrats (N. mexicana), dusky-footed woodrats (N. fuscipes), and bushytail woodrats (N. cinerea) in rangelands, pastures, noncrop rights-of-way adjacent to canals or waterways, dormant orchards, tree farms, and rural agricultural buildings. Do not apply bait by air. Use baits made from wheat, oats, barley, rye or millet.

APPLICATION DIRECTIONS:

BAITING

Outdoors: When baiting outside at the sites noted above, scatter teaspoon amounts (4-5 grams) of bait over one square foot of ground in runway near or leading to the entrance of the den.

In Rural Agricultural Buildings: Place one ounce of bait in a shallow open container near each point of woodrat activity. if you are able to bait in areas not accessible to children, pets, domestic animals, and wildlife, and, where contamination of food or feed will not occur. In all other locations bait must be placed in tamper-resistant bait stations secured, if necessary, to prevent bait from being spilled out of the unit. Check stations frequently for continued presence of bait and to remove any sticks or other foreign objects brought into stations by woodrats.

Replenish bait as long as there is continued evidence that woodrats are taking it. Remove all bait when woodrats cease to accept it.

KANGAROO RATS

USE RESTRICTIONS: For control of Ord's kangaroo rats (Dipodomys ordii), Merriam's kangaroo rats (D. merriami), and banner-tailed kangaroo rats (D. spectabilis) in rangelands, pastures, and noncrop areas. Do not broadcast bait. Do not apply bait by air. Do not apply bait to bare ground unless artificial cover is added. Use baits made from wheat, oats, barley, rye, or millet.

APPLICATION DIRECTIONS:

HAND BAITING: Place one tablespoon (about 12 grams) of bait in two locations on opposite sides of mounds, concentrating on the feeding runs near entrances to burrows.

[illegible]TS AND NUTRIA

USE RESTRICTIONS: For control of muskrats (Ondatra zibethica) and nutria (Myocaster coypu) in areas where these animals damage levees, irrigation ditchbanks, or water impoundments, or where they might feed on rice, soybean, milo or corn crops, or damage turf. Do not apply baits directly where crops are growing. Do not apply baits where nontarget species might be adversely affected. Check with State and local authorities to determine whether there are any legal restrictions against poisoning muskrats or nutria. Use baits made from carrots, sweet potatoes, apples, or pears.

APPLICATION DIRECTIONS:

PREBAITING: Before preparing or using treated baits, prebait by applying carrots, sweet potatoes, apples, or pears, prepared in the manner indicated above in the FRUIT OR VEGETABLE BAITS section. Cut carrots or sweet potatoes into 2-inch lengths.

When preparing to control muskrats or nutria on large waterways (large streams, canals, ponds, lakes, and bayous), place 10 pounds of prebait on large (4 feet by 4 feet) rafts spaced 1/4-1/2 mile apart. On small waterways (small streams, irrigation ditches), place 4 pieces of prebait on rafts that are a least 6 inches by 6 inches. Anchor rafts appropriately for sizes of rafts and the bodies of water in which they are placed, considering factors such as size, depth, winds, current, and potential for flooding. Locate rafts near burrows and runways used by muskrats and nutria or near places where these animals are causing damage.

Prebait may also be placed on the ground beside burrows or runways used by muskrats or nutria. Use 2-5 pieces of prebait at ground locations.

Check each raft or ground placement daily to asses the amount of prebait that has been taken.

BAITING: When at least half of the prebait has been taken by the target species, replace prebait with treated bait of the same vegetable or fruit carrier.

Large Rafts: If all or nearly all of the prebait has been taken, apply 10 pounds of treated bait to the raft. If 1/2-3/4 of the prebait has been taken, remove the remainder and apply 5 pounds of treated bait. If most of the treated bait is eaten on the first night, replenish bait to the amount originally used. Regardless of the level of initial consumption of treated bait, keep at least 5 pounds of treated bait present for 72-hour period.

Small Rafts and Ground Placements: Once prebaits have been eaten, apply 4 pieces of treated bait per raft or ground placement. Maintain this level of baiting for a 72-hour period.

Collect and properly dispose of uneaten bait and observed dead rodents after completion of the control program. Terminate the program if nontarget animals are consuming baits. Extend the program beyond 72 hours only if there is evidence that target animals still are consuming bait or if factors other than bait shyness (e.g., weather) appear to have limited bait acceptance on one or more days.

Do not treat the same area with zinc phosphide bait at intervals of less than 30 days.

POCKET G[illegible]S

USE RESTRICTIONS: For control of pocket gophe (Geomys spp., Thomomys spp., or Pappogeomy spp.) in rangelands, croplands, reforestation area parks, lawns, and noncrop areas. Bait must applie directly into underground burrow systems. Do n broadcast bait or apply it above ground in any wa Use baits made from wheat, oats, barley, rye, or millet

APPLICATION DIRECTIONS:

HAND BAITING: Remove burrow plug from flat sid of fan-shaped mound or locate the main burrow b probing with a metal rod or wooden stick. Begi probing 6-12 inches from the flat side of the moun until the main underground tunnel is located. So resistance against the probe will drop abruptly when th tunnel is entered. Through the opening created b probing or removing the plug, insert one teaspoonful (grams) of bait into the main tunnel. Bait may b applied with a manually-operated mechanical probe Close the tunnel with a rock, sod, or other object tha will exclude light. Take care that no soil fails in an covers the bait. One pound of bait will treat 1-8 acres depending upon pocket gopher density. Pick up an bury all spilled bait.

BURROW BUILDER: Follow manufacturer' instructions for the type of equipment used. Apply 1-2 pounds of bait per acre into tunnels created by the burrow builder. Space artificial tunnels 20 to 30 fee apart. Apply bait by this method only when soi condition is proper to insure formation of good artificia burrows. Pick up and bury all spilled bait.

GROUND SQUIRRELS

USE RESTRICTIONS: For control of whitetail antelope squirrell (Ammospermophilus leucurus), Townsend's ground squirrel (Spermophilus townsendii), California ground squirrel (S. beecheyi), Columbian ground squirrel (S.columbianus), Franklin's ground squirrel (S. franklinii), golden-mantled ground squirrel (S. lateralis), Richardson's ground squirrel (S. richardsonii), round-tailed ground squirrel (S. tereticaudus), thirteen lined ground squirrel (S. tridecemlineatus), rock squirrel (S. variegatus), Unita ground squirrel (S. armatus), Belding's ground squirrel (S. beldingi), Idaho ground squirrel (S. brunneus), Wyoming ground squirrel (S. elegans), and Washington ground squirrel (S. washingtoni) in noncrop rights-of-way, dormant orchards and vineyards, ornamentals, cemeteries, highway medians, golf courses, nurseries, canal and ditch banks, rangelands, pastures, lawn and turf grasses, and along fence rows. Do not apply bait on roads, near residential areas, or over water. Do not apply bait by air.

Do not treat the same area with zinc phosphide bait at intervals of less than 30 days. Grain baits are not recommended for controlling Belding's ground squirrel.

Use baits made from grain or fruit and vegetable baits noted in mixing directions.

APPLICATION DIRECTIONS:

PREBAITING: Prebaiting with untreated grain of the type to be used for preparing treated bait is strongly recommended as a means of enhancing acceptance of treated bait. Apply prebait 2-4 days before treated bait is to used. Prebait should be exposed in the same manner as is to be used for applying treated bait. If treated bait is to be applied manually, scatter a teaspoon amount (4 grams) on the ground near each burrow or runway. If treated bait is to be ground-broadcast, broadcast prebait at a rate of 6 pounds per acre.

Before prebait is applied, it may be helpful to scatter small amounts of several different grains in the infested area to determine: (1) whether the ground squirrels are ready to accept grains; (2) which grain they seem to prefer; and (3) whether there is significant consumption of grain by nontarget species.

BAITING

Spot Baiting: After all or most of the prebait has been taken by the target species, scatter a tablepoon amount of treated bait around each active burrow or runway. Allow bait to fall through grass to ground surface but do not apply to bare ground. Do not place bait in heaps or piles.

Ground-Broadcast Baiting: Broadcast toxic bait only after all or most of the prebait has been consumed. Apply bait using hand-powered or ground driven broadcasting equipment in swaths 10-15 feet wide in infested areas. Apply treated bait at rates of 6 pounds per acre or less, depending upon rate of acceptance of prebait and ground squirrel density.

Bury spilled or unused bait, and observed animal carcasses within three days after bait application.

IE DOGS

USE RESTRICTIONS: For control of black-tailed prairie dogs (Cynomys ludovicianus), white-tailed prairie dogs (C. leucurus), and Gunnison prairie dogs (C. gunnisoni) on rangelands and pastures in the western United States (North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Utah, Wyoming, and Montana) where nontarget species, especially the black footed ferret, will not be at risk (see "ENDANGERED SPECIES CONSIDERATIONS" on this label). Do not use this product to control the endangered Utah prairie dog (see "ENDANGERED SPECIES CONSIDERATIONS"). Do not apply bait by air. Baits may only be applied from mid-summer through mid-winter (July to February) of the following year. Do not apply zinc phosphide bait more than once during this period.

Use baits made from wheat, oats, barley, rye, and millet.

APPLICATION DIRECTIONS:

PREBAITING: Prebaiting with untreated grain of the type to be used for preparing treated bait is required. Apply prebait 1-2 days before treated bait is to be used. Scatter a teaspoon amount (4 grams) of prebait on ground near each active mound.

Before prebait is applied, it may be helpful to scatter small amounts of several different grains in the infested area to determine: (1) whether the prairie dogs are accepting grains; (2) which grain they seem to prefer; and (3) whether there is significant consumption of grain by nontarget species.

OBSERVATION: Before and during prebaiting observe infested area regularly and systematically to assess presence and potential for exposure of nontarget animals to treated bait. If nontarget animals that might be harmed by the bait are observed in the infested area, do not apply treated bait.

BAITING

After all or most of the prebait has been taken by prairie dogs, scatter a teaspoon amount (no more than 4 grams) of treated bait in 6-inch (diameter) bait spots at the edges of each active mound or in adjacent feeding areas.

Bury spilled or unused bait and observed animal carcasses within three days after bait application.

WOODCHUCKS, YELLOWE MARMOTS, AN BLACK-TAILED JACKRABBITS

USE RESTRICTIONS: For control of woodchuck (Marmota monax), yellowbelly marmots (M flaviventris), and black-tailed jackrabbits) Lepu californicus) in rangelands, pastures, and noncro areas. Do not apply baits made from this product i food- or feed-crop areas. Do not apply baits by air Use baits made from fruit or vegetables.

APPLICATION DIRECTIONS:

PREBAITING: Prebaiting with untreated 1- to 2-incl pieces of fruit or vegetable is recommended to enhanc acceptance of treated bait by target species and t assess potential for risks associated with bait take b nontarget species. Treat fruit or vegetable pieces wit corn oil.

Marmots Place 4-5 pieces of prebait under roc overhangs, in protected crevices, or at the sides o burrows dug in areas that are not rocky. Plac prebait in the morning.

Jackrabbits: Prepare furrow adjacent to field being damaged or other areas from which it i desired to exclude black-tailed jackrabbits. Plac 6-9 fruit or vegetable pieces per site.

BAITING

Apply treated bait in locations where prebait wa accepted, using the same procedures that were employed for prebaiting.

Collect and properly dispose of uneaten bait and anima carcasses after completion of the baiting program which should be set at 72 hours under mos circumstances. Extend the baiting period only i circumstances other than bait shyness appeared t have adversely affected bait acceptance on one o more days. Shorten baiting period if animals othe than marmots or black-tailed jackrabbits are takin baits.

ENDANGERED SPECIES ATTACHMENT

The endangered species considerations listed in this attachment must be regarded as part of the label for **Zinc Phosphide Concentrate for Rodent and Lagomorph Control.**

Do not use this product outdoors within 100 yards of the occupied habitats of the following endangered animals:

Alabama beach mouse (Peromyscus polionotus ammobates) in Baldwin County, Alabama;

Anastasia Island beach mouse (P. p. phasma) on Anastasia Island, St. John's County, Florida;

Choctawhatchee beach mouse (P. p. allophrys) in Wilton and Bay counties, Florida:

Perdido Key beach mouse (p. p. trissyllepsis) in Baldwin County, Alabama, and in Escambia County, Florida;

Southeastern beach mouse (P. p. niveaventris) in Volusia and St. Lucie counties, Florida;

Key Largo cotton mouse (P. gossypinus allapaticola) on Key Largo, Monroe County, Florida;

Key Largo woodrat (Neotoma floridana smalli) on Key Largo, Monroe County, Florida;

Amargosa vole (Microtus californicus scirpensis) in Inyo County, California;

Florida salt marsh vole (M. pennsylvanicus dukecampbelli) in the Waccasassa bay area in Levy County, Florida;

Hualapai Mexican vole (M. mexicanus hualpaiensis) in Mohave County, Arizona;

Fresno kangaroo rat (Dipodomys nitratoides exilis) in Fresno and Merced counties, California;

Giant kangaroo rat (D. ingens) in Merced, Fresno, Kings, Tulare, Kern, San Luis Obispo, and Santa Barbara counties, California;

Morro Bay kangaroo rat (D. heermanni morroensis) in San Luis Obispo County, California;

Stephen's kangaroo rat (D. stephensi) in Riverside, San Diego, and San Bernardino Counties, California;

Tipton kangaroo rat (D. nitratoides nitratoides) in Kings Tulare, Kern, and Fresno counties;

S[illegible]sh harvest mouse (Reithrodontomys raviventris) in Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, San Mateo, and San Francisco counties, California;

Silver rice rat (Orysomys palustris natator, aka O. argentatus) on Big Torch, Johnston, Middle Torch, Raccoon, Saddlebunch, Little Pine, Summerland, and Water keys in Monroe County, Florida:

Point Arena mountain beaver (Aplodontia rufa nigra) in Mendocino County, California:

Delmarva Peninsula fox squirrel (Sciurus niger cinereus) on the Delmarva Peninsula in Delaware, Maryland, and Virginia;

Lower Keys rabbit (Sylvilagus palustris hefneri) on Sugarloaf, Welles, Annette, Hopkins, Geiger, Boca Chica, and Big Pine keys in Monroe County, Florida.

Do not use this product outdoors within 100 yards of occupied habitat of the following organisms unless the bait is used in tamper-resistant bait stations capable of excluding the endangered animal in question:

Attwater's greater prairie chicken (Tympanuchus cupido attwateri) in Austin, Fort Bend, Galveston, and Refugio counties, Texas;

Nene (hawaiian goose, (Nesochen sandvicensis) on the islands of Hawaii, Kauai, and Maui; and

Mariana crow (Corvus kubaryi) on Guam.

Do not use this product outdoors within the occupied habitats of the following endangered animals:

Carolina northern flying squirrel (Glaucomys sabrinus coloratrus) in North Carolina and Tennessee; and

Utah prairie dog (Cynomys parvidens) in Garfield, Iron, Kane, Wayne, Sevier, and Piute counties, Utah;

Do not use this Product outdoors within the occupied habitats of the following organisms unless the bait is used in tamper-resistant bait stations capable of excluding the endangered animal in question:

Louisiana black bear (Ursus americanus luteolus) in Louisiana and Mississippi;

San Joaquin kit fox (Vulpes macrotis mutica) in Alameda, Contra Costa, Fesno, Kern, Kings, Merced, Monterey, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Stanislaus, or Tulare counties, California;

Alala (Hawaiia[illegible] Corvus hawaiie[illegible] the island of Hawaii);

Mississippi sandhill crane (Grus car[illegible] pulla) in Jackson County, Mississippi;

Puerto Rican plain pigeon (Columba wetmore) in Puerto Rico;

Yellow-shouldered Blackbird (A[illegible] xanthomus) in Puerto Rico: and

San Clemente sage sparrow (Amphisp[illegible] clementeae) on San Clemente Island, C[illegible]

Do not use this product in habitats occu[illegible] occasionally visited by whooping cranes [illegible] americana) during the period from 30 days be[illegible] expected arrival of cranes to 30 days after the [illegible] their usual departure, unless the bait is ap[illegible] tamper-resistant bait stations that appear [illegible] capable of excluding cranes.

Do not use this product within 7 kilometer[illegible] miles) of any prairie dog town to limit risks [illegible] black-footed ferret (Mustela nigripes) from e[illegible] to Zinc Phosphide or destruction of its pre[illegible] unless the colony is an isolated black-tailed [illegible] dog town less than 80 acres in size or an [illegible] white-tailed or Gunnison prairie dog town le[illegible] 200 acres in size, or unless the town ha[illegible] appropriately surveyed, using methods accep[illegible] the U.S. Fish and Wildlife Service, and found [illegible] FWS not to be a suitable site for [illegible] reintroductions.

To protect the Hawaiian coot (Fulica americ[illegible] and the Hawaiian duck (Anas wyvilliana), do [illegible] this product within 100 yards of any water or [illegible] on or adjacent to any golf course or turf farm [illegible] islands of Kauai, Oahu, or Maui, unless the b[illegible] a tamper-resistant bait station believed to be [illegible] of excluding these birds.

Unless the local U.S. Fish and Wildlife Servic[illegible] has determined that there are no gray wolves [illegible] lupus) or grizzly bears (Ursus actos horribilus) [illegible] general vicinity of bait applications in A[illegible] Colorado, Idaho, Michigan, Minnesota, Montan[illegible] Mexico, Oregon, Wisconsin, and Wyoming, [illegible] apply this product outdoors within occupied ha[illegible] these species unless the bait is applied in t[illegible] resistant bait stations capable of excluding [illegible] species.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use. Use rubber gloves if contact with skin may occur when mixing or placing baits. Wash all utensils, spoons, or measuring devices thoroughly.

ENVIRONMENTAL HAZARDS

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, ponds, or streams. This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.

Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)*
Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Bend, Galveston, Goliad, Harris, Refugio, Victoria, Waller, and Wharton.

Yellow-Shouldered Blackbird *(Agelaius xanthomus)* and **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)*
Do not use in critical habitat except in tamper-proof bait boxes within 6.3 miles of central Aguirre Lago Cicra, Ceiba, San German; 9.4 miles of La Esperanza; south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island, Puerto Rico.

Utah Prairie Dog (Cynomys parvidens)
Do not use this product in critical habitat of the Utah prairie dog. (Utah)

Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)*
Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River. (California)

Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)*
Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay. (California)

Aleutian Canada Goose *(Branta canadensis leucopareia)*
Do not use this product from October to March in the federally closed goose hunting areas in the State of California. See current duck and goose hunting game laws for current map.

RESTRICTED USE PESTICIDE

DUE TO HIGH ACUTE TOXICITY

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE ON WHEAT

FOR MOUSE CONTROL

For the control of meadow voles, prairie voles, pine voles, mountain voles, and white-footed mice in ornamentals, orchards, vineyards, rangelands, forests, lawns, golf courses, parks, nurseries, and highway medians.

ACTIVE INGREDIENT:	
Zinc Phosphide	1.82%
INACTIVE INGREDIENTS:	98.18%
TOTAL	100.00%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

Any persons applying zinc phosphide products and experiencing signs and symptoms such as nausea, abdominal pain, tightness in the chest, or weakness, should be seen by a physician immediately.

IF SWALLOWED: Immediately call a Poison Control Center or physician, or transport the patient to the nearest hospital. Do not drink water. Do not administer anything by mouth or make the patient vomit unless advised to do so by a physician.

IF IN EYES: Flush with plenty of water. Get medical attention if irritation persists.

IF ON SKIN: Remove contaminated clothing and wash affected areas with soap and water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Riverdale, MD 20737-1237
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-3

Net Weight lbs.

4/98

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of bags in a sanitary landfill or by incineration if allowed by State and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Do not apply bait on roads, over water, or where plants are grown for food or feed. Wear rubber gloves when handling bait. Due to compaction, can should be shaken before opening.

ORCHARDS, GROVES, NURSERIES, VINEYARDS, ORNAMENTALS, AND NONBEARING FRUIT TREES

USE RESTRICTIONS: For control of meadow, prairie, and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* in orchards, groves, nurseries, vineyards, ornamentals, and nonbearing fruit trees. In orchards and vineyards, apply bait after harvest while in a nonbearing phase.

HAND BAITING: Near the base of each infested tree, place teaspoonful quantities of bait at 2-4 locations, either on surface or at the mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass back into place. Do not disturb the runway system. Bait at the rate of 3-5 pounds per acre of infested trees.

TRAILBUILDER: Drop teaspoonful quantities of bait at 4-5 foot intervals in the artificial trail made by the machine just inside the drip line on both sides of the trees. Apply at the rate of 2-3 pounds per acre.

BROADCAST BAITING: Under infested trees broadcast evenly by cyclone seeder or by hand. Concentrate in areas with the heaviest vegetative cover. Apply at the rate of 6-10 pounds per acre.

AERIAL APPLICATION: Broadcast bait at a rate of 6-10 pounds per acre. Bait applications should be made immediately after harvest and before leaf fall, when the grass is not yet matted. Do not make broadcast application of bait over growing crops when the bait may lodge on the plant. Do not apply to bare ground.

See back panel for additional Directions For Use

DIRECTIONS FOR USE
(Continued)

RANGELANDS AND REFORESTATION SEEDING AREAS

USE RESTRICTIONS: For control of meadow, prairie, and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* during rangeland and reforestation seedings and plantings. Treatment at the rate of 6-10 pounds per acre should occur in the fall before the seed fall or seeding efforts. Treatment may be necessary in spring to protect emergent seedlings.

BAITING: For hand baiting place teaspoonful of bait in surface runways or in burrow entrances. If a trailbuilder is used, apply at the rate of one teaspoonful of bait at 4-5 foot intervals. For broadcast baiting, apply in 20 foot swaths evenly by hand or with a cyclone seeder. For aerial application, broadcast bait at the rate of 6-10 pounds per acre.

NONCROP AREAS

USE RESTRICTIONS: For control of meadow, prairie, and pine voles *(Microtus spp.)* and white-footed mice *(Peromyscus spp.)* in non-crop areas such as right-of-ways, lawns, parks, nurseries, and golf courses when damage or heavy mouse infestations occur. Prebaiting with 3-5 pounds per acre of untreated wheat 2-3 days before applying toxic bait may provide more consistent toxic bait acceptance.

HAND BAITING: Place teaspoonful quantities of bait, either in surface runways or at mouth of holes leading to underground burrow systems. Bait at the rate of 3-5 pounds per acre in infested areas.

TRAILBUILDER: Apply teaspoonful of bait 4-5 foot intervals in the artificial runways around infested areas.

BROADCAST BAITING: Apply evenly by cyclone seeder or by hand at the rate of 3-5 pounds per acre.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Keep away from humans, domestic animals, and pets. May be fatal or harmful if swallowed. Avoid eye or skin contact. Do not breathe dust. Avoid contamination of feed or food stuffs. Prevent the contact of bait with acids. Wash hands thoroughly with soap and water after use. Use rubber gloves if contact with skin occur when mixing or placing bait. Wash all utensils, spoons, or measuring devices thoroughly.

ENVIRONMENTAL HAZARDS

Notice: It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species. The use of this product may pose a hazard to Federally designated endangered/threatened species. Suggested measures to protect endangered species in your county may exist in an EPA "Interim Measures" pamphlet. You may call EPA's Endangered Species Hotline, 1-800-447-3813, to find out if an "Interim Measures" pamphlet exists for your county and have one sent to you. You can also consult your local county extension office or pesticide state lead agency to determine whether they have imposed any requirements in your area to protect endangered and threatened species.

This product is toxic to wildlife and fish. Birds and other wildlife feeding in treated areas may be killed. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. For terrestrial uses, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. This product shall not be applied over bodies of water, in areas inhabited by livestock, or where a hazard exists to rare or endangered species. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

Whooping Crane *(Grus americana)*
Do not use this product 30 days prior to arrival and 30 days after the whooping crane leaves its known critical habitat.
Attwater's Greater Prairie Chicken *(Tympanuchus cupido attwateri)* Do not use this product in critical habitat of the Attwater's greater prairie chicken in the following Texas counties: Aransas, Austin, Brazoria, Colorado, De Witt, Ft. Bend, Galveston, Goliad, Harris, Refugio, Victoria, Waller, and Wharton.
Yellow-Shouldered Blackbird *(Agelaius xanthomus)* and **Puerto Rican Plain Pigeon** *(Columba inornata wetmorei)* Do not use in critical habitat except in tamper-proof bait boxes within 6.3 miles of central Aquirre Lago Cicra, Ceiba, San German, 9.4 miles or La Esperanza; south of highway 2 from city at Mayaquez to the city of Ponce, and all of Mona Island, Puerto Rico.
Utah Prairie Dog *(Cynomys parvidens)* Do not use this product in critical habitat of the Utah prairie dog (Utah)
Salt Marsh Harvest Mouse *(Reithrodontomys raviventris)* Do not use this product in critical habitat within 0.5 mile of salt marsh vegetation and/or brackish water wetlands which are located 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and the San Joaquin River. (California)
Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis)* Do not use this product in critical habitat within 2.5 miles of Baywood park which is located on Morro Bay (Californis)
Aleutian Canada Goose *(Branta canadensis leucopareia)* Do not use this product from October to March in the federally closed

RESTRICTED USE PESTICIDE

Due to hazards to nontarget species
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

ZINC PHOSPHIDE ON OATS

For the control of black-tailed prairie dogs, white-tailed prairie dogs, and Gunnison's prairie dogs on rangelands in the following states: North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Montana, Utah and Wyoming.

For the control of California ground squirrels along noncrop rights-of-way in the following states: California, Nevada, and Oregon.

For the control of meadow and pine voles, and white-footed mice in orchards and groves.

ACTIVE INGREDIENT:

Zinc Phosphide	2.0%
INERT INGREDIENTS:	98.0%
TOTAL	100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

Any persons applying zinc phosphide products and experiencing signs or symptoms such as nausea, abdominal pain, tightness in the chest or weakness, should be seen by a physician immediately.

IF SWALLOWED: Immediately call a Poison Control Center or physician, or transport the patient to the nearest hospital. Do ot drink water. Do not administer anything by mouth or make the patient vomit unless advised to do so by a physician.
IF IN EYES: Flush with plenty of water. Get medical attention if irritation persists.
IF ON SKIN: Remove contaminated clothing and wash affected areas with soap and water.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Riverdale, MD 20737-1237
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-14

Net Weight:

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage disposal.

STORAGE: Store only in original container, in a dry pla inaccessible to children, pets, and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acute hazardous. Improper disposal of excess pesticide, spill bait, or rinsate is a violation of Federal law. If these wast cannot be disposed of by use according to label instructio contact your State Pesticide or Environmental Control Agen or the Hazardous Waste representative at the nearest EF Regional Office for guidance.

CONTAINER DISPOSAL: Completely empty by shaking a tapping sides and bottom to loosen clinging particles. Emp residue into application equipment then dispose of bags in sanitary landfill or by incineration if allowed by State and lo authorities.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in manner inconsistent with its labeling.

PRAIRIE DOGS

USE RESTRICTIONS: For control of black-tailed *(Cynom* ludovicianus), white-tailed *(C. leucurus)*, and Gunnison prairie dogs *(C. gunnisoni)*, on rangeland in Western Unit States (North Dakota, South Dakota, Nebraska, Kansa Oklahoma, Texas, New mexico, Arizona, Colorado, Montan Utah, and Wyoming) where non-target species will not endangered.

PREBAITING: Prebait with 4 grams (1 teaspoon) untreated steam-rolled oats per mound, 1-2 days prior baiting, to increase acceptance of treated baits by prai dogs.

BAITING: Apply bait only after all or most of prebait is eat and only to areas where untreated bait was consume Establish observation period during prebaiting. Apply bait hand as a six-inch bait spot on edge of each mound or adjacent feeding areas. Application rate should not exceed grams (1 teaspoon) per bait spot. Treat during late summ or fall period (July-February). Do not apply more than 1 b application during this period. Dispose of spilled or unwant bait by burial.

SEE BACK PANEL FOR ADDITIONAL DIRECTIONS FO USE.

5/96

DIRECTIONS FOR USE *(Continued)*

CALIFORNIA GROUND SQUIRRELS

USE RESTRICTIONS: For control of California ground squirrels *(Spermophilus beecheyi)* on noncrop rights-of-way adjacent to canal and ditch banks and other noncrop borders during late Spring and Summer. Zinc phosphide must not be applied on roads, near residential areas, over water of where plants are grown for food or feed. Before undertaking ground squirrel control with this product, consult local, State, and Federal game authorities to insure use is in accordance with regulations.

PREBAITING: Prebait with 6 pounds of untreated oat groats per acre along rights-of-way 2-3 days prior to applying toxic bait to increase bait acceptance by ground squirrels.

BAITING: Treat only once during treatment period and only after prebait is consumed. Broadcast bait in a 10-15 foot swath along right-of-way. Using hand or ground-driven bait dispensing devices not to exceed 6 pounds per acre. Bait will be applied only to the canal right-of-way between the base of the levee and adjacent properties. The canal and levee will not be treated. Dispose of bait and carcasses by burial within 3 days after treatment.

VOLES AND WHITE-FOOTED MICE

USE RESTRICTIONS: For control of meadow and pine voles *(Microtus spp.)* and white-footed mice (Peromyscus spp.) in orchards and groves. Apply bait after harvest while the orchard or grove is in a nonbearing phase. Do not apply on bare ground or growing crops. Wear rubber gloves when handling bait. Do not graze animals in treated areas.

HANDBAITING: Near the base of each infested tree, place teaspoonful quantities of bait at 2-4 locations, either on surface or at the mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass back into place. Do not disturb the runway system. Bait at the rate of 2-3 pounds per acre of infested trees.

TRAILBUILDER: Drop teaspoonful quantity of bait at 4-5 foot intervals in the artificial trail made by the machine just inside the drip line on both sides of the trees. Apply at the rate of 2-3 pounds per acre.

BROADCAST BAITING: Under infested trees broadcast evenly by cyclone seeder or by hand. Concentrate in areas with the heaviest vegetation cover. Apply at the rate of 6-10 pounds per acre.

AERIAL: Broadcast bait at a rate of 6-10 pounds per acre.

U.S. Department of Labor
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET

SECTION I

Manufacturer's Name
BIOSYNTH AG

Address (Number, Street, City, State, and ZIP Code)
Rietlistrasse 4, P. O. Box 125, 9422 Staad
Switzerland

Emergency Telephone Number: INFOTRAC: 1-800-535-5053
+41 (71) 858 20 20

Date Prepared: August 30, 2000

Chemical Name
alpha-Chloralose (≤15% beta-anomer)
$C_8H_{11}Cl_3O_6$ CAS RN [15879-93-3]

Cat. No.
C-3305

SECTION II - Hazardous Ingredients/Identiy Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
not applicable				

SECTION III - Physical/Chemical Characteristics

Boiling Point
not available

Specific Gravity (H_2O = 1)
not available

Vapor Pressure (mm Hg)
not available

Melting Point
179 - 183°C

Vapor Density (AIR = 1)
not available

Evaporation Rate (Butyl Acetate = 1)
not available

Solubility in Water
slightly soluble in warm water

Appearance and Odor
white to off-white powder; no characteristic odor

SECTION IV - Fire and Explosion Hazard Data

Flash Point (Method Used)
not available

Flammable Limits
not available

LEL

UEL

Extinguishing Media
Water spray, carbon dioxide, dry chemical powder or appropriate foam.

Special Fire Fighting Procedures
Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

Unusual Fire and Explosion Hazards
oxic fumes under fire conditions.

SECTION V - Reactivity Data

Stability	Unstable	Conditions to Avoid
	Stable X	

Incompatibility (Materials to Avoid)
Strong oxidizing agents, strong acids, strong bases

Hazardous Decomposition or Byproducts
Toxic fumes of: carbon monoxide; carbon dioxide; nitrogen oxides; hydrogen chloride gas

Hazardous Polymerization	May Occur	Conditions to Avoid
	Will Not Occur X	

SECTION VI - Health Hazard Data

Route(s) of Entry: Inhalation? yes Skin? yes Ingestion? yes

Health Hazards (*Acute and Chronic*)
May be harmful by inhalation, ingestion, or skin absorption. To the best of our knowledge the toxicological properties have not been thoroughly investigated. RTECS No. FM 9450000 ORL-RAT LD50: 400 mg/kg, ORL-MUS LD50: 200 mg/kg,

Carcinogenity: NTP? IARC Monographs? OSHA Regulated?

IPR-MUS LD50: 175 mg/kg, ORL-DOG LD50: 250 mg/kg.

Signs and Symptoms of Exposure
Can cause effects on behavioral (somnolence, tremor, excitement, ataxia, analgesia), cardiac (other changes), respiratory system (respiratory depression, tumors), blood (tumors), skin and appendages (hair), tumorigenic. May cause irritation.

Medical Conditions Generally Aggravated by Exposure
Call a physician; if swallowed, wash out mouth with water provided person is conscious; in case of contact, flush with copious amounts of water for at least 15 minutes; remove contaminated clothing and shoes;

Emergency and First Aid Procedures
if inhaled remove to fresh air; if breathing is difficult, give oxygen; in case of contact with eyes, flush with copious amounts of water for at least 15 minutes; assure adequate flushing by separating the eyelids with fingers

SECTION VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled
Evacuate area; wear self-contained breathing apparatus, rubber boots and heavy rubber gloves; absorb on sand or vermiculite and place in closed containers for disposal; ventilate area nd wash spill site after material pickup is complete.

Waste Disposal Method
Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber; observe all federal, state and local environmental regulations.

Precautions to Be Taken in Handling and Storing
Wear appropriate NIOSH/MSHA-approved respirator, chemical-resistant gloves, safety goggles, other protective clothing; use only in a chemical fume hood; safety shower and eye bath; do not get in eyes, on skin, on clothing;

Other Precautions
do not breathe dust; avoid prolonged or repeated exposure; wash thoroughly after handling; keep tightly closed; store in a cool dry place; keep away from sources of ignition - No smoking

SECTION VIII - Control Measures

Respiratory Protection (*Specific Type*)
filter mask

Ventilation	Local exhaust yes	Special none
	Mechanical (*General*) yes	Other none

Protective Gloves	Eye Protection
rubber or vinyl	goggles or face shield

Other Protective Clothing or Equipment
lab apron or equivalent

Work/Hygienic Practises
wash the skin after handling

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. Only selected

BEDFORD LABORATORIES™

300 Northfield Road
Bedford, OH 44146
Telephone: (440) 232-3320
-or- (800) 562-4797

MATERIAL SAFETY DATA SHEET

Section I - IDENTITY

Common/Trade Name: Ketamine Hydrochloride Injection, USP (10mL; 50mg/mL)
Chemical Names: (®)-2-(0-Chlorophenyl)-2-(methylamino)cyclohexanone hydrochloride
Synonyms: Ketalar®; Ketamine Hydrochloride, Calipsol, CI 581, Vetalar
Manufacturer's Name: BEN VENUE LABORATORIES, INC.
Address: 300 NORTHFIELD ROAD
BEDFORD, OH 44146
Emergency Telephone Number: Chemtrec: 1(800)424-9300
Telephone Number for Info.: (440)232-3320 or (800)562-4797
Medical Emergency: Professional Services: 1(800)521-5169
Date Prepared: June 19, 1996
Date Revised: December 18, 2001

Section II - HAZARDOUS INGREDIENTS/COMPOSITION INFORMATION

Component	%	CAS#	OSHA PEL	ACGIH TLV	Other Limits Recommended
Ketamine Hydrochloride	5.77	1867-66-9	NONE	NONE	25 mcg/m3 0.2 mg/m3 (SKIN)
Benzethonium Chloride	0.01	121-54-0	NONE	NONE	NONE
Water for Injection	94.22	7732-18-5	NONE	NONE	NONE

Ketamine is a general anesthetic that is a Schedule III controlled substance. Ketamine is a sterile injectable liquid drug provided in a vial.

Section III - HEALTH HAZARD DATA

Routes of Entry: Product may be absorbed via inhalation or skin or eye absorption.
Health Hazard (Acute & Chronic): Ketamine is a general anesthetic for diagnostic and surgical procedures. Product affects the central nervous and circulatory systems. Exposure may elevate blood pressure and increase pulse rate. May cause allergic reaction.
Carcinogenicity: **NTP?** NO **IARC Monographs?** NONE
OSHA Regulated? NO
Signs & Symptoms of Exposure: Nausea, vomiting, tingling, numbness, tiredness, and muscle movements may be observed. May irritate eyes, skin, and respiratory tract. Allergic reactions are possible.
Medical Conditions Generally Aggravated by Exposure: Exposure may elevate blood pressure.
BVL Hazard Category: 3

Section IV - FIRST AID MEASURES

Eye Exposure: Flush eyes with large volumes of water for 15 minutes.
Skin Exposure: Wash skin with cool, soapy water.
Ingestion: If ingestion occurs, flush mouth with water and seek medical attention immediately. If person is conscious, induce vomiting. Never induce vomiting on an unconscious person.
Inhalation: If difficulty breathing, administer oxygen. Seek attention of a physician immediately. If necessary, provide artificial respiration.

Section V - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used): Not Applicable **LEL:** NA **UEL:** NA
Flammable Limits: Not Applicable
Extinguishing Media: Use water or an ABC multi-purpose extinguisher.
Special Fire Fighting Procedures: As with all fires, evacuate personnel to a safe area. Fire fighters should wear self-contained breathing apparatus to avoid inhalation of smoke. Product is aqueous-based and is not expected to present a fire hazard concern.
Unusual Fire/Explosion Hazards: None

Section VI - ACCIDENTAL RELEASE INFORMATION

Release to Land: Absorb Ketamine Hydrochloride with absorbent materials and dispose according to local, state, and federal guidelines.
Release to Air: If aerosolized, reduce exposures by ventilating area; clean up spill immediately to prevent evaporation.
Release to Water: Refer to local water authority. Drain disposal is not recommended; however, refer to local state and federal disposal guidelines.

Section VII - PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be taken in case material is released or spilled: See Section VI above. Wear latex or nitrile gloves and safety glasses when cleaning spills. A dust/mist respirator (N95) may be necessary if excessive aerosols are generated.
Waste Disposal Method: Incineration in an approved incinerator is recommended.
Precautions to be taken in handling and storing: Refer to local, state, and federal rules.
Other Precautions: None

Section VIII - CONTROL MEASURES AND PERSONAL PROTECTIVE EQUIPMENT

Respiratory Protection: Under normal use, respirators are not required. If aerosols are generated, a disposable dust/mist respirator (N95) may be used. Personnel wearing respirators should be fit tested and approved for respirator use under the OSHA Respiratory Protection Standard 29 CFR 1910.134.
Ventilation: Handle product in a well-ventilated area.
Protective Gloves: Latex or nitrile
Eye Protection: Safety glasses or goggles

Other Protective Clothing or Equipment: Lab coat
Work/Hygienic Practices: Wash hands following use. No eating, drinking, or smoking while handling this product.

Section IX - PHYSICAL/CHEMICAL CHARACTERISTICS

Physical State: Liquid
Specific Gravity: 1.014
Appearance and Odor: Clear, colorless to slightly yellowish liquid with no odor
Melting Point: Not Applicable
Boiling Point: Not available
Evaporation Rate: Not available
Vapor Pressure: Not available
Solubility in Water: Water soluble
Vapor Density: Not available

Section X - STABILITY AND REACTIVITY DATA

Stability: Stable materials
Incompatibility (Materials to Avoid): Strong oxidizers and water reactive materials
Hazardous Decomposition or Byproducts: Decomposition products of this compound may include carbon monoxide, carbon dioxide, and sulfur oxides.
Hazardous Polymerization: Will not occur
Conditions to Avoid: Storage with oxidizers or water-reactive materials

Section XI - TOXICOLOGICAL INFORMATION

For Ketamine Hydrochloride

LD_{50} rat, oral = 447 mg/kg
LD_{50} mouse, oral = 617 mg/kg
LD_{50} rat, intravenous = 59 mg/kg
LD_{50} mouse, intravenous = 56 mg/kg
LD_{50} rat, intraperitoneal = 224 mg/kg
LD_{50} mouse, intraperitoneal = 224 mg/kg
LD_{50} mouse, intramuscular = 356 mg/kg
LD_{50} guinea pig, intramuscular = 361 mg/kg

Additional reproductive health data is available from the National Institute for Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS).

Section XII - ENVIRONMENTAL IMPACT INFORMATION

Information is currently not available on the environmental impact of Ketamine. Handle in a manner to prevent spills or releases to the environment.

Section XIII - DISPOSAL INFORMATION

Dispose of by incineration at an approved/permitted incinerator. Ketamine is a Schedule III controlled substance and requires documentation of disposal.
Review local, state, and federal regulations for your regulatory area.

Section XIV - TRANSPORTATION INFORMATION

Ketamine Hydrochloride Injection is not a D.O.T. hazardous material.
Ketamine Hydrochloride Injection is not a Marine Pollutant.

Section XV - REGULATORY INFORMATION

SARA 313 listed?: NO
CERCLA listed?: NO
RCRA listed?: NO
Ketamine is a Schedule III Controlled Substance

Section XVI - OTHER DATA

1. Use of this product should be through or under the direction of a physician. This MSDS does not address the therapeutic use of this material.

2. Persons administering this drug to patients must be careful to avoid needle sticks to syringes and other sharps used in the administration. All needle sticks must be reported to your company management.

The information provided is believed to be complete and accurate. It is the user's responsibility to use the information according to their application. Bedford Laboratories and Ben Venue Labs, Inc. assumes no additional liability or responsibility resulting from the use of or reliance on this information.

Material Safety Data Sheet

DOT	HCS Risk Phrases	Protective Clothing
	Not an HCS controlled material in USA.	

Section I. Product Identification and Uses

Common/Trade name	**Xylazine HCl Injection (NADA 140-442)**	**CI#**	Not available.
Synonyms	Xylazine HCl Injection, 100 mg/mL	**DSL**	TSCA inventory No products were found
Chemical Name	Not applicable.	**CAS #**	Not applicable.
Chemical Formula	Not available.	**Code**	MSDS ID#: P140-442
Chemical Family	Not available.	**Molecular Weight**	Not applicable.
Supplier	BOEHRINGER INGELHEIM VETMEDICA, INC. 2621 NORTH BELT HWY ST. JOSEPH MO 64506-2002	**Manufacturer**	BOEHRINGER INGELHEIM VETMEDICA, INC. 2621 NORTH BELT HWY ST. JOSEPH MO 64506-2002
Material Uses	Veterianry Anesthetic		

Section 2. Hazardous Ingredients

Name	CAS #	% by Weight	Exposure Limits	LC_{50}/LD_{50}
1) Xylazine HCl	7361-61-7	10	Not established	Not available

Section 3. Physical Data

Physical State and Appearance	Liquid.	**Odor**	Not available.
pH (1% soln/water)	Not available.	**Taste**	Not available.
Odor threshold	Not available.	**Color**	Colorless to light yellow.
Volatility	Not available.		
Melting/Sublimation point	Not available.		
Boiling/Condensation point	Not available.		
Specific gravity	1.02 (Water = 1)		
Vapor Density	Not available.		
Vapor pressure	Not available.		
$LogK_{ow}$	Not available.		
Ionicity (surface active agent)	Not available.		
Critical temperature	Not available.		
Instability temperature	Not available.		
Conditions of instability	No additional remark.		
Dispersion properties	See solubility in water.		
Solubility	Easily soluble in cold water, hot water.		

Continued on Next Page

Section 4. First Aid Measures

Eye contact	Flush eyes with copious amounts of water.
Skin contact	After contact with skin, wash immediately with plenty of water.
Slight inhalation	Allow the victim to rest in a well ventilated area. Apply artificial respiration if needed.
Slight ingestion	Notify physician or Poison Control Center immediately. Drink large amounts of water.

Section 5. Fire and Explosion Data

The product is:	Not available
Auto-ignition temperature	Not available.
Fire degradation products	Toxic and/or noxious fumes may be emitted when burned.
Flash points	Not available.
Flammable limits	Not available.
Fire extinguishing procedures	SMALL FIRE: Use DRY chemicals, CO_2, water spray or foam. LARGE FIRE: Use water spray, fog or foam. DO NOT use water jet. NIOSH approved SCBA and full protective gear is recomended to fire fighters.
Flammability	Not available
Risks of explosion	Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. No specific information is available in our database regarding the product's risks of explosion in the presence of various materials.

Section 6. Reactivity Data

Stability	The product is stable.
Hazardous Decomposition Products	Noxious fumes.
Degradability	Not available.
Products of degradation	Noxious fumes. Not available.
Corrosivity	No specific information is available in our database regarding the corrosivity of this product in presence of various materials.
Reactivity	No specific information is available in our database regarding the reactivity of this material in presence of various other materials.

Continued on Next Page

Section 7. Toxicological Properties

Routes of entry	Not available.
TLV	Not available.
Toxicity to animals	LD50: Not available. LC50: Not available.
Chronic effects on humans	**CARCINOGENIC EFFECTS:** Not available. **MUTAGENIC EFFECTS:** Not available. **TERATOGENIC EFFECTS:** Not available. **DEVELOPMENTAL TOXICITY:** Not available.There is no known effect from chronic exposure to this product. Repeated or prolonged exposure is not known to aggravate medical condition.
Acute effects on humans	No additional information.

Section 8. Preventive Measures

Waste information	Dispose of waste and containers in accordane with all laws.
Waste stream	Not available.
Storage	Store at room temperature. Keep out of reach of children.
Precautions	Read and follow all label directions.
Small spill and leak	Absorb with an inert material and place in an appropriate waste disposal container.
Large spill and leak	No additional information.
Protective Clothing	Rubber gloves. Safety glasses/goggles.

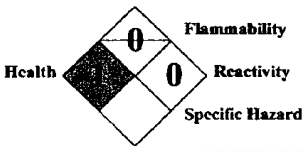
Section 9. Classification

DOT	Not a DOT controlled material (United States).
	Not applicable.
Maritime transportation	Not available.
HCS	Not an HCS controlled material in USA.
Federal and State Regulations	Not applicable

HMIS (U.S.A.)

Health	1
Flammability	0
Reactivity	0
Personal Protection	B

National Fire Protection Association (U.S.A.)



Continued on Next Page

Section 10. Protective Measures

Protective Clothing Rubber gloves. Splash goggles.

Engineering controls Good general ventilation should be sufficient to control airborne levels.

Section 11. Other Information

References Not available.

No additional remark.

Validated by Company on 08/05/2002.

Verified by Company.

Printed 09/04/2002.

CALL 1(800) 821-7467
Emergency Medical: (816) 232-2525 or (800)530-5432
Chemtrec: (800)424-9300

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

The information provided herein is offered by Boehringer Ingelheim Vetmedica, Inc. ("BIV") in good faith as accurate as of the date hereof, but without guarantee. This information includes information which has been generated by other parties and provided to BIV, and which BIV has not independently verified. The information provided herein relates only to the specific product designated, and may not be valid where such product is used in combination with any other materials or in any process. The information provided herein is offered solely for your consideration, investigation and verification, and Boehringer Ingelheim Vetmedica, Inc. ("BIV") expressly disclaims all liability for reliance thereon. BIV EXPRESSLY DISCLAIMS ALL WARRANTIES OF EVERY KIND AND NATURE (INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO THE USE OR SUITABILITY OF THE PRODUCT. In addition, since the conditions of use and suitability of the product for particular uses are beyond BIV's control, ALL RISKS OF USE OF THE PRODUCT ARE THEREFORE ASSUMED BY THE USER, AND BIV EXPRESSLY DISCLAIMS ANY AND ALL LIABILITY AS TO ANY RESULTS OBTAINED OR ARISING FROM ANY USE OF THE PRODUCT.
Use or re-transmission of the information contained herein in any other format than the format as presented is strictly prohibited. Nothing herein shall be construed as a permission or recommendation for the use of the product in a manner that might infringe an existing patent. BIV neither represents nor warrants that the format, content or product formulas contained in this document comply with the laws of any other country except the United States of America.
© Copyright 2001 Boehringer Ingelheim Vetmedica, Inc. All rights reserved.

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Trade Name: Potassium Chloride
Chemical Nature: Metal halide
Chemical Formula: KCl
CAS #: 7447-40-7

II HAZARDOUS INGREDIENTS

TLV (units): Not set

III PHYSICAL DATA

Boiling Point 760 mm Hg: 1500 °C, sublimes
Density: 1.984
Reaction with Water: None
Appearance and Odor: Colorless crystalline solid. No odor.
Melting Point: 700 °C
Molecular Weight: 74.55
Solubility in H_2O: Soluble

IV FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): Not a fire hazard under most conditions.

V HEALTH HAZARD INFORMATION

Threshold Limit Values: Not set
Other: Relatively non-toxic via all routes of exposure.
Irritation: Moderate eye irritation
Corrosivity: Skin and eyes. Reversible.

EMERGENCY AND FIRST AID PROCEDURES:

EYES: Flush with copious amounts of water for 15 minutes.
SKIN: Flush with soap and water.
INHALATION: Remove to fresh air.
INGESTION: Induce vomiting

VI REACTIVITY DATA

Stability: Stable
Hazardous Decomposition Products: N/A
Incompatibility (Materials to avoid): N/A
Hazardous Polymerization: N/A

VII SPILL OR LEAK PROCEDURES

Steps to Be Taken in Case Material Is Released or Spilled: Sweep or scoop up and remove.

Waste Disposal Method: In accordance with Local, State and Federal waste disposal regulations. Dispose of with normal refuse.

VIII SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify type): Filter-Dust, Fume, Mist
Eye Protection: Safety glasses

Ventilation: Use adequate ventilation
Other Protective Equipment: Normal Lab wear

IX SPECIAL PRECAUTIONS

Other Handling and Storage Conditions:

•Do not get in eyes, on skin or clothing.
•Do not breathe dust, vapor, mist or gas.
•Keep container closed.
•Store in tightly closed containers.

Prepared By: S. Dierks
Date: December 1994

Labeling Information

IMRAB® 3

Vaccine

Rabies Vaccine, Killed Virus

U.S. Vet. Lic. No.: 298

© 2000 North American Compendiums, Inc.
All rights reserved. Reprinted with permission.

Contents: IMRAB® 3 rabies vaccine, killed virus, manufactured by Merial contains the same virus strain that is used in the human vaccine. The virus is grown on a stable cell line, inactivated and mixed with a safe and potent adjuvant.

Contains gentamicin as a preservative.

Indications: IMRAB® 3 is recommended for the vaccination of healthy cats, dogs, sheep, cattle, horses and ferrets against disease caused by rabies virus.

Claims: Virus purification through filtration and virtual freedom of serum in the vaccine ensure the safety of the product. IMRAB® 3 meets or exceeds regulatory testing requirements prior to sale.

Dosage and Administration: Using aseptic technique, inject 1 mL subcutaneously or intramuscularly in healthy cats and dogs when 3 months of age or older, and inject 2 mL in healthy sheep, cattle and horses when 3 months of age or older. Inject 1 mL subcutaneously in healthy ferrets when 3 months of age or older. Revaccinate ferrets, cattle and horses annually; cats, dogs and sheep one year after the first vaccination, and then every three years.

Precaution(s): Shake well before using. Store at 2°-7°C (35°-45°F). Do not freeze.

Caution(s): Use the entire contents when first opened. Do not use chemicals to sterilize syringes and needles. A transient local reaction may occur at the injection site following subcutaneous administration. In case of an anaphylactic reaction, administer epinephrine.

Public Health Authorities may require rabies-vaccinated ferrets that bite humans be sacrificed and tested for rabies infection.

Package insert for

RABIES VACCINE, Live Vaccinia Vector
MERIAL Raboral V-RG® Baits

1.0 INTRODUCTION:

MERIAL Raboral V-RG® is a product developed and manufactured using state-of-the-art biotechnology. The product is specifically designed to impede or prevent the spread of lethal rabies disease in raccoons. Since rabies is spread by animal-to-animal contact, vaccination of a significant number of raccoons may effectively establish a barrier between rabies endemic and uninfected areas. Over time, repeat vaccination campaigns may reduce the reservoir of susceptible raccoons.

While a program to vaccinate raccoons against rabies may reduce the rate of infection in wild animals, the main objective of any rabies vaccination program is to limit the exposure of domestic animals to rabid wild animals. Because people are more likely to contact domestic animals, the ultimate goal is to protect the human population from rabies.

A raccoon vaccination program does not and is not intended, in any way, to eliminate the need for vaccination of pets or other domestic animals. All animals owners are encouraged to have their animals vaccinated in accordance with local, state, or federal regulations by qualified veterinarians.

2.0 DIRECTIONS FOR USE:

This product is recommended for the oral vaccination of raccoons against disease caused by pathogenic rabies virus. The vaccine is restricted for use in rabies control programs approved and directed by an appropriated federal or state agency. Control of the use of the vaccine rests with the sponsoring agency which has the responsibility to define conditions for proper use in its program. Assessment of such factors as raccoon population, baiting densities, competitive species, habitat, methods and frequency of distribution, public awareness, safety procedures, and any appropriate parameters is the responsibility of the sponsoring state or federal agency.

3.0 COMPOSITION:

This product is available in two vaccine-filled presentations; fish-meal polymer baits (FMPB) and coated sachets (CS). The vaccine is a Category III recombinant virus which means it contains a live virus vector which carries and expresses a foreign gene. In this case, the viral vector is vaccinia virus and the expressed gene product is rabies virus glycoprotein. This vaccine cannot cause rabies because it expresses only the antigen which is important in inducing immunity. It has been demonstrated safe in more than 50 species of animals including primates. It has been shown to be effective in protecting raccoons against virulent rabies challenge in controlled studies in the USA. The fish-meal polymer bait (FMPB) contains tetracycline as a biomarker. Both bait presentations (FMPB & CS) contain gentamicin as a preservative.

4.0 ROUTE OF ADMINISTRATION:

This vaccine is effective when administered by the oral route.

5.0 PACKAGING AND STORAGE:

The product exists in two presentations:

1. Fish-meal polymer baits (FMPB)
2. Coated sachets (CS)

Shipped refrigerated. Store refrigerated 2-7°C (35-45°F). Do not freeze. Each bait contains one single-dose ready for field use.

6.0 QUALITY CONTROL:

The quality of this product is confirmed by testing for:

PURITY	-Tested for bacteria, fungi, and mycoplasma to assure no detectable contaminants in accordance with USDA requirements.
POTENCY	-Tested to assure each lot meets or exceeds the viral content required in accordance with Production Outlines specifications approved by USDA-APHIS.
SAFETY	-Tested for safety to assure no adverse affects are attributable to the vaccine in accordance with USDA requirements.
IDENTITY	-Tested to ensure the vaccinia virus identity and to confirm the expression of rabies in accordance with USDA requirements.

7.0 PRECAUTIONARY MEASURES

Labels are applied or printed to each bait, clearly identifying the recombinant vaccine and listing a toll-free phone number (1-877-722-6725) automatically routing calls to the appropriate public health authorities. It is recommended that public education should be conducted prior to distribution of the baits to inform local communities as to the purpose of distribution, the type of vaccine, times and areas of distribution, public health concerns and reasons for not disturbing the baits. This education may include newspaper articles, local television and radio reports, public meetings, and distribution of brochures and posters. In certain areas, signs may be posted at the periphery and at strategic points within the distribution area notifying visitors of rabies control efforts and warning them not to disturb the vaccine-filled baits.

The local public health authorities in the areas where the recombinant rabies vaccine is used should be notified prior to the distribution of the baits. This notification should include instructions for addressing animal and human exposure to the vaccine.

The key personnel conducting the rabies control programs should be trained in the appropriate precautions and techniques for handling and distributing the vaccine-filled baits. Because a small risk of vaccinia infection exists when handling materials contaminated by the vaccine suspension, vaccination may be considered for this group. All personnel who will be handling the vaccine should be non-pregnant adults at least 18 years of age without eczema of any degree or other skin conditions, and free of any known immune-suppressive condition(s).

Any adverse reactions observed in the areas where the recombinant rabies vaccine is used should be reported to the licensed manufacturer, who will forward this information to the USDA-APHIS, Center for Veterinary Biologics.

Mail or fax the reports to:

MERIAL
Rabies Vaccine -- Program Director
115 Transtech Drive
Athens, GA 30601
Telephone: (706) 548-9292 or 1-877-722-6725
Fax: (706) 548-0608

MERIAL, INC. USDA License No. 298
MERIAL Product Code 2314R-01, 2315-01, 2316R-01

CONTRAC® Rodenticide Place Pac

MSDS
Date of Issue:
August 01

MANUFACTURER'S ADDRESS:	PREPARED BY:	TELEPHONE NO:	EMERGENCY PHONE NOS:
BELL LABORATORIES, INC. 3699 KINSMAN BLVD. MADISON, WI 53704	PSM/CAR	(608) 241-0202	**Medical** (877) 854-2494 **Transportation (Spills)** (800) 424-9300 CHEMTREC
PRODUCT NAME: **CONTRAC® Rodenticide Place Pac**			
USE: Anticoagulant Rodenticide	**BAIT FORM:** Granular Dry Bait		**EPA REGISTRATION NO:** 12455-86

SECTION I. HAZARDOUS INGREDIENTS

INGREDIENT NAME	% BY WEIGHT	CURRENT TLV
Bromadiolone [3-[3-(4'-Bromo-[1,1'-biphenyl]-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxy-2H-1-benzopyran-2-one] CAS No. 28772-56-7	0.005 %	N/A

This product contains no components subject to the reporting requirements of Section 313 of the Superfund Amendment and Reauthorization Act (SARA) of 1986

SECTION II. PHYSICAL DATA

APPEARANCE:	COLOR:	ODOR:	SPECIFIC GRAVITY:
Pellet	Blue	Sweet, grain-like	0.768 gm/cc
VAPOR DENSITY:	**MELTING POINT:**	**WATER REACTIVITY:**	**EVAPORATION RATE:**
N/A	N/A	N/A	N/A
VAPOR PRESSURE:	**BOILING POINT:**	**SOLUBILITY:**	**BULK DENSITY:**
N/A	N/A	Not soluble in water	N/A

SECTION III. FIRE AND EXPLOSION DATA

FLASH POINT (Method Used):	FLAMMABLE LIMIT:	AUTOIGNITION TEMP:
N/A	**Upper Limit:** N/A **Lower Limit:** N/A	N/A

EXTINGUISHING MEDIA:
Extinguish with water, foam or inert gas

SPECIAL FIREFIGHTING PROCEDURES:
Firefighters should be equipped with protective clothing and self-contained breathing apparatus.

UNUSUAL FIRE OR EXPLOSION HAZARDS:
None

SECTION IV. REACTIVITY HAZARD DATA

STABILITY:	CONDITIONS TO AVOID:
Stable	None
POLYMERIZATION:	**CONDITIONS TO AVOID:**
Will not occur	None

INCOMPATIBILITY (MATERIALS TO AVOID):	HAZARDOUS DECOMPOSITION PRODUCTS:
Strongly alkaline materials	Oxides of carbon

SECTION V. TOXICITY DATA

LD50, ORAL (INGESTION):	LD50, DERMAL (SKIN CONTACT):	LC50, INHALATION:
>5000 mg/kg (rats)	> 2000 mg/kg (rats)	N/A
EYE IRRITATION:	**SKIN IRRITATION:**	**DERMAL SENSITIZATION:**
None (rabbits)	None (rabbits)	Not Considered a Sensitizer

SECTION VI. HEALTH HAZARDS

PRIMARY ROUTE OF ENTRY:	SIGNS & SYMPTOMS OF EXPOSURE:
Ingestion	Nausea, vomiting, loss of appetite, extreme thirst, lethargy, diarrhea, bleeding

EMERGENCY FIRST AID PROCEDURES:
Eyes: Flush with cool water for at least 15 minutes. If irritation develops, obtain medical assistance.
Skin: Wash with soap and water.
Ingestion: Call physician or emergency phone number immediately. Do not give anything by mouth or induce vomiting unless instructed by physician.
Inhalation: None.

NOTE TO PHYSICIAN:
If ingested, administer Vitamin K_1 intramuscularly or orally as indicated by bishydroxycoumarin overdoses. Repeat as necessary as based upon monitoring of prothrombin times.

SECTION VII. CONTROL AND PROTECTIVE MEASURES

RESPIRATOR TYPE:
Not required

EYE PROTECTION:	GLOVES (Recommended):	VENTILATION:
Not required	Rubber Gloves	Not required

OTHER PROTECTIVE MEASURES:
Not required

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:
HEALTH: 1 (Caution) **FIRE**: 0 (Will not burn) **REACTIVITY**: 0 (Stable) **SPECIFIC HAZARD**: None

HAZARDOUS MATERIAL INFORMATION (HMIS) RATINGS:
HEALTH: 2 (Moderate) **FLAMMABILITY**: 0 (Minimal) **REACTIVITY**: 0 (Minimal) **PROTECTIVE EQUIPMENT**: B

SECTION VIII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN THE EVENT MATERIAL IS RELEASED OR SPILLED:
Sweep up spilled material, place in properly labeled container for disposal or re-use.

WASTE DISPOSAL METHOD:
Wastes resulting from use may be disposed of on-site or at an approved waste disposal facility. Dispose of all wastes in accordance with all Federal, state and local regulations.

SECTION IX. SPECIAL PRECAUTIONS AND STORAGE DATA

STORAGE TEMPERATURE:	AVERAGE SHELF LIFE:
Room temperature	Bait is stable for a minimum of 1 year when stored at room temperature

SPECIAL SENSITIVITY (HEAT, LIGHT, MOISTURE):
Avoid exposure to light and extreme humidity

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Store in a cool, dry place inaccessible to children, pets and wildlife. Keep container tightly closed when not in use. Avoid contamination of lakes, streams and ponds by use, storage or disposal. Wash thoroughly with soap and water after handling.

SECTION X. SHIPPING DATA

DOT SHIPPING NAME:	DOT HAZARD CLASSIFICATION:
None required	Non-hazardous
DOT LABELS REQUIRED:	**FREIGHT CLASSIFICATION:**
None required	LTL Class 60

WARRANTY: The information provided in this Material Safety Data Sheet has been obtained from sources believed to be reliable. Bell Laboratories, Inc. provides no warranties, either expressed or implied, and assumes no responsibility for the accuracy or completeness of the data contained herein. This information is offered for your consideration and investigation. The user is responsible to ensure that they have all current data relevant to their particular use.

MSDS
Date of Issue:
August 01

CONTRAC® Rat and Mouse Bait RTU Place Pac

MANUFACTURER'S ADDRESS:	PREPARED BY:	TELEPHONE NO:	EMERGENCY PHONE NOS:
BELL LABORATORIES, INC. 3699 KINSMAN BLVD. MADISON, WI 53704	PSM/CAR	(608) 241-0202	**Medical** (877) 854-2494 **Transportation (Spills)** (800) 424-9300 CHEMTREC
PRODUCT NAME: **CONTRAC® Rat and Mouse Bait RTU Place Pac**			
USE: Anticoagulant Rodenticide	**BAIT FORM:** Granular Dry Bait		**EPA REGISTRATION NO:** 12455-75

SECTION I. HAZARDOUS INGREDIENTS

INGREDIENT NAME	% BY WEIGHT	CURRENT TLV
Bromadiolone [3-[3-(4'-Bromo-[1,1'-biphenyl]-4-yl)-3-hydroxy-1-phenylpropyl]-4-hydroxy-2H-1-benzopyran-2-one] CAS No. 28772-56-7	0.005 %	N/A

This product contains no components subject to the reporting requirements of Section 313 of the Superfund Amendment and Reauthorization Act (SARA) of 1986

SECTION II. PHYSICAL DATA

APPEARANCE:	COLOR:	ODOR:	SPECIFIC GRAVITY:
Meal	Blue	Sweet, grain-like	N/A
VAPOR DENSITY:	**MELTING POINT:**	**WATER REACTIVITY:**	**EVAPORATION RATE:**
N/A	N/A	N/A	N/A
VAPOR PRESSURE:	**BOILING POINT:**	**SOLUBILITY:**	**BULK DENSITY:**
N/A	N/A	Not soluble in water	N/A

SECTION III. FIRE AND EXPLOSION DATA

FLASH POINT (Method Used):	FLAMMABLE LIMIT:	AUTOIGNITION TEMP:
N/A	Upper Limit: N/A Lower Limit: N/A	N/A

EXTINGUISHING MEDIA:
Extinguish with water, foam or inert gas

SPECIAL FIREFIGHTING PROCEDURES:
Firefighters should be equipped with protective clothing and self-contained breathing apparatus.

UNUSUAL FIRE OR EXPLOSION HAZARDS:
None

SECTION IV. REACTIVITY HAZARD DATA

STABILITY:	CONDITIONS TO AVOID:
Stable	None
POLYMERIZATION:	**CONDITIONS TO AVOID:**
Will not occur	None

INCOMPATIBILITY (MATERIALS TO AVOID):	HAZARDOUS DECOMPOSITION PRODUCTS:
Strongly alkaline materials	Oxides of carbon

SECTION V. TOXICITY DATA

LD50, ORAL (INGESTION):	LD50, DERMAL (SKIN CONTACT):	LC50, INHALATION:
>5000 mg/kg (rats)	> 2000 mg/kg (rats)	N/A
EYE IRRITATION:	**SKIN IRRITATION:**	**DERMAL SENSITIZATION:**
None (rabbits)	None (rabbits)	Not Considered a Sensitizer

SECTION VI. HEALTH HAZARDS

PRIMARY ROUTE OF ENTRY:
Ingestion

SIGNS & SYMPTOMS OF EXPOSURE:
Nausea, vomiting, loss of appetite, extreme thirst, lethargy, diarrhea, bleeding

EMERGENCY FIRST AID PROCEDURES:
Eyes: Flush with cool water for at least 15 minutes. If irritation develops, obtain medical assistance.
Skin: Wash with soap and water.
Ingestion: Call physician or emergency phone number immediately. Do not give anything by mouth or induce vomiting unless instructed by physician.
Inhalation: None.

NOTE TO PHYSICIAN:
If ingested, administer Vitamin K_1 intramuscularly or orally as indicated by bishydroxycoumarin overdoses. Repeat as necessary as based upon monitoring of prothrombin times.

SECTION VII. CONTROL AND PROTECTIVE MEASURES

RESPIRATOR TYPE:
Not required

EYE PROTECTION:
Not required

GLOVES (Recommended):
Rubber Gloves

VENTILATION:
Not required

OTHER PROTECTIVE MEASURES:
Not required

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:
HEALTH: 1 (Caution) **FIRE**: 0 (Will not burn) **REACTIVITY**: 0 (Stable) **SPECIFIC HAZARD**: None

HAZARDOUS MATERIAL INFORMATION (HMIS) RATINGS:
HEALTH: 2 (Moderate) **FLAMMABILITY**: 0 (Minimal) **REACTIVITY**: 0 (Minimal) **PROTECTIVE EQUIPMENT**: B

SECTION VIII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN THE EVENT MATERIAL IS RELEASED OR SPILLED:
Sweep up spilled material, place in properly labeled container for disposal or re-use.

WASTE DISPOSAL METHOD:
Wastes resulting from use may be disposed of on-site or at an approved waste disposal facility. Dispose of all wastes in accordance with all Federal, state and local regulations.

SECTION IX. SPECIAL PRECAUTIONS AND STORAGE DATA

STORAGE TEMPERATURE:
Room temperature

AVERAGE SHELF LIFE:
Bait is stable for a minimum of 1 year when stored at room temperature

SPECIAL SENSITIVITY (HEAT, LIGHT, MOISTURE):
Avoid exposure to light and extreme humidity

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Store in a cool, dry place inaccessible to children, pets and wildlife. Keep container tightly closed when not in use. Avoid contamination of lakes, streams and ponds by use, storage or disposal. Wash thoroughly with soap and water after handling.

SECTION X. SHIPPING DATA

DOT SHIPPING NAME:
None required

DOT HAZARD CLASSIFICATION:
Non-hazardous

DOT LABELS REQUIRED:
None required

FREIGHT CLASSIFICATION:
LTL Class 60

WARRANTY: The information provided in this Material Safety Data Sheet has been obtained from sources believed to be reliable. Bell Laboratories, Inc. provides no warranties, either expressed or implied, and assumes no responsibility for the accuracy or completeness of the data contained herein. This information is offered for your consideration and investigation. The user is responsible to ensure that they have all current data relevant to their particular use.

DITRAC® All-Weather Blox

MSDS
Date of Issue:
November 01

MANUFACTURER'S ADDRESS:	PREPARED BY:	TELEPHONE NO:	EMERGENCY PHONE NOS:
BELL LABORATORIES, INC. 3699 KINSMAN BLVD. MADISON, WI 53704	CAR/PSM	(608) 241-0202	**Medical** (877) 854-2494 **Transportation (Spills)** (800) 424-9300 CHEMTREC
PRODUCT NAME: ***DITRAC*® All-Weather Blox**			
USE: Anticoagulant Rodenticide	**BAIT FORM:** Formulated Dry Bait		**EPA REGISTRATION NO:** 12455-80

SECTION I. HAZARDOUS INGREDIENTS

INGREDIENT NAME	% BY WEIGHT	CURRENT TLV
Diphacinone [2-(Diphenylacetyl-1H-indene-1,3(2H)-dione] CAS No. 82-66-6	0.005 %	N/A

This product contains no components subject to the reporting requirements of Section 313 of the Superfund Amendment and Reauthorization Act (SARA) of 1986

SECTION II. PHYSICAL DATA

APPEARANCE:	COLOR:	ODOR:	SPECIFIC GRAVITY:
Polygonal Block	Pale Green	Sweet, grain-like	N/A
VAPOR DENSITY:	**MELTING POINT:**	**WATER REACTIVITY:**	**EVAPORATION RATE:**
N/A	N/A	N/A	N/A
VAPOR PRESSURE:	**BOILING POINT:**	**SOLUBILITY:**	**BULK DENSITY:**
N/A	N/A	Not soluble in water	N/A

SECTION III. FIRE AND EXPLOSION DATA

FLASH POINT (Method Used):	FLAMMABLE LIMIT:	AUTOIGNITION TEMP:
N/A	Upper Limit: N/A Lower Limit: N/A	N/A

EXTINGUISHING MEDIA:
Extinguish with water, foam or inert gas

SPECIAL FIREFIGHTING PROCEDURES:
Firefighters should be equipped with protective clothing and self-contained breathing apparatus.

UNUSUAL FIRE OR EXPLOSION HAZARDS:
None

SECTION IV. REACTIVITY HAZARD DATA

STABILITY:	CONDITIONS TO AVOID:
Stable	None
POLYMERIZATION:	**CONDITIONS TO AVOID:**
Will not occur	None

INCOMPATIBILITY (MATERIALS TO AVOID):	HAZARDOUS DECOMPOSITION PRODUCTS:
Strongly alkaline materials	Oxides of carbon

SECTION V. TOXICITY DATA

LD50, ORAL (INGESTION):	LD50, DERMAL (SKIN CONTACT):	LC50, INHALATION:
>5000 mg/kg (rats)	> 2000 mg/kg (rats)	N/A
EYE IRRITATION:	**SKIN IRRITATION:**	**DERMAL SENSITIZATION:**
None (rabbits)	None (rabbits)	Not Considered a Sensitizer

SECTION VI. HEALTH HAZARDS

PRIMARY ROUTE OF ENTRY:	SIGNS & SYMPTOMS OF EXPOSURE:
Ingestion	Nausea, vomiting, loss of appetite, extreme thirst, lethargy, diarrhea, bleeding

EMERGENCY FIRST AID PROCEDURES:
Eyes: Flush with cool water for at least 15 minutes. If irritation develops, obtain medical assistance.
Skin: Wash with soap and water.
Ingestion: Call physician or emergency phone number immediately. Do not give anything by mouth or induce vomiting unless instructed by physician.
Inhalation: None.

NOTE TO PHYSICIAN:
If ingested, administer Vitamin K_1 intramuscularly or orally as indicated by bishydroxycoumarin overdoses. Repeat as necessary as based upon monitoring of prothrombin times.

SECTION VII. CONTROL AND PROTECTIVE MEASURES

RESPIRATOR TYPE:
Not required

EYE PROTECTION:	GLOVES (Recommended):	VENTILATION:
Not required	Rubber Gloves	Not required

OTHER PROTECTIVE MEASURES:
Not required

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:
HEALTH: 1 (Caution) **FIRE**: 0 (Will not burn) **REACTIVITY**: 0 (Stable) **SPECIFIC HAZARD**: None

HAZARDOUS MATERIAL INFORMATION (HMIS) RATINGS:
HEALTH: 2 (Moderate) **FLAMMABILITY**: 0 (Minimal) **REACTIVITY**: 0 (Minimal) **PROTECTIVE EQUIPMENT**: B

SECTION VIII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN THE EVENT MATERIAL IS RELEASED OR SPILLED:
Sweep up spilled material, place in properly labeled container for disposal or re-use.

WASTE DISPOSAL METHOD:
Wastes resulting from use may be disposed of on-site or at an approved waste disposal facility. Dispose of all wastes in accordance with all Federal, state and local regulations.

SECTION IX. SPECIAL PRECAUTIONS AND STORAGE DATA

STORAGE TEMPERATURE:	AVERAGE SHELF LIFE:
Room temperature	Bait is stable for a minimum of 1 year when stored at room temperature

SPECIAL SENSITIVITY (HEAT, LIGHT, MOISTURE):
Avoid exposure to light and extreme humidity.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Store in a cool, dry place inaccessible to children, pets and wildlife. Keep container tightly closed when not in use. Avoid contamination of lakes, streams and ponds by use, storage or disposal. Wash thoroughly with soap and water after handling.

SECTION X. SHIPPING DATA

DOT SHIPPING NAME:	DOT HAZARD CLASSIFICATION:
None required	Non-hazardous
DOT LABELS REQUIRED:	**FREIGHT CLASSIFICATION:**
None required	LTL Class 60

WARRANTY: The information provided in this Material Safety Data Sheet has been obtained from sources believed to be reliable. Bell Laboratories, Inc. provides no warranties, either expressed or implied, and assumes no responsibility for the accuracy or completeness of the data contained herein. This information is offered for your consideration and investigation. The user is responsible to ensure that they have all current data relevant to their particular use.

syngenta

MATERIAL SAFETY DATA SHEET

Syngenta Crop Protection, Inc.
Post Office Box 18300
Greensboro, NC 27419

In Case of Emergency, Call
1-800-888-8372

1. PRODUCT IDENTIFICATION

Product Name: **TALON G** Product No.: A10976C

EPA Signal Word: Caution

Active Ingredient(%): Brodifacoum Technical (0.005%) CAS No.: 56073-10-0

Chemical Name: 3-[3-(4'-bromo[1,1'-biphenyl]-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2H-1-benzopyran-2-one

Chemical Class: A coumarin-type anticoagulant rodenticide

EPA Registration Number(s): 100-1050, 1051, 1052, 1057 (formerly 10182-334, 335, 336, 341) **Section(s) Revised: All sections**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Material	OSHA PEL	ACGIH TLV	Other	NTP/IARC/OSHA Carcinogen
Brodifacoum Technical (0.005%)	Not Established	Not Established	0.002 mg/m³ TWA***	No

*** Syngenta Occupational Exposure Limit (OEL)

Ingredients not precisely identified are proprietary or non-hazardous. Values are not product specifications.

3. HAZARDS IDENTIFICATION

Symptoms of Acute Exposure

Slightly irritating to the eyes. The active ingredient is designed to cause bleeding after repeated ingestion.

Hazardous Decomposition Products

Can decompose at high temperatures forming toxic gases.

Physical Properties

Appearance: Green pellets

Odor: Faint grain-like

Unusual Fire, Explosion and Reactivity Hazards

During a fire, irritating and possibly toxic gases may be generated by thermal decomposition or combustion.

4. FIRST AID MEASURES

Have the product container, label or Material Safety Data Sheet with you when calling Syngenta (800-888-8372), a poison contol center or doctor, or going for treatment.

Ingestion: If swallowed: Call Syngenta (800-888-8372), a poison control center or doctor immediately for treatment advice. Have the person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so after calling 800-888-8372 or by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

Eye Contact: If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after 5 minutes, then continue rinsing eye. Call Syngenta (800-888-8372), a poison control center

or doctor for treatment advice.

Skin Contact: If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call Syngenta (800-888-8372), a poison control center or doctor for treatment advice.

Inhalation: If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call Syngenta (800-888-8372), a poison control center or doctor for further treatment advice.

Notes to Physician

There is no specific antidote if this product is ingested.

This product may reduce the clotting ability of the blood and cause hemorrhaging. If poisoning occurs, intramuscular and oral administration of Vitamin K1 are indicated, as in poisoning from overdose of bishydroxy coumarin. For human cases, Vitamin K1 is antidotal at doses of 10 - 20 mg (not mg/kg). For animal cases, Vitamin K1 is antidotal at 2 - 5 mg/kg. Repeated doses may need to be given up to two weeks (based on monitoring of prothrombin time). In severe cases, blood transfusions may be necessary.

Medical Condition Likely to be Aggravated by Exposure

None known.

5. FIRE FIGHTING MEASURES

Fire and Explosion

Flash Point (Test Method):	>375°F (paraffin wax) Method: PMCC	
Flammable Limits (% in Air):	Lower: % Not Applicable	Upper: % Not Applicable
Autoignition Temperature:	Not Available	
Flammability:	Not flammable	

Unusual Fire, Explosion and Reactivity Hazards

During a fire, irritating and possibly toxic gases may be generated by thermal decomposition or combustion.

In Case of Fire

Use dry chemical, foam or CO2 extinguishing media. Wear full protective clothing and self-contained breathing apparatus. Evacuate nonessential personnel from the area to prevent human exposure to fire, smoke, fumes or products of combustion. Prevent use of contaminated buildings, area, and equipment until decontaminated. Water runoff can cause environmental damage. If water is used to fight fire, dike and collect runoff.

6. ACCIDENTAL RELEASE MEASURES

In Case of Spill or Leak

Control the spill at its source. Contain the spill to prevent it from spreading, contaminating soil, or entering sewage and drainage systems or any body of water. Clean up spills immediately, observing precautions outlined in Section 8. If a solid, sweep up material and place in a compatible disposal container. If a liquid, cover entire spill with absorbing material and place into compatible disposal container. Scrub area with hard water detergent (e.g. commercial products such as Tide, Joy, Spic and Span). Pick up wash liquid with additional absorbent and place into compatible disposal container. Once all material is cleaned up and placed in a disposal container, seal container and arrange for disposition.

7. HANDLING AND STORAGE

Store the material in a well-ventilated, secure area out of reach of children and domestic animals. Do not store food, beverages or tobacco products in the storage area. Prevent eating, drinking, tobacco use, and cosmetic application in areas where there is a potential for exposure to the material. Wash thoroughly with soap and water after handling.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

THE FOLLOWING RECOMMENDATIONS FOR EXPOSURE CONTROLS/PERSONAL PROTECTION ARE INTENDED FOR THE MANUFACTURE, FORMULATION, PACKAGING AND USE OF THIS PRODUCT.

FOR COMMERCIAL APPLICATIONS AND ON-FARM APPLICATIONS CONSULT THE PRODUCT LABEL.

Ingestion: Prevent eating, drinking, tobacco usage and cosmetic application in areas where there is a potential for exposure to the material. Wash thoroughly with soap and water after handling.

Eye Contact:	Where eye contact is likely, use chemical splash goggles. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.
Skin Contact:	Where contact is likely, wear chemical-resistant (such as nitrile or butyl) gloves, coveralls, socks and chemical-resistant footwear. For overhead exposure, wear chemical-resistant headgear.
Inhalation:	Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below exposure limits. A NIOSH-certified combination air-purifying respirator with an N, P or R 95 or HE class filter and an organic vapor cartridge may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. Use a pressure demand atmosphere-supplying respirator if there is any potential for uncontrolled release, exposure levels are not known, or under any other circumstances where air-purifying respirators may not provide adequate protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Green pellets
Odor:	Faint grain-like
Melting Point:	Not Available
Boiling Point:	442 - 446°F (Brodifacoum)
Specific Gravity/Density:	40.00 lbs./cu.ft.
pH:	Not Available

Solubility in H2O

Brodifacoum Technical:	Insoluble

Vapor Pressure

Brodifacoum Technical:	6 x 10(-6) mmHg @ 68°F (20°C)

10. STABILITY AND REACTIVITY

Stability:	Stable under normal use and storage conditions.
Hazardous Polymerization:	Will not occur.
Conditions to Avoid:	None known.
Materials to Avoid:	None known.
Hazardous Decomposition Products:	Can decompose at high temperatures forming toxic gases.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity/Irritation Studies (Finished Product)

Ingestion:	Practically Non-Toxic	
	Oral (LD50 Rat) :	> 5,000 mg/kg body weight
Dermal:	Moderately Toxic	
	Dermal (LD50 Rabbit) :	> 500 mg/kg body weight
Inhalation:	Not Available	
	Inhalation (LC50 Rat) :	See "Other Toxicity Information", Sec. 11
Eye Contact:	See "Other Toxicity Information", Sec. 11	
Skin Contact:	See "Other Toxicity Information", Sec. 11	
Skin Sensitization:	Not Available	

Neurotoxicity

Brodifacoum Technical:	No neurotox studies have been conducted.

Reproductive Effects

Brodifacoum Technical:	Not teratogenic, embryotoxic or fetotoxic in rats or rabbits at doses up to 0.02 mg/kg/day - the dose causing excessive maternal toxicity. Non-genotoxic in a range of assays.

Chronic/Subchronic Toxicity Studies

Brodifacoum Technical:	The biological half-life for brodifacoum in body tissue in rats is 150-200 days. Adverse clinical effects can develop from body accumulation. Prolonged prothrombin time, depression, pallor, subcutaneous hemorrhage, bleeding of nose or gums, gastrointestinal hemorrhage, cerebral hemorrhage, shock and death can develop following exposures.

Carcinogenicity

Brodifacoum Technical:	Unlikely to be carcinogenic.

Other Toxicity Information

Systemically toxic concentrations of this product will probably not be absorbed through human skin.
No toxic effects are known to be associated with inhalation of dust from this material.
No irritation is likely to develop following contact with human eyes.
Irritation will probably not develop following contact with human skin.

Effects of overexposure are those of anticoagulant overdose, i.e., reduced blood clotting ability with spontaneous bleeding in various organs. Body accumulation can result from repeated exposures since the half-life of brodifacoum is estimated to be 120 days. Individuals with blood clotting disorders may be more susceptible to overexposure effects.

Toxicity of Other Components

Not Applicable

Target Organs

Active Ingredients

Brodifacoum Technical:	Blood

Inert Ingredients

:	Not Applicable

12. ECOLOGICAL INFORMATION

Summary of Effects

Brodifacoum Technical:

Very toxic to aquatic organisms.

Eco-Acute Toxicity

Brodifacoum Technical:	Rainbow Trout 96-hour LC50 0.051 mg/L Daphnia magna 48 hours EC50 0.064 mg/L

Eco-Chronic Toxicity

Brodifacoum Technical:	Not Available

Environmental Fate

Brodifacoum Technical:

No data available for the formulation. The information presented here is for the active ingredient, brodifacoum. A thorough review of environmental information is not possible in this document. For additional information call the toll free number listed in Section 16.
Soil/Environment: Degraded in soils (pH 5.5 to pH 8) under aerobic and flooded conditions. Koc (average) 50000, range 14000 - 106000; Kd 1040 (average), range 625 - 1320 DT50 >12 w. Unlikely to leach; <2% leached >2 cm in laboratory columns.

13. DISPOSAL CONSIDERATIONS

Disposal

Do not reuse product containers. Dispose of product containers, waste containers, and residues according to local, state, and federal health and environmental regulations.

Characteristic Waste: Not Applicable

Listed Waste: Not Applicable

14. TRANSPORT INFORMATION

DOT Classification
Not regulated by DOT.

B/L Freight Classification
Exterminator, Vermin, O/T Poison

Comments
None.

15. REGULATORY INFORMATION

EPCRA SARA Title III Classification

Section 311/312 Hazard Classes:	Acute Health Hazard Chronic Health Hazard
Section 313 Toxic Chemicals:	Not Applicable

California Proposition 65
Not Applicable

CERCLA/SARA 302 Reportable Quantity (RQ)
None

RCRA Hazardous Waste Classification (40 CFR 261)
Not Applicable

TSCA Status
Exempt from TSCA, subject to FIFRA

16. OTHER INFORMATION

NFPA Hazard Ratings		HMIS Hazard Ratings			
Health:	1	Health:	1	0	Minimal
Flammability:	1	Flammability:	1	1	Slight
Instability:	0	Reactivity:	0	2	Moderate
				3	Serious
				4	Extreme

For non-emergency questions about this product call:

1-800-334-9481

Original Issued Date: 09/20/2000
Revision Date: 05/14/2002 Replaces:

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

RSVP# : SCP-955-00361A

End of MSDS

ECOSORB PRODUCT INFORMATION
POCATELLO SUPPLY DEPOT

DESCRIPTION
ECOSORB is not a masking agent, but rather an odor neutralizer. It contains a blend of 31 natural plant oils, a food-grade surfactant, and water. It neutralizes malodors by Van Der Waal's Forces. That is, the malodor molecules are neutralized when ECOSORB molecules contact and attach to them, which increases their mass and weight, causing them to become odorless and fall to the ground to biodegrade naturally by forming carbon dioxide and water.

APPLICATIONS
ECOSORB is currently used in numerous home, farm, and industrial/commercial applications. Odor problems vary greatly in their strength, level of obnoxiousness, area of concern, atmospheric conditions, etc. Application is generally accomplished by spraying a fine mist on the area of the malodor until it disappears.

HOME APPLICATIONS
-fish odors
-cooking odors
-pet odors
-smoke
-litter boxes
-bathroom odors
-tennis shoes
-carpet
-diaper pails
-spoiled food odors
-garlic & onion
-garbage cans

FARM APPLICATIONS
-barn odors
-vehicle odors
-pollen
-trap odors
-chicken pens
-dust control
-lagoon odors
-diesel fumes
-smoke
-work clothing
-manure odor
-skunk odor
-slaughter areas
-musty/mold odors
-feed lot odors
-misc. chemicals

INDUSTRIAL/COMMERCIAL APPLICATIONS
-sewer plants
-food processor
-bars/lounges
-waste transfer stations
-foundries
-vacuum trucks
-hotels/motels
-jails
-lagoons
-pulp mills
-gym facilities
-land fills
-environmental spills
-dust control
-nursing homes
-animal shelters
-kennels
-asphalt plants
-roofing tar odors
-beauty salons
-chemical plants
-veterinarians
-rendering plants
-hospitals
-schools

ECOSORB has been tested and found to be safe around people and animals. A Material Safety Data Sheet is provided with each order.

SUGGESTED USES

ECOSORB is sold to our customers in either a 4-ounce pump-sprayer bottle, or in pint, quart, or gallon bulk quantities. Spray ECOSORB directly on the source of the malodor. Several applications may be necessary, depending on the strength of the odor. For clothing, floor, or carpet applications, spray the odor source with ECOSORB, first; then clean them with normal laundry, floor, or carpet cleaners. Use additional applications of ECOSORB, as needed. DO NOT mix ECOSORB with other cleaners or solutions. Spray ECOSORB, first, and apply the other cleaners, afterwards. Repeat, if necessary.

For large-area farm, industrial, or commercial applications, please contact us for further information for planning customized applications to suit your specific needs.

PERSONAL PROTECTION

No special protection is needed when using ECOSORB since it is composed of natural plant oils. However, eye contact should be avoided since it may cause minor irritation. See Material Safety Data Sheet for specific information.

LIABILITY

Pocatello Supply Depot is not responsible for the use or misuse of ECOSORB or for any accidents caused by the use or misuse of this product. The user accepts the sole responsibility when using ECOSORB.

GUARANTEE OR CLAIMS OF EFFECTIVENESS

Pocatello Supply Depot makes no guarantee nor does it claim ECOSORB to be 100% effective in eliminating all malodorous materials.

Pocatello Supply Depot
238 E Dillon St, Pocatello, ID 83201
Phone: (208) 236-6920
FAX -6922
E-Mail: pocsplydepot@gemstate.net

04-99

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List)

Ecosorb 606

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

SECTION I

Manufacturer's Name

Odor Management, Inc.

Address (Number, Street, City, State and Zip Code)

2720 Nevada Avenue North
New Hope, MN 55427

Emergency Telephone Number
(612) 546-9730
INFOTRAC: 1-800-535-5053

Telephone Number for Information
(612) 546-9730

Date Prepared
10/12/92
Reviewed: 3-8-00

SECTION II - Hazardous Ingredients/Identity Information

Hazardous Components (Specify Chemical Identity: Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	%
All constituents are not considered hazardous according to the Federal Hazard Communication Standard (29 CFR 1910.1200)				

SECTION III - Physical/Chemical Characteristics

Boiling Point: 212 deg F	Specific Gravity (H2O) = 1): 1.0 - 1.08
Vapor Pressure: 0.7 psia @ 100 deg F	Melting Point: N/A
Vapor Density (Air = 1): Approximately same as water	Evaporation Rate (Butyl Acetate = 1): 8
Solubility in Water: Soluble	pH: 6.0
Percent Volatile: < 0.5	
Appearance and Odor: Milky white/opaque white, slight citrus or floral odor	

SECTION IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
None		N/A	N/A

Extinguishing Media
Does not burn

Special Fire Fighting Procedures
None

Unusual Fire and Explosion Hazards
None

(over)

SECTION V - Reactivity Data

Stability
Stable

Incompatibility (Materials to Avoid)
Strong oxidizing agents

Hazardous Decomposition or By-products
None known

Hazardous Polymerization
Will not occur

SECTION VI - Health Hazard Data

Route(s) of Entry	Inhalation?	Skin?	Ingestion?
	Yes	Eyes	

Health Hazards (Acute and Chronic)
Eye contact may cause mild irritation - Wash 15 minutes with water
Seek medical attention if symptoms persist

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
	No	No	No

Signs and Symptoms of Exposure
None

Medical Conditions Generally Aggravated by Exposure
None known

Emergency and First Aid Procedures
Eyes - wash with water 15 minutes
Ingestion - drink several glasses of water, see physician if symptoms persist

SECTION VII - Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled
Flush to drain with large quantities of water

Waste Disposal Method
Flood with water to drain

Precautions to Be Taken in Handling and Storing
Storage of product below 32 deg F may cause layering

Other Precautions
Wash with soap and water if exposed

SECTION VIII - Control Measures

Respiratory Protection (Specify Type)
None required

Ventilation
Good ventilation

Eye Protection
None required

Gloves/Other Protective Clothing or Equipment
None required

Work/Hygienic Practices
Wash with soap and water before eating or smoking

Fritzsche Dodge & Olcott™
76 Ninth Avenue, New York, N. Y. 10011

... now a Division of
GIVAUDAN CORPORATION

MATERIAL SAFETY DATA SHEET

PIN#: 593053

In case of emergency call:
Fritzsche Dodge & Olcott 212-929-4100
Chemtrec 800-424-9300

HEALTH 2
FLAMMABILITY 2
[illegible] 0

HAZARD RATING
LEAST 0 SLIGHT 1
MODERATE 2 HIGH 3 EXTREME 4

REVISION DATE 3/06/91

SECTION I - IDENTIFICATION AND GENERAL INFORMATION

PRODUCT NUMBER: 593053

PRODUCT NAME: PERFUME COMPOUND WATER SOLUBLE NEUTROLEUM ALPHA 06491

CHEMICAL NAME: N/A
CHEMICAL FAMILY: FRAGRANCE COMPOUND
SYNONYMS: N/A

MOLECULAR WEIGHT: N/A
MOLECULAR FORMULA: N/A

CAS NUMBER: N/A
TSCA REGISTERED: N/A
FDA APPROVED: N/A
RIFM APPROVED: N/A
RIFM NUMBER: N/A
FEMA APPROVED: N/A
FEMA NUMBER: N/A

SECTION II - HAZARDOUS INGREDIENT(S)

The identity of the individual components of this product is proprietary information and is considered a trade secret pursuant to 29 CFR 1910.1200.

SECTION III - PHYSICAL DATA

BOILING POINT (DEG C): N/A
MELTING POINT (DEG): N/A
SPECIFIC GRAVITY: 1.0190 - 1.0280 AT 25 C
REFRACTIVE INDEX: 1.4680 - 1.4750 AT 20 C
ALCOHOL CONTENT: N/F
WATER CONTENT: N/F
VAPOR PRESSURE: N/F
SOLUBILITY IN WATER: SOLUBLE

FLASHPOINT: 125
VAPOR DENSITY: N/F
% VOLATILE: N/F

APPEARANCE: A YELLOW TO AMBER COLORED LIQUID
CHARACTERISTIC ODOR AND FLAVOR.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Extinguishing Media: Carbon Dioxide, Dry Chemicals or Foam.
Special Fire Fighting Procedures: Use of self contained breathing apparatus and protective clothing is recommended.
Unusual Fire and Explosion Hazards: Sealed containers may build up pressure at high temperatures. Keep containers cool whenever possible.

Fritzsche Dodge & Olcott™
76 Ninth Avenue, New York, N. Y. 10011

MATERIAL SAFETY DATA SHEET

In case of emergency call:
Fritzsche Dodge & Olcott 212-929-4100
Chemtrec 800-424-9300

HEALTH 2
FLAMMABILITY
[redacted]

HAZARD RATING
LEAST 0 SLIGHT 1
MODERATE 2 HIGH 3 EXTREME 4

REVISION DATE 3/06/91

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (ACGIH TLV): N/F
THRESHOLD LIMIT VALUE (OSHA PEL): N/F

CARCINOGENICITY: THIS MATERIAL CONTAINS NO SUSPECTED CARCINOGENS AS REPORTED BY NTP OR IARC.

ACUTE TOXICITY DATA:

ORAL LD50: N/F

INHALATION LC50: N/F

DERMAL LD50: N/F

HEALTH HAZARDS (ACUTE AND CHRONIC):

INGESTION: SLIGHT HEALTH HAZARD

INHALATION: SLIGHT HEALTH HAZARD

SKIN CONTACT: SLIGHT HEALTH HAZARD

IRRITATION (SKIN): CAUSES IRRITATION

IRRITATION (EYE): CAUSES EYE IRRITATION

OTHER EFFECTS:

INGESTION:
REPEATED DOSING ORALLY AND DERMALLY OF LARGE AMOUNTS TO RATS HAS CAUSED REPRODUCTIVE EFFECTS.

DRINKING SMALL AMOUNTS (UP TO 20 MLS.) HAS CAUSED POISONING AND DEATH.

INHALATION:
VAPOR IS IRRITATING TO THROAT AND LUNGS.

BREATHING HIGH CONCENTRATIONS OF VAPOR MAY CAUSE ANESTHETIC EFFECTS.

EXCESSIVE INHALATION OF VAPORS HAS BEEN REPORTED TO CAUSE KIDNEY AND BLADDER DAMAGE.

SKIN CONTACT:

N/F

SARA TITLE III - This product does not contain any Toxic Chemicals subject to the reporting requirements of Section 313 40 CFR Part 372.

The health hazard information is based on laboratory animal test data for the individual components of this product in their pure form as provided under 29 CFR 1910.1200 (d)(5)(ii). The user should [illegible]

SECTION VI - EMERGENCY FIRST AID PROCEDURES

Eye contact- Flush immediately with cold clean water for at least 15 minutes. Contact a physician immediately.
Skin contact- The affected area should be thoroughly washed with soap and water. Flush with large quantities of water. If irritation persists call a physician.
Inhalation: remove to fresh air and contact a physician if necessary.
Ingestion: Administer water or milk to dilute. Contact a physician or local poison control center immediately.

SECTION VII - REACTIVITY DATA

This material presents no signifigant reactivity hazard.
Hazardous Polymerization will not occur and it will not react violently with water.
Contact with highly reactive chemical oxidants should be avoided.
If burned this product will produce carbon monoxide and/or carbon dioxide.

SECTION VIII - PERSONAL PROTECTION

s: The use of goggles or a face shield is recommended.
spiratory: Respiratory protection is normally not required in well ventilated areas however, NIOSH approved respiratory protection may be required when the material is rated toxic by inhalation or if the material is to be used in a confined area.
Other Protective Equipment: Chemical resistant gloves are recommended.

Ventilation: Ventilation meeting ACGIH standards should be employed.
Work/Hygienic Practices: Use good, personal hygiene practices: Limit exposure to product whenever possible. Wash after any contact. Thoroughly

wash any contaminated clothing or shoes before reuse.

SECTION IX - SPILL, LEAK AND WASTE DISPOSAL PROCEDURES

Remove any sources of flame or sparks. If in a confined area NIOSH approved respiratory protection may be required.
Absorb spills on vermiculite or other suitable absorbant material and remove to an approved disposal container.
Dispose of in accordance with current laws and regulations.

Fritzsche Dodge & Olcott™

76 Ninth Avenue, New York, N. Y. 10011

MATERIAL SAFETY DATA SHEET

PIN#: 593055

In case of emergency call:
Fritzsche Dodge & Olcott 212-929-4100
Chemtrec 800-424-9300

HEALTH 2
FLAMMABILITY 1
[redacted] 0

HAZARD RATING
LEAST 0 SLIGHT 1
MODERATE 2 HIGH 3 EXTREME 4

REVISION DATE 3/06/91

SECTION X - STORAGE AND HANDLING

Store in tight full containers in a cool dry place, away from light.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED ACCURATE AND RELIABLE; NEVERTHELESS, YOU SHOULD PERFORM YOUR OWN INVESTIGATION AND INDEPENDENT VERIFICATION. NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OR CORRECTNESS OF THESE DATA. SINCE THE USE OF THIS INFORMATION AND THE CONDITIONS OF USE OF PRODUCT ARE NOT WITHIN THE CONTROL OF FRITZSCHE, DODGE & OLCOTT, IT IS THE USER'S OBLIGATION TO DETERMINE THE CONDITION OF SAFE USE OF THE PRODUCT.

********** END OF MSDS **********

NEUTROLEUM ALPHA Information Sheet
Pocatello Supply Depot, February, 1992

Description:

NEUTROLEUM ALPHA(NA) is a perfume compound deodorant fomulated to mask difficult malodor problems. It is a water soluble, yellow to amber-colored liquid with a characteristic odor.

Uses:

NA is used in a variety of applications for odor control as recommended by the manufacturer, some of which are listed below:

Sickrooms	Gym/Weight Rooms
Nursing Homes	Bars/Lounges
Youth Homes	Garbage Containers
Hotels/Motels	Smoking Areas
Locker Rooms	Animal Odor Control

Other reported uses include:

Carpet Deodorizers
Laundry Deodorizers
Air Freshners
(There is no data from the manufacturer to support these uses, however)

Suggested Use Levels:

For most uses, NA should be diluted 2 ounces per gallon of warm water and used as either a spray or a direct cleaning solution. The quantity of NA can be reduced if desired, but this may reduce its effectiveness. For carpet and laundry deodorizing, use 1 ounce per 2 gallons of warm water. As an air freshner, use 2 teaspoons per quart of warm water in a spray bottle.

Personal Protection:

It is recommended that rubber gloves be worn when mixing NA concentrate with water. Avoid direct inhalation of vapors from an open bottle and mix in a well ventilated room. Do not mix NA with other cleaners or solvents. Store NA in a cool place away from direct sunlight and sources of heat.

Accidental Contact With NA:

Eye Contact: flush immediately with cold water for 15 minutes and contact a physician.
Skin Contact: wash thoroughly with soap and water. If irritation persists, contact a physician.
Ingestion: administer water or milk to dilute. Contact a physician or local poison control center immediately.
Allergies: NA may irritate some people with certain types of allergies. If irritation occurs, cease use of this product immediately.

Liability:

Pocatello Supply Depot is not responsible for the use or misuse of NA or for uses other than those previously listed or for any accidents caused by the use or misuse of NA. The user accepts sole responsibility in the use of this product.

Guarantee Or Claims Of Effectiveness:

Pocatello Supply Depot makes no guarantee nor does it claim this product to be 100% effective in deodorizing malodorous materials.

XPAK LIQUID

Material Safety Data Sheet

SLURRY EXPLOSIVE CORP.

5700 N. Portland, Suite 301 / Oklahoma City, OK 73112 / Phone: (405) 947-0765 / Fax: (405) 947-0768

SECTION 1 - PRODUCT INFORMATION

TRADE NAME:	XPak Liquid
SYNONYM:	Arming Liquid
CHEMICAL FAMILY:	Nitromethane
FORMULA:	CH3 NO2
CAS NUMBER:	None
UN/NA NUMBER	UN1261
DOT HAZARD CLASS:	3

SECTION 2 - HEALTH ALERT

DANGER - If misused or disposed of improperly, material could explode and cause death or serious injury.
DO NOT HANDLE WHEN IN DOUBT!!
See section VIII - Personal Protection
CHEM-TEL, INC. (800) 255-3924.

SECTION 3 - HEALTH HAZARD INFORMATION

EYE: May cause moderate irritation.
SKIN: May cause moderate irritation characterized my redness and pain.
INHALATION: Inhalation of decomposed products may irritate the respiratory tract. Prolonged exposure to these fumes may result in respiratory difficulties (shortness of breath, etc.) and possibly more severe toxic effects.
INGESTION: Swallowing large quantities may toxicity characterized by dizziness, bluish skin coloration, methemoglobinemia, unconsciousness, abdominal spasms, nausea, and pain.

SECTION 4 - EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: Flush with large amounts of water. Seek medical aid.
SKIN CONTACT: Remove contaminated clothing. Wash skin thoroughly with soap and water.
INHALATION: Remove from exposure. If breathing stops or is difficult, administer artificial respiration or oxygen. Seek medical aid.
INGESTION: Give 1 - 2 large glasses of milk or water. Induce vomiting. Seek medical aid.

SECTION 5 - RECOMMENDED OCCUPATIONAL EXPOSURE LIMIT/ HAZARDOUS INGREDIENTS

EXPOSURE LIMIT (PRODUCT): None required for product.

HAZARDOUS INGREDIENTS:	PERCENT	EXPOSURE LIMIT	PPM	MG/M3
Nitromethane	Min. 95-100	8 Hours	100	

SECTION 6 - REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY: Heat (confinement); Stacking (burning).
INCOMPATIBILITY: Can react violently or explode, with reducing agents and organic materials. Avoid amines, strong alkalies & acids.
HAZARDOUS REACTION / DECOMPOSITION PRODUCTS: At high temperatures, especially >374 F, may emit severe toxic fumes of nitrogen oxides.
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION: Not applicable.

SECTION 7 - FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT & METHOD: 36 C (96 F) Tag Closed Cup AUTO IGNITION TEMPERATURE: Explodes
FLAMMABLE LIMITS (% BY VOLUME/AIR): LOWER: 7.3 UPPER: NA
EXTINGUISHING MEDIA: Water, Foam, CO2
FIRE-FIGHTING PROCEDURES: When explosive is burning, EVACUATE AREA. Avoid breathing vapor
FIRE & EXPLOSION HAZARDS: Dangerous when exposed to heat or flame. Can support combustion of other materials involved in a fire and is capable of undergoing detonation if heated to high temperatures, especially under confinement including being piled on itself in a burning fire. When heated to decomposition, highly toxic fumes may be emitted. Do not return to area of explosion until smoke and fumes have dissipated. Dry alkali or amine salts are explosive.

XPAK LIQUID

SLURRY EXPLOSIVE CORP.

MSDS Con't.

SECTION 8 - PERSONAL PROTECTION INFORMATION

EYE PROTECTION: Safety goggles approved for the handling of explosives materials.

SKIN PROTECTION: Neoprene, natural rubber, polyethylene or polyvinyl chloride gloves. Use barrier creams, hand protection and protective clothing.

RESPIRATORY PROTECTION: Not normally required. Mechanical filter or supplied air type respirator as required for concentrations exceeding the occupational exposure limit.

VENTILATION: Maintain adequate ventilation. Use local exhaust if needed.

SECTION 9 - PERSONAL HANDLING INSTRUCTIONS

HANDLING: Explosives should not be abandoned at any location for any reason. Do not handle during electrical storms.

STORAGE: Store in a cool, dry, well-ventilated area remote from operations. Storage area should be of non-combustible construction. Organic materials, flammable substances and finely divided metals should be stored separately. Flames, smoking and unauthorized personnel are prohibited where this product is used or stored. Protect against physical damage, static electricity and lightning.

WARNING: Use of this product by persons lacking adequate training, experience and supervision may result in death or serious injury. Obey all Federal, State, and local laws / regulations applicable to transportation, storage, handling, and use of explosives.

DISTANCE: Always stay from area of explosion or disposal sites. Stay behind suitable barriers.

SECTION 10 - SPILL & LEAK PROCEDURES

PROCEDURES IF MATERIAL IS RELEASED OR SPILLED (IN ADDITION, SEE SECTION 8): Isolate area. Eliminate ALL sources of ignition. Avoid skin contact. Scrape up. Remove soiled clothing.

WASTE DISPOSAL - USE APPROPRIATE METHOD(S): Disposal of unexploded or deteriorated explosives material can be hazardous. Expert assistance is positively recommended in destroying explosives. Accidents can be prevented by thorough planning and handling in accordance with approved methods. Consult your supervisor, or the nearest SEC Regional Office for assistance. If improperly disposed of, material could explode and cause death or serious injury.

In all cases, follow facility emergency response procedures. Contact Facility Environmental Manager for assistance. Report any discharge of oil or hazardous substance that may enter surface waters to the National Response Center (800) 424 - 8802.

Observe all applicable local, state, and federal environmental spill and water quality regulations.

SECTION 11 - PHYSICAL DATA

BOILING POINT:	101 C (219 F)	SPECIFIC GRAVITY:	1.13
MELTING POINT:	-28.6 C %	VOLATILE BY VOLUME:	100
VAPOR PRESSURE:	36.6 mmg @ 25 C	EVAPORATION RATE (N-BUTYLACETATE=100):	139
VAPOR DENSITY (AIR=1):	2.1	VISCOSITY:	0.647 cp @ 20 C
SOLUBILITY IN WATER:	1.8% by wt. @ 20 C		
APPEARANCE/ ODOR:	Blue to Green Liquid, Aromatic Odor		

SECTION 12 - COMMENTS

This product is classified as a flammable liquid, ltd. quantities and need not be stored in a high explosive magazine, except where required by local regulations. Storage should be in a well constructed, well ventilated, dry structure located to conform with local, state, and federal regulations.

Normal operating conditions are assumed unless otherwise stated. If any given information is not clear or does not apply to your situation, STOP, store the material suitably, and seek correct help from your supervisors, Institute of Makers of Explosives or Slurry Explosive Corporation. Disposal sites must be clear of people at the time of disposal.

NOTICE: The data and recommendations presented herein are based upon data which are considered to be accurate. However, Slurry makes no guarantee or warranty, either expressed or implied, of the accuracy or completeness of these data and recommendations.

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communications Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
SAFETY FUSE UA (M-700)	

Section I

Manufacturer's Name TEC HARSEIM S.A.I.C.	Emergency Telephone Number 56-2-641-1007
2304 CAUPOLICAN	Telephone Number for Information (817) 478-8888
RENCA, SANTIAGO - CHILE	Date Prepared JAN. 96
	Signature of Preparer (optional)

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
BLACK POWDER WEIGHT 5.5 GR/M				
POTASSIUM NITRATE *				
SULPHUR *				
CHARCOAL *				

* Not hazardous substances by themselves

Section III - Physical/Chemical Characteristics

Boiling Point N/A		Specific Gravity (H2) = 1) N/A	
Vapor Pressure (mm Hg.) N/A		Melting Point N/A	
Vapor Density (AIR = 1) N/A		Evaporation Rate (Butyl Acetate = 1) N/A	

Solubility in Water
NEGLIGIBLE

Appearance and Odor
CORE OF BLACK POWDER MIXTURE WRAPPED IN PVC PLASTIC (ORANGE)

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
N/A	N/A	N/A	N/A

Extinguishing Media
DO NOT TRY TO EXTINGUISH THE FLAMES - ISOLATE AREA AND EVACUATE PERSONNEL

Special Fire Fighting Procedures
DO NOT FIGHT THE FIRE

Unusual Fire and Explosion Hazards
WILL BURN WITH EXTREMELY HOT FLAMES

IDENTITY (As used on Label and List)
SAFETY FUSE UA (M-700)

Section V - Reactivity Data

Stability			Conditions to Avoid
	Unstable		EXTREME HEAT, HUMIDITY AND ELECTROSTATIC
	Stable X		DISCHARGE

Incompatibility (Materials to Avoid)

NO KNOW CHEMICAL INCOMPATIBLITIES

Hazardous Decomposition or Byproducts

Hazardous Polymerization			Conditions to Avoid
	May Occur		
	Will Not Occur	X	

Section VI - Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
	N/A	N/A	N/A

Health Hazards (Acute and Chronic)

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
	N/A	N/A	N/A

Signs and Symptons of Exposure

N/A

Medical Conditions Generally Aggravated by Exposure

NONE

Emergency and First Aid Procedures

IN CASE OF FIRE, FOR EYES AND SKIN BURNS, IT IS RECOMMENDED TO CALL A PHYSICIAN

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled

REVIEW FIRE SAFETY PROCEDURES BEFORE STARTING ANY CLEAN UP AND WEAR APPROPRIATE PERSONAL PROTECTION ATTIRE.

Waste Disposal Method

COSULT AN EXPLOSIVES MANUFACTURER FOR PROPER GUIDANCE, USE PROPERLY TRAINED PERSONNEL AND RECOMMENDED PROCEDURES

Precautions to Be Taken in Handling and Storing

STORAGE MUST COMPLY WITH ATF REGULATIONS. MUST COMPLY WITH DOT REGULATIONS FOR PACKAGING AND TRASNPORTATION

Other Precautions

REFER TO INSTRUCTIONS AND WARNING LABELS AND LITERATURE PROVIDED BY THE MANUFACTURER

Section VIII - Control Measures

Respiratory Protection (Specify Type)

N/A

Ventilation		
	Local Exhaust N/A	Special N/A
	Mechanical (General) N/A	Other N/A

Protective Gloves	Eye Protection
N/A	N/A

Other Protective Clothing or Equipment

N/A

Work/Hygenic Practices N/A

* U.S.G.P O.: 1986-491-529/45775

All information in this MSDS has been obtained from sources considered reliable but is submitted without any warranties.

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communications Standard,
29 CFR 1910.1200. Standard must be
consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
MANTESPO #8 PLAIN CAP	

Section I

Manufacturer's Name EXPLO-INDUSTRIAS QUIMICAS E EXPLOSIVOS S.A.	Emergency Telephone Number 800-255-3924
Address (Number, Street, City, State, and ZIP Code) AV. INDUSTRIA QUIMICA MANTIQUEIRA, 317	Telephone Number for Information (817) 478-8888
LORENA, S.P. BRAZIL	Date Prepared 6-Mar-96
DOT CLASS: " DETONATORS, NON- ELECTRIC, 1.4B, UN0267, PGII" EX-8511062	Signature of Preparer (optional)

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Pentaerythrite Tetranitrate (PETN)	n/a	1.5mg/m3	n/a	
Lead Azide Pb(N3)2	n/a	1.5mg/m3	n/a	
Lead Styphnate, Lead Trinitroresorcinate, C6H3n3o9Pb	n/a	1.5mg/m3	n/a	

Section III - Physical/Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H2) = 1)	1.7
Vapor Pressure (mm Hg.)	N/A	Melting Point	N/A
Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate = 1)	0%

Solubility in Water
negligible

Appearance and Odor
odorless white solids

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
N/A	n/a	N/A	N/A

Extinguishing Media DETONATORS WILL DETONATE WHEN SET ON FIRE. ISOLATE AREA. DO NOT ATTEMPT TO EXTINGUISH THE FIRE. EVACUATE PERSONNEL TO A SAFE DISTANCE.

Special Fire Fighting Procedures DETONATORS WILL DETONATE WHEN SET ON FIRE. ISOLATE AREA. DO NOT ATTEMPT TO EXTINGUISH THE FIRE. EVACUATE PERSONNEL TO A SAFE DISTANCE.

Unusual Fire and Explosion Hazards
DETONATORS WILL EXPLODE WITH VIOLENT RELEASE OF GASES WHEN SET ON FIRE OR SUBMITTED TO SEVERE IMPACT.

(Reproduce locally)

Section V - Reactivity Data

Stability			Conditions to Avoid
	Unstable	X	KEEP AWAY FROM HEAT, SPARKS AND OPEN FLAME. AVOID SEVERE IMPACT.
	Stable		

Incompatibility (Materials to Avoid)
NO KNOWN CHEMICAL INCOMPATIBILITY

Hazardous Decomposition or Byproducts
PRODUCES NITROGEN OXIDES WHEN DETONATED

Hazardous Polymerization			Conditions to Avoid
	May Occur		
	Will Not Occur	X	

Section VI - Health Hazard Data

Route(s) of Entry: Inhalation? N/A Skin? N/A Ingestion? N/A

Health Hazards (Acute and Chronic)
NONE

Carcinogenicity: N/A
NTP? N/A
IARC Monographs? N/A
OSHA Regulated? N/A

Signs and Symptons of Exposure
N/A

Medical Conditions
Generally Aggravated by Exposure N/A

Emergency and First Aid Procedures
IN CASE OF INJURY SUSTAINED BY DETONATION, SEEK EMERGENCY MEDICAL CARE IMMEDIATELY.

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled REVIEW FIRE AND EXPLOSION SAFETY PROCEDURES BEFORE STARTING CLEAN UP OPERATIONS. WEAR APPROPRIATE PERSONAL PROTECTION CLOTHING.

Waste Disposal Method USE ONLY PROPERLY TRAINED PERSONNEL AND PROCEDURES. CONSULT EXPLOSIVES MANUFACTURER OR CONSULTANT IN CASE EXPERT PERSONNEL IS NOT AVAILABLE.

Precautions to Be Taken in Handling and Storing STORAGE OF EXPLOSIVES MUST COMPLY WITH ATF REGULATIONS PACKAGING, MARKING AND LABELING OF BOXES MUST COMPLY WITH 49 CFR DEPT. OF TRANSPORTATION REGULATIONS.

Other Precautions
KEEP PACKAGE CLOSED WHEN NOT IN USE. KEEP AWAY FROM CHILDREN. NO SMOKING IN THE GENERAL VICINITY WHERE THE MATERIAL IS BEING HANDLED. REFER TO INSTRUCTIONS AND WARNING LABELS PROVIDED BY MANUFACTURER.

Section VIII - Control Measures

Respiratory Protection (Specify Type)
n/a

Ventilation		
	Local Exhaust n/a	Special n/a
	Mechanical (General) n/a	Other n/a

Protective Gloves
n/a

Eye Protection
n/a

Other Protective Clothing or Equipment
n/a

Work/Hygenic Practices
n/a

* U.S.G.P.O.: 1986-491-529/46

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communications Standard,
29 CFR 1910.1200. Standard must be
consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
MANTELEC 2m.3m.5m. ELECTRIC DETONATOR	

Section I

Manufacturer's Name EXPLO INDUSTRIAS QUIMICAS E EXPLOSIVOS S.A.	Emergency Telephone Number 1-800-255-3924
AV. INDUSTRIA QUIMICA MANTIQUEIRA, 317	Telephone Number for Information (817) 478-8888
LORENA S.P. BRAZIL	Date Prepared May-96
	Signature of Preparer (optional)

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))		OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
PENTARYTHRITE TETRANITRATE	500mg	N/A	1.5mg/m3	N/A	
LEAD AZIDE STYPHNATE	300mg	N/A	1.5mg/m3	N/A	

Common name: 2m, 3m and 5m

Section III - Physical/Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H2) = 1)	1.7
Vapor Pressure (mm Hg.)	N/A	Melting Point	N/A
Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate = 1)	0%

Solubility in Water
NEGLIGIBLE

Appearance and Odor
ODORLESS WHITE SOLIDS

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
N/A	N/A	N/A	N/A

Extinguishing Media
ELECTRIC DETONATORS WILL EXPLODE WHEN SET ON FIRE. DO NOT TRY TO EXTINGUISH THE FIRE.

Special Fire Fighting Procedures
DO NOT ATTEMPT TO EXTINGUISH THE FIRE. EVACUATE ALL PERSONNEL TO A SAFE DISTANCE.

Unusual Fire and Explosion Hazards
DETONATORS WILL EXPLODE WITH VIOLENT RELEASE OF GASES AND DEBRIS

WHEN SET ON FIRE OR SUBMITTED TO VIOLENT IMPACT PR EXPOSED TO ELECTRIC CURRENT

IDENTITY (As used on Label and List)
MANTELEC , ELECTRIC DETONATOR

Section V - Reactivity Data

Stability			Conditions to Avoid
	Unstable	X	SEVERE IMPACT, FIRE, EXTREME HEAT, ELECTROSTATIC DISCHARGE.
	Stable		

Incompatibility (Materials to Avoid)
NO KNOW CHEMICAL INCOMPATIBILITIES

Hazardous Decomposition or Byproducts
PRODUCE NITROGEN OXIDES WHEN DETONATED

Hazardous Polymerization			Conditions to Avoid
	May Occur		
	Will Not Occur	X	

Section VI - Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
	N/A	N/A	N/A

Health Hazards (Acute and Chronic)
N/A

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
	N/A	N/A	N/A

Signs and Symptoms of Exposure
N/A

Medical Conditions
Generally Aggravated by Exposure N/A

Emergency and First Aid Procedures
IN CASE OF INJURIES SUSTAINED BY DETONATION, SEEK EMERGENCY MEDICAL CARE IMMEDIATELY

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
REVIEW FIRE AND EXPLOSION SAFETY PROCEDURES BEFORE
STARTING CLEAN-UP OPERATION. WEAR APPROPRIATE PERSONAL PROTECTION CLOTHING.

Waste Disposal Method
USE ONLY PROPERLY TRAINED PERSONNEL AND RECOMMENDED PROCEDURES. CONSULT
AN EXPLOSIVES MANUFACTURER OR CONSULTANT IN CASE AN EXPERT PERSONNEL IS NOT AVAILABLE.

Precautions to Be Taken in Handling and Storing
STORAGE OF DETONATORS MUST COMPLY WITH ATF REGULATIONS.
PACKAGING, MARKING AND LABELING OF BOXES MUST COMPLY WITH 49 CFR DEPT. OF TRANSPORTATION REGULATIONS.

Other Precautions

Section VIII - Control Measures

Respiratory Protection (Specify Type) N/A

Ventilation				
	Local Exhaust	N/A	Special	N/A
	Mechanical (General)	N/A	Other	N/A

Protective Gloves	Eye Protection
N/A	N/A

Other Protective Clothing or Equipment N/A
Work/Hygenic Practices N/A

A U.E.C.P.O.: 1986-401-570/45275

Material Safety Data Sheet

Product Name: Weatherproof Igniter, P/N 1090

SECTION I

Manufacturer's Name:
Martin & Shaft Co
Address: P. O. Box 3280, Idaho Springs, CO 80452

Telephone No.:
303-567-4801

Chemical Name & Synonyms:
Not A Chemical

Trade Name & Synonyms:
Weatherproof Igniter

Proper Shipping Name:
Lighters, Fuse UN0131

Chemical Family: N/A

Formula: N/A

C.A.S. Number: N/A

SECTION II - HAZARDOUS INGREDIENTS

Ingredient: Approximately 50 mg ignition material containing:

	CAS #	PERCENT	EXPOSURE LIMITS
Potassium Chlorate	3811-04-9	88%	No Data
Charcoal	068-647-869	10%	No Data
Other ingredients		2%	N/A
Ingredient: Approximately 10 mg Scratch Mix containing:			
Red Phosphorus	7723-14-0	98%	0.1mg/cu.mtr.
Other ingredients		2%	N/A

Note: Above ingredients enclosed within a plastic tube preventing respiratory, ingestion and skin exposure. Refer to individual MSDS from chemical manufacturer for more specific data on each ingredient.

SECTION III - PHYSICAL DATA

Boiling Point:	N/A	**Specific Gravity:**	N/A
Vapor Pressure:	N/A	**Percent Volatile:**	N/A
Vapor Density:	N/A	**Evaporation Rate:**	N/A
Solubility in Water:	N/A	**Melting Point:**	N/A

Appearance and Odor: Orange or O.D. Green plastic tube approximately 5 inches (13 cm) long.

SECTION IV - FIRE AND EXPLOSION DATA

Flash Point: N/A **Flamm. Limits:** Lel: N/A Uel: N/A

Extinguishing Media: Water

Special Fire Fighting Procedures: Saturate with water. If other explosive materials are involved see corresponding product's MSDS.

Unusual Fire and Explosion Hazards: Will not explode or burn any more rapidly than plastic tubes. Hot gases are vented out the back end of the Igniter during functioning. Do not point either end at any unprotected part of the body or flammable material.

Auto Ignition Temperature: Greater than 220 deg. F

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value: None Established

Effects of Overexposure

Eye Contact: Not A Likely Route of Exposure **Skin Contact:** Not A Likely Route of Exposure
Inhalation: Not A Likely Route of Exposure **Ingestion:** Not A Likely Route of Exposure

Emergency and First Aid Procedures

Eye Contact: Flush with water for at least 15 minutes.
Skin Contact: Wash with soap and water. For burns, cool with water and bandage appropriately.
Inhalation: If fumes from ignition are inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. If breathing is difficult give oxygen. Call a physician.
Ingestion: See individual chemical's MSDSs.

NOTE: Health hazards of the mixture contained within this article are the same as those of the individual ingredients. Refer to individual MSDS from chemical manufacturer for more specific data on each ingredient.

SECTION VI - REACTIVITY DATA

Stability: Stable **Conditions To Avoid:** Becomes unstable with flames, sparks, or heat.
Incompatibility: Incompatible with acids, alkalis, oxidants.
Hazardous Decomp. Products: Decomposes with heat. Hazardous gases produced are carbon, nitrogen, potassium, and phosphorus.
Hazardous Polymerization: Will not occur.
Conditions to Avoid: Flame, sparks, heat. Avoid breathing fumes from ignition.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps To Be Taken In Case Material Is Released Or Spilled: Clean up spilled product carefully. Wear safety glasses, leather gloves and apron. Place in metal container. Check spill site for presence of incompatible materials listed under Section VI of this MSDS that may be picked up with spilled product. If no incompatible materials were picked up with product, soak with water and seal container.
Waste Disposal Method: Refer to MSDSs of individual chemicals listed under Section II of this MSDS prior to disposal in a landfill. The chemical mixture contained within this article is considered reactive and should be disposed of as a reactive hazardous waste in accordance with all applicable state and federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection: None under normal conditions.
Local Exhaust: N/A **Special:** N/A **Mechanical:** N/A **Other:** N/A
Protective Gloves: Leather Work Gloves depending upon particular circumstances of use.
Eye Protection: Safety Glasses **Other Protective Equipment:** As required by specific application.

SECTION IX - SPECIAL PRECAUTIONS

Precautions To Be Taken In Handling and Storing, Etc.: Transportation and storage must be within local, state and federal regulations for a 1.4S (Low) Explosive
Other Precautions: Refer to manufacturer's instructions and warnings supplied with product. Read and follow manufacturer's instructions with all other products used in conjunction with Pull Wire Fuse Lighters.

Data Sheet Prepared By: B. D. Martin
Last Data Sheet Revision: May 30, 1996

The information given herein is based upon research and reports which Martin & Shaft Co considers to be reliable and correct. However, Martin & Shaft Co. does not represent, warrant or guarantee, expressly or implicitly, that this information is current, accurate or suitable to all circumstances of use.

The Ensign-Bickford company

MATERIAL SAFETY DATA SHEET

ENSI128

Manufacturer's Name:

The Ensign-Bickford Company

Emergency Telephone No:

Product Information: 1-860-843-2276
CHEMTREC: 1-800-424-9300

Address:

660 Hopmeadow St., Simsbury, CT
06070

Chemical Name and Synonyms:
N/A

Trade Name and Synonyms:
Shock Tube
2500 ft. Trunkline (TL)

Cage Code:

96336

EBCo Product Code:

X205072, X206072
X207072, X208072
DJ025025

Ingredient:	C.A.S. No.	OSHA PEL	ACGIH TLV
Cyclotetramethylene-Tetranitramine (HMX)	02691-41-0	None	None
Aluminum	7429-9-05	15mg/m³ (total dust) 5mg/m³ (resp. fraction)	10mg/m³

Ethylene-methacrylic acid copolymer, partial metal salt (Du Pont Surlyn®)	7439-92-1	None	None
Methacrylic acid	79-41-04	None	70 mg/m³
Color Concentrate	N/A	None	None
Polyethylene	9002-88-4	None	None

Boiling Point:
Aluminum: 2450° C

Specific Gravity:
N/A

Vapor Pressure:
N/A

Percent Volatile:
N/A

Vapor Density:
N/A

Evaporation Rate:
N/A

Solubility in Water:
Aluminum: No
HMX: No

Melting Point:
Aluminum: 660° C
HMX: 275° C

Appearance and Odor:
Natural or colored hollow plastic tubing with a dust coating of HMX and Aluminum powder on the interior walls of the inner tubing. The mixture by volume is approximately 14 to 16 mg. per meter ± 4.5 mg. per meter. The dust mixture is silver and has no detectable odor.

Special Fire Fighting Procedures:	**DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. ISOLATE THE AREA. EVACUATE PERSONNEL TO A SAFE PLACE.**
Extinguishing Media:	Do not fight fires involving explosives. Water may be applied through a fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate.
Unusual Fire and Explosion Hazards:	Shock Tube will burn rather than detonate. When used with one or more detonators the product may detonate. Gases which are produced are carbon dioxide, carbon monoxide and hydrocarbon gases.
Auto Ignition Temperature:	N/A

General:	Slight exposure to the powdered dust may occur during normal handling. Puncture of the plastic jacketed tube will increase the risk from exposure.
Eye Contact:	Dust will irritate. Flush immediately with running water. Seek medical attention.
Skin Contact:	Irritation may result. If exposure occurs, wash thoroughly with soap and water. If skin irritation occurs seek medical attention.
Inhalation:	Breathing dust can cause nasal and respiratory irritation . Inhalation of fine aluminum dust may be connected to pulmonary fibrosis. At processing temperatures fumes irritating to the eyes, nose and throat may be evolved. Exposure may result in redness, itching and tearing of the eyes and soreness in the nose and throat together with coughing.
Ingestion:	Methacrylic Acid and HMX are poisonous by ingestion.

The Ensign-Bickford company

MATERIAL SAFETY DATA SHEET

ENSI128

Eye Contact:	Flush using running water for 15 minutes. If irritation persists, seek medical attention.
Skin Contact:	Wash thoroughly with soap and water. If skin irritation occurs, seek medical attention.
Inhalation:	Remove victim to fresh air. If not breathing administer artificial respiration. Seek medical attention.
Ingestion:	Seek immediate medical attention.

Stability:	Stable, but do not expose to heat, fire, friction, impact, shock or static charge.
Conditions To Avoid:	Heat, shock, friction, impact or static charge.
Incompatibility:	Strong oxidizers and acids.
Hazardous Decomp Products:	Ignition will produce carbon dioxide and carbon monoxide and hydrocarbon gases. The molten plastic may cause severe thermal burns. Molten may remain hot for some time due to the low thermal conductivity of the plastic polymer. Use care when disposing of or handling the material.
Hazardous Polymerization:	Will not occur.

Step's To Be Taken In Case Material is Released or Spilled:	Review Fire and Explosive Hazards and Safety Precautions before proceeding with clean-up. Use appropriate Personal Protective Equipment during clean-up. "Loose" powder spills should be wetted down and cleaned using a damp rag or sponge. Store all collected powder in conductive bag or conductive container. Store all collected material in a secure area, to await proper disposal. Only qualified personnel should perform any clean-up and disposal.

The Ensign-Bickford company

MATERIAL SAFETY DATA SHEET

ENSI128

Waste Disposal Method:	Shock tube waste should be handled and stored in accordance with local, state and federal regulations. Any treatment of shock tube waste must be performed by qualified personnel. The preferred method of waste disposal is incineration at a controlled licensed site. The uncontrolled open burning of shock tube may result in the release of particulate listed in Section IV. Consult local, state and federal regulations for proper waste disposal procedures.

Respiratory Protection:	Under normal surface use no respiratory protection is required. Any extended testing of the product indoors may require respiratory protection. See section V, Inhalation.
Ventilation:	Product is intended for outside use and for use in underground mines. Ventilation should be provided when used in underground mines or if any extended testing is to be performed indoors.
Protective Gloves:	None
Eye Protection:	Safety glasses with side shields.
Other Protection:	None

Precautions To Be Taken In Handling and Storage:	Transportation and storage must be in accordance with local, state and federal regulations. Store away from sparks or other sources of ignition. Avoid heat, shock and impact.

SARA 313 Information: This product does not contain any compounds which fall under the reporting requirements of SARA Title III; Section 313.

Data Sheet Prepared By: The Ensign-Bickford Company

Last Data Sheet Revision: 04/19/2000

The Ensign-Bickford company

ENSI123

MATERIAL SAFETY DATA SHEET

HMIS	
0	HEALTH
4	FLAMMABILITY
4	REACTIVITY
X	PROTECTIVE EQUIPMENT

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer's Name:
The Ensign-Bickford Company
660 Hopmeadow St.
Simsbury, CT 06070

Emergency Telephone No:
Product Information: (860) 843-2276
(860) 658-4411 (24 hours a day)

Chemical Name and Synonyms:
Not applicable

Trade Name and Synonyms:
PRIMADET® NONELECTRIC DETONATORS, SHORT LEAD (SL), EZ TRUNKLINE™ DELAY (EZTL), NOISLESS TRUNKLINE DELAY (NTD), LONG PERIOD (LP), EZ DET®, MILLISECOND (MS), MS CONNECTOR (MSC), EZ DRIFTER®), OPTIMIZER®, OPTISLIDE®, OPTISURFACE®, OPTI-TL®

Cage Code:
96336

EBCo Product Code(s):
SL, EZTL, NTD, LP, EZ DET®, MS, MSC, EZ DRIFTER®, OPTIMIZER®, OPTISLIDE®, OPTISURFACE®, OPTI-TL®

SECTION 2 - COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient:	CAS NUMBER	OSHA PEL	ACGIH TLV
Molybdenum	7439-98-7	15 mg/m^3	10 mg/m^3
Tungsten	7440-33-7	5 mg(W)/m^3 insoluble, 1 mg(W)/m^3 soluble	5 mg(W)/m^3 insoluble, 1 mg(W)/m^3 soluble
Aluminum	7429-9-5	15 mg/m^3 total dust 5 mg/m^3 resp. frac.	10 mg/m^3
Silicon	7440-21-3	15 mg/m^3 total dust 5 mg/m^3 resp. frac.	15 mg/m^3 total dust 5 mg/m^3 resp. frac.
Selenium	7782-49-2	0.2 mg/m^3	0.2 mg/m^3
Potassium Perchlorate	7778-74-7	None	None
Red Lead (Lead tetroxide)	1314-41-6	0.05 mg(Pb)/m^3	0.05 mg(Pb)/m^3
Titanium Dioxide	13463-67-7	10 mg/m^3	10 mg/m^3
Barium Chromate	12094-40-3	TWA 2691.41 mg(CrO_3)/m^3; 0.5 mg/(Ba)/m^3	TWA 0.5 mg/(Ba)/m^3 0.05 mg(Cr)/m^3 confirmed carcinogen
Lead Chromate	7758-97-6	TWA 0.05 mg(Pb)/m^3; CL 0.1 mg(CrO_3)/m^3	0.05 mg(Cr)/m^3; confirmed carcinogen
Barium Sulfate	7727-43-7	15 mg/m^3 total dust 5 mg/m^3 resp. frac.	10 mg/m^3 total dust
Silica (crystalline)	61790-53-2	TWA Resp Frac 10 mg/m^3/2(%SiO_2+2); TWA 0.05 mg/m^3	TWA Resp Frac 0.05 mg/m^3
Pentaerythritol Tetranitrate (PETN)	78-11-5	None	None
Lead Azide	13424-46-9	0.05 mg(Pb)/m^3	0.15 mg(Pb)/m^3 TWA
Lead	7439-92-1	0.05 mg(Pb)/m^3	0.15 mg(Pb)/m^3 TWA
Antimony	7440-36-0	TWA 0.5 mg/m^3	TWA 0.5 mg/m^3
Cyclotetramethylene Tetranitramine (HMX)	02691-41-0	Not established	Not established

JUN 26 '00 15:30 FR B3 TRAINING 860 843 2513 TO 9803786947 2 P.02/14

SECTION 3 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

Detonators are designed to explode with substantial energy release. Detonators are not to be placed in contact with corrosive acidic or caustic environments which may corrode the aluminum detonator shell to potentially allow ingress of contaminants which increase the sensitivity of the internal components. Detonators must not be subjected to impact, electrostatic discharge or conditions that could penetrate the aluminum shell and cause detonation.

POTENTIAL HEALTH EFFECTS:

Eye Contact:	Not a likely exposure because the detonator is sealed and the user is not subjected to the component during normal handling and before detonation. Post detonation reaction products may produce dust that can irritate; corneal injury may result. Flush immediately with running water for at least 15 minutes. Seek Medical attention. Symptoms of exposure include redness, swelling, itching, tearing and pain.
Skin Contact:	Not a likely route of exposure since the detonator is a sealed assembly. If exposed to post-detonation reaction products occurs, wash thoroughly with soap and water. If skin irritation occurs, seek medical attention. Symptoms may include redness, swelling, itching and pain.
Inhalation:	Breathing dust from post detonation reaction products can cause nasal and respiratory irritation and lowering of blood pressure. Lead exposure at high levels can cause acute or chronic symptoms can range from eye and skin irritation to permanent brain damage, vomiting and convulsions. Prolonged or repeated exposure to post function residue may result in respiratory tract irritation, and symptoms may include coughing, shortness of breath, sore throat and runny nose. If sufficient amounts are inhaled and absorbed, symptoms may resemble those in acute ingestion.
Ingestion:	See INHALATION. Post function residue is toxic by ingestion. Symptoms may include gastroenteritis (inflammation of the lining membrane of the stomach and intestines) with abdominal pain, nausea, vomiting and diarrhea. Systemic effects may follow and may include ringing of the ears, dizziness, elevated blood pressure, blurred vision and tremors.
Carcinogenicity:	ACGIH classifies Lead as a "Suspected Human Carcinogen", and insoluble Chromium VI as "Confirmed Human Carcinogen". NTP, OSHA, and IARC consider components contained in this detonator carcinogenic. Reference Section 11, Toxicological Information, in this MSDS.

SECTION 4 - FIRST AID MEASURES

Product is fully contained and presents low risk of skin contact, ingestion or inhalation of chemical constituents during normal handling. Personnel could be exposed to by-products during functional detonation of the unit and post clean up.

Eye Contact:	Flush using running water for at least 15 minutes. If irritation persists, seek medical attention.
Skin Contact:	Wash exposed area with soap and water. If irritation persists, seek medical attention.
Inhalation:	Remove victim to fresh air. If breathing is difficult, give oxygen. If not breathing, administer artificial respiration. Seek medical attention.
Ingestion:	Give large quantities of water. Induce vomiting in a conscious victim. Seek immediate medical attention. .

JUN 26 '00 15:30 FR B3 TRAINING 860 843 3513 TO 9803786947 2 P.03/14

SECTION 5 - FIRE FIGHTING MEASURES

Flash Point: N/A	**Explosive Limits:** LEL: N/A UEL: N/A
Special Fire Fighting Procedures:	DO NOT FIGHT FIRES INVOLVING DETONATORS OR EXPLOSIVES, PRODUCT MAY EXPLODE. ISOLATE THE AREA, EVACUATE PERSONNEL TO A SAFE DISTANT LOCATION. ALLOW FIRE TO BURN OR FIGHT FIRE REMOTELY.
Extinguishing Media:	DO NOT FIGHT FIRES INVOLVING DETONATORS AND EXPLOSIVES. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate. Extinguish fire using inert powder, but only if it can be applied remotely.
Unusual Fire and Explosion Hazards:	All the PRIMADET® Nonelectric Detonators covered in this MSDS are sealed at manufacture. Should a detonator break open to expose the internal components, extreme care must be used when handling. Only authorized personnel should handle a damaged detonator. A damaged detonator can explode if exposed to shock, impact, friction, or electrostatic discharge (ESC). Hazardous gasses released upon detonation are nitrogen oxides, carbon monoxide and carbon dioxide. The likelihood of mass detonation is increased if the fire occurs in a confined space. All personnel must be evacuated.
Auto Ignition Temperature:	190°C at which PETN may detonate. Other components may also detonate at higher temperatures.
Hazardous Combustion Products:	Hazardous gasses produced are oxides of nitrogen and carbon. Airborne particulates, including the metals found in Section 2 may be released.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

For the following reasons, only properly qualified and authorized personnel should involved with handling and clean-up of damaged detonators PRIMADET® Nonelectric Detonators contain Lead Azide which is extremely sensitive to initiation by electrostatic discharge which can cause detonation. Precautions must be taken to avoid generation and discharge of electrostatic energy during all procedures. In the event of any spill of loose powder, such as from a broken detonator, all spilled material should be treated with Ceric Ammonium Nitrate killing solution (10%). This will chemically decompose the Lead Azide, but PETN and pyrotechnics will remain reactive, therefore, all residue materials must be assumed to be explosive-contaminated until proper waste disposal (see below) is complete. Only qualified personnel should perform a clean up and disposal of explosive material. Use recommended exposure controls/protective clothing, equipment and handling procedures (see Section 7 & Section 8).

Review Fire and Explosive Hazards and Safety Precautions before proceeding with clean up. Isolate the spill area; removing all sources of ignition from the location. Remove all explosives that were not involved in the spill from the spill area. Carefully collect the spilled material and place in a (Velostat®) electrically conductive bag. Contamination of this material with sand, grit, or dirt will render the material more sensitive to detonation. If safe, separate material that is not contaminated from contaminated material. Loose powder spills should be cleaned-up in a manner that does not disperse dust into the air. The preferred method is to desensitize the spilled material with water and wipe up with a soapy damp sponge. Collect wash water for approved disposal. Store all collected water/material in a secure area, to await proper disposal. Keep from entering water or ground water.

JUN 26 '00 15:31 FR B3 TRAINING 860 843 3513 TO 9803786947 2 P.04/14

SECTION 7 - HANDLING AND STORAGE

HANDLING: ***Only properly qualified and authorized personnel should handle and use PRIMADET® Nonelectric Detonators.*** Avoid breathing post-detonation dust; avoid getting in eyes or on skin. Wash thoroughly after handling shot detonators or after exposure to post-detonation residues. Protect shipping container against physical damage. Store in cool, dry place, and avoid sources of heat, shock, impact, friction and electrostatic discharge (ESD). Utilize recommended exposure controls/protective clothing (Section 8) when working with post-detonation residues or the contents of a damaged detonator.

TRANSPORTATION AND STORAGE: Must be in accordance with Federal, State and Local Regulations. Store away from sparks or other ignition sources. Avoid heat, impact and shock.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection:	NIOSH/MSHA approved high efficiency particulate respirator to protect against dust if OSHA PEL is exceeded. NIOSH/MSHA approved self-contained respirator for emergency use. However, respiratory protection is not required for normal use of these detonators providing PEL is not exceeded.
Ventilation:	Product is intended for outside use and underground mines. Ventilation should be provided for underground use. Ventilation should also be provided if repetitive indoor testing is to be performed. Provide local exhaust and mechanical ventilation as needed so as not to exceed PEL.
Protective Gloves:	Not required for normal use and handling of detonators as received from the manufacturer. Protective gloves should be worn when handling post-detonation residues, the contents of damaged detonators, and any chemicals used to chemically decompose Lead Azide. Rubber gloves are recommended.
Eye Protection:	Safety glasses or goggles are recommended for handling, testing, or clean up.
Other Protection:	Detonators are to be handled only by qualified and authorized personnel. Follow instructions on the manufacturers data sheet.

JUN 26 '00 15:32 FR B3 TRAINING 860 843 2513 TO 9803786947 2 P.05/14

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Component	Boiling Point (°C)	Melting Point (°C)	Solubility in Water	Specific Gravity (gm/cc)
Molybdenum	425	2622	No	10.2
Tungsten	5900	3980	No	19.3
Aluminum	2450	660	No	2.7
Silicon	2675	1410	No	2.4
Selenium	690	217	No	4.81
Potassium Perchlorate	Decomp at melting	400 decomp	Yes	2.52
Red Lead	Decomp at melting	500 decomp	No	9.29
Titanium Dioxide	Decomp at melting	1640 decomp	No	4.26
Barium Chromate	Not established	Not established	No	4.5
Lead Chromate	Decomp at melting	844	No/slight	6.3
Barium Sulfate	Decomp at melting	1580	No	4.5
Silica (crystalline)	2230	1710	No	2.6
PETN	Decomp at melting	140	Slight	1.76
Lead Azide	Decomp at melting	Explodes 330	Slight	4.8
Lead	1740	327	No	11.34
Antimony	1636	630	No	6.68
HMX	Decomp at melting	274	Slight	1.96

Boiling Point:
Aluminum: 1 mm @ 1284°C
Lead: 1 mm @ 973°C

Specific Gravity:
See above table

Vapor Pressure: N/A

Percent Volatile: N/A

Vapor Density: N/A

Evaporation Rate: N/A

Appearance and Odor: The aluminum detonator shell contains a lead sheathed pyrotechnic which is located between an explosive output change consisting of PETN and or Lead Azide, and a length of flexible plastic tube (Shock Tube). The shock tube is inserted into a black rubber bushing and both are retained in the aluminum shell by a secure crimp at the open end of the shell. The shock tube contains a dust on the inside surface of a mixture of explosive and aluminum powder. The shock tube may be of various colors, vary from several feet to over one hundred feet in length, in coils or on spools. The detonator may be enclosed in a plastic housing (connector), and the MS Connector has a detonator and plastic housing on each end of a short length of shock tube.

Odor: odorless

SECTION 10 - STABILITY AND REACTIVITY

Stability:	Stable under normal conditions, but improper handling can result in accidental detonation.
Conditions To Avoid:	High temperatures, shock, impact, friction and electrical static discharge (ESD).
Incompatibility:	Detonators are designed to explode with substantial release of energy to initiate other explosive devices. Detonators are not to be placed in corrosive environments that may corrode the aluminum detonator shell to allow ingress of contaminants that may react adversely with internal components.
Hazardous Decomposition Products:	Functioning of these PRIMADET® Nonelectric Detonators, may evolve oxides of carbon (CO and CO_2) and oxides of nitrogen, heavy metal oxides, sulfides and chromates. Solid elemental Lead and Antimony and fumes will be present.
Hazardous Polymerization:	Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION	
Compound	**Toxicological Information**
Molybdenum	**Carcinogenicity:** not listed as carcinogenic by NTP, IARC or OSHA. **Irritant:** fumes and dust may cause eye, nose, throat, and respiratory tract irritation. **General Toxicity:** LDLo 70 mg/kg in rabbit caused fibrosis, focal effects. **Reproductive Effects:** TDLo 448 mg/kg oral mouse (multigenerations) caused fetotoxicity, fetal death. Mutagenicity: cytogenetic analysis, rat-inhalation, dose 19500 ug/m^3, ref. Gig Tr Prof Zabol, vol 24(9), pg 33, 1980 (GTPZAB)
Tungsten	**Carcenogenicity:** not listed as carcinogenic by NTP, IARC or OSHA. **Irritant:** 500 mg/24H, mild irritant to eyes and skin (rabbit), dust may cause eye, throat, and irritation. **General Toxicity:** LD50 rat intraperitoneal dose 5 gm/kg effects vascular, blood and liver. **Reproductive Effect:** LDLo oral rat dose 1210 ug/kg, (35W pre) musculoskeletal system abnormalities. changes, post-implantation mortality.
Aluminum	**Carcenogenicity:** not listed as carcinogenic by NTP, IARC or OSHA. **Irritant:** mild irritant to eyes, dust may cause eye, throat, or respiratory irritation. **General Toxicity:** Inhalation of finely divided powder may cause pulmonary fibrosis. **Mutagenicity:** no data.
Silicon	**Carcenogenicity:** not listed as carcinogenic by NTP, IARC or OSHA. **Irritant:** mild irritant to eyes (eye, rabbit, 3 mg), dust may cause skin or respiratory irritation, **General Toxicity:** LDLo intraperitoneal, rat, dose 500 mg/kg, effect sense organs and special senses, lungs, thorax or respiration. **Reproductive Effect:** no data, **Mutagenicity:** no data
Selenium	**Carcenogenicity:** not listed as carcinogenic by NTP, IARC or OSHA, TDLo 480 mg/kg/60D-C, oral mouse, tumorigenic, skin and appendages. **Irritant:** eye and respiratory irritation. **General Toxicity:** Reported kidney damage, liver damage to lab animals from chronic exposure. LCLo inhalation rat 33 mg/kg/8H, hemorrhage, emphysema, acute pulmonary edema, LD50 oral rat 6700 mg/kg, somnolence, dyspnea. **Reproductive Effect:** LDLo oral mouse is 134 mg/kg producing fetotoxicity, fetal death. **Mutagenicity:** no data.
Potassium Perchlorate	**Carcenogenicity:** not listed as carcinogenic by NTP, IARC or OSHA. **Irritant:** may cause eye and respiratory irritation. **General Toxicity:** no data. **Reproductive Effects:** TDLo oral rat 27675 mg/kg causes abnormalities of endocrine system. **Mutagenicity:** no data
Red Lead (Lead Tetroxide)	**Carcenogenicity:** Red lead is not listed by NTP, IARC or OSHA as carcinogenic, however, Lead is an IARC listed 2B carcinogen, possibly carcinogenic to humans, see Lead. **Irritant:** no data. **General Toxicity:** excessive exposure may cause nervous, digestive, renal and reproductive system disorders. Moderately toxic by ingestion. LDLo guinea pig oral dose 1 gm/kg effected behavior, nucleated red blood cells. **Reproductive Effect:** may cause reproductive system disorders with excessive exposure. **Mutagenicity:** no data.
Titanium Dioxide	**Carcenogenicity:** not listed by NTP, IARC or OSHA as carcinogenic to humans. TCLo inhalation rat dose 250 mg/m^3 tumorigenic to lungs, thorax or respiratory system. **Irritant:** mild human skin irritant, 300 ug/3D-I. **General Toxicity:** no data. **Reproductive Effect:** no data. **Mutagenicity:** no data.
Barium Chromate	**Carcenogenicity:** Listed as NTP and IARC as a Group 1 chemical, carcinogenic to humans. **Irritant:** may cause severe skin, eye and respiratory irritation. **General Toxicity:** no data. **Reproductive Effect:** no data. **Mutagenicity:** no data.
Lead Chromate	**Carcinogenicity:** NTP 5th Report, IRAC group 1 classification as carcinogenic to humans. ACGIH lists Lead Chromate as a substance suspect of carcinogenic potential in man. TDLo subcutaneous rat dose 135 mg/kg causes tumors at site of application. **Irritant:** May cause skin, eye and respiratory irritation. **General Toxicity:** LD50 oral rat dose >12 gm/kg. **Reproductive Effect:** no data. **Mutagenicity:** no data.

JUN 26 '00 15:32 FR B3 TRAINING 860 843 2613 TO 980378694 72 P.07/14

Barium Sulfate	**Carcenogenicity:** Not listed by NTP, IARC or OSHA as carcinogenic. TDLo intrapleural rat dose, 200 mg/kg produced tumors of lungs, thorax or respiration. **Irritant:** may cause skin and eye irritation. **General Toxicity:** LD intratracheal mouse, >600 uL/kg produced changes in lungs, thorax or respiration. Reproductive Effect: no data. **Mutagenicity:** : Micronucleus test, mouse intraperitoneal dose 12500 ug/kg, effect not listed (ref. GWZHEW)
Silica (Ottawa Sand) (crystalline silica)	**Carcenogenicity:** Classified by IARC as a Group 2A chemical, which is probably carcinogenic to humans. **Irritant:** mild to eyes. **General Toxicity:** Exposure to crystalline free silica may cause silicosis, pulmonary fibrosis. Moderately toxic as an acute irritating dust. **Reproductive Effect:** no data. **Mutagenicity:** no data
Pentacrythritol Tetranitrate (PETN)	**Carcenogenicity:** Not listed by NTP, IARC or OSHA as carcinogenic. **Irritant:** Skin and eye irritant. **General Toxicity:** moderately toxic by ingestion. Vasodilator. PETN can lower blood pressure. LD50 intraperitoneal mouse dose >5 gm/kg causes arteriolar or venous dilation. TDLo oral man, 1669 mg/kg/8Y-C, dermatitis after systemic exposure. **Reproductive Effect:** no data. **Mutagenicity:** no data.
Lead Azide	**Carcinogenicity:** Not considered to be a carcinogen by IARC, NTP or OSHA, however, Sax's Dangerous Properties of Industrial Materials lists Lead as IARC 2B, possibly carcinogenic to humans. **Irritant:** may cause eye and skin irritation. **General Toxicity:** A deadly poison may be fatal if swallowed, may cause anemia, kidney damage. **Reproductive Effect:** may cause damage to reproductive system. **Mutagenicity:** no data.
Lead	**Carcenogenicity:** Lead is classified by IARC to be a 2B carcinogen, possibly carcinogenic to humans. **Irritant:** May cause eye and skin irritation. **General Toxicity:** may be fatal if swallowed, may cause anemia, kidney damage and damage to reproductive system. TDLo oral woman dose 450 mg/kg/6Y produced peripheral nerve and sensation effects, hallucinations, distorted perceptions, muscle weakness. TCLo inhalation human. **Reproductive Effect:** may cause damage to reproductive system. TCLo inhalation rat dose, 10 mg/m^3/24H(1-21D preg) produced effects on embryo or fetus (fetotoxicity) or specific developmental abnormalities of the blood and lymphatic systems. **Mutagenicity:** no data
Antimony	**Carcinogenicity:** Antimony is not considered to be carcinogenic by the IARC, NTP or OSHA. TCLo inhalation rat, dose 50 mg/m^3/7W/52W-I, causes tumors of lungs, thorax or respiratory system. **Irritant:** no data. **General Toxicity:** inhalation of dusts may cause acute pneumonitis, nausea, vomiting. LD50 oral rat dose, 7 gm/k. **Reproductive Effect:** no data. **Mutagenicity:** no data.
HMX	**Carcinogenicity:** Not considered to be a carcinogen by IARC, NTP or OSHA. . **Irritant:** Skin and eye irritant. **General Toxicity:** A poison by ingestion and intravenous routes. LD50 oral guinea pig 300 mg/kg. **Reproductive Effect:** no data. **Mutagenicity:** no data.

SECTION 12 - ECOLOGICAL INFORMATION

Data not available at the present time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Disposal Method:	All detonators are classified as hazardous waste with the characteristic of reactivity, EPA Hazardous Waste Number of D003; see CFR 40 Section 261. Any such waste should be treated and stored in accordance with local, state and federal regulations. The current preferred method of waste treatment for waste detonators is remote detonation in a confined chamber designed for this purpose. The (unconfined) detonation of waste detonators may result in the release of lead particulate. Open burning of detonators is likely to result in detonation, and is not recommended. Any treatment of waste detonators must be performed by qualified personnel at permitted facilities and may require a permit.

JUN 26 '00 15:33 FR B3 TRAINING 860 843 3513 TO 9803786942 P.08/14

SECTION 14 - TRANSPORT INFORMATION

Transportation:	Transport only in accordance with Federal, State and Local regulations for transportation of explosives. Additional reference information for transportation of explosives and energetic materials is provided in the DoD Contractor's Safety Manual for Ammunition and Explosives, DoD 4145.26-M.

SECTION 15 - REGULATORY INFORMATION

SARA 313 Information:	The Primadet nonelectric delay detonators contain chemicals that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986, and 40 CFR Part 372. See attachments for quantities present specific to each product.

SECTION 16 - OTHER INFORMATION

Disclaimer:	****The information described in this material safety data sheet cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations are based on the manufacturer's experiences and research. They are believed to be accurate, but no warranties are made, expressed or implied. The information is offered as typical and not as a product specification. The recommended handling procedures are believed to be generally applicable, however, each user should review these recommendations in the context of the specific intended use.*
Other Precautions:	Refer to Manufacturer's Instructions and Warnings supplied with Product Data Sheet
Prepared By:	E.L. Gladden, Manager M/S
Date Data Sheet Prepared:	May 14, 1999
Data Sheet Reviewed By:	J. W. Fowler

JUN 26 '00 15:34 FR B3 TRAINING 860 843 2513 TO 9803786947 2 P.09/14

ORICA

Material Safety Data Sheet

Orica Canada Inc.
6275 Northam Dr. Unit 1,
Mississauga, Ont. L4V 1Y8
For MSDS Requests: (905) 405-5617

Orica USA Inc.
9781 Meridian Blvd.
Englewood, CO 80112-5911 USA
For MSDS Requests: (303) 268-5000

EMERGENCY CONTACTS

FOR CHEMICAL EMERGENCIES(24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: IN CANADA CALL THE ORICA CANADA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT 1-877-561-3636; IN THE U.S. CALL CHEMTREC (800) 424-9300. IN THE U.S. FOR LOST, STOLEN OR MISPLACED EXPLOSIVES CALL: BATF (800) 424-9555.

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Non-Electric Detonator Assemblies**
MSDS Number: 20080

MATS Index: 58594
Date Issued: 26-AUG-98
(Amended Section 2, 15-MAR-99)
(Amended Section 9, 03-MAR-00)
(Amended Section 14, 03-MAR-00)
(Amended Name & Address, 03-MAR-00)

Product Use: Explosives.

SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENT(S)	% (w/w)	ACGIH TWA	CAS NO.

A signal line (solid core and/or shock tube) containing an explosive charge of PETN (Anoline) or HMX/A1 blend (NONEL/EXEL) and a detonator containing:

Pentaerythritol Tetranitrate (PETN) (CAS 78-11-5)
Lead Azide (13424-46-9)

May contain a lead sheathed delay element(s); may include a delay composition.

SECTION 3 - HAZARD IDENTIFICATION

Emergency Overview: Risk of explosion by shock, friction, fire or other sources of ignition. Read the entire MSDS for amore thorough evaluation of the hazards.

SECTION 4 - FIRST AID MEASURES

General: Not applicable; this is a packaged product that will not result in exposure to the contents under normal conditions of use. In the event of contact, administer first aid appropriate for burns, lacerations and bruises.

SECTION 5 - FIRE-FIGHTING MEASURES

Flash Point: Not applicable.
Flammable Limits (Lower): Not applicable.
Flammable Limits (Upper): Not applicable.
Auto Ignition Temperature: PETN explodes at 190-210°C (374 to 410°F)
Decomposition Temperature: PETN melts at 140°C (284°F). Prolonged heating of detonators may cause an explosion at a lower temperature.
Rate of Burning: Product will burn and detonate.
Explosive Power: Not available.
Sensitivity to Mechanical Impact: Sensitive to mechanical impact.
Sensitivity to Static Discharge: Relatively insensitive to electrostatic discharge.
Hazardous Reactions: None known.
Fire and Explosion Hazards: This product is a high explosive with a mass detonation hazard.
Extinguishing Media: See below.

Fire Fighting Procedures: DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against reentry.
Fire Fighting Protective Equipment: Not applicable.
NOTE: Also see "Section 10 - Stability and Reactivity".

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spills, Leaks, or Releases: Pick up by hand. Use normal precautions taken for handling explosives.
Deactivating Chemicals: Not required. If detonators are broken, contact the product advisor.

SECTION 7 - HANDLING AND STORAGE

Handling: This product is an explosive and should only be used under the supervision of trained personnel. Avoid rough handling. Keep upwind from discharging unit.
Storage Requirements: Store under moderate temperatures recommended by a technical service representative. Store under dry conditions in a well ventilated magazine that has been approved for detonator storage. DO NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, sparks and flames. Keep containers closed. Initiating explosives should be kept well away from explosives; protected from physical damage; separated from oxidizing materials, combustibles, and sources of heat. Keep away from incompatibles. Meet all regulatory requirements for shipping and magazining.
Storage Temperature: It is recommended that detonators not be exposed to temperatures greater than 70°C (158°F). without approved procedures to address the elevated temperatures.

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

PREVENTIVE MEASURES:
Recommendations listed in this section indicate the type of equipment which will provide protection against overexposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: Full handling precautions should be taken at all times.
PERSONAL PROTECTIVE EQUIPMENT:
Eye Protection: Use safety glasses as good general practice.
Skin Protection: Not required.
Respiratory Protection: Not required.
EXPOSURE GUIDELINES:
PRODUCT:
None established for product.
HAZARDOUS INGREDIENT(S):

Nitrogen Dioxide:		
	ACGIH TLV	3 ppm
	OSHA STEL	1 ppm
Carbon Monoxide:		
	ACGIH TLV	25 ppm
	OSHA STEL	35 ppm
Sulphur Dioxide:		
	ACGIH TLV	2 ppm
Lead:		
	ACGIH TLV	0.05 mg/m3
	OSHA STEL	0.05 mg/m3
	Internal Guideline	0.05 mg/m3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Alternate Name(s):

TYPE A: Anodet MS, Bunch Connector, Exel Constadet, Exel Handidet, Exel Handidet LP, Exel Handidet XT, Exel HTD XT, Exel LP, Exel MS, Exel MS Connectors, Exel RTD Detonators, Exel SHD, Exel T&D, Exel XT, NLLD, Exel Noiseless Lead-in Line Detonators, Uniconnector, X-331 MS Connector, X-332 , X-333 LP, X-334 Lead-in Line, X-335 SD, X-375 XT, X-387 Exel.

TYPE B: Exel Constadet, Exel Handidet, Exel Handidet LP, Exel Handidet XT, Exel HTD XT, Exel LP, Exel MS, Exel MS Connectors, Exel T&D, Exel XT, X-375 XT

TYPE C: Exel HTD, Exel HTD XT, Exel Noiseless Lead-in Line Detonators

Chemical Name: Not applicable.

Chemical Family: Explosive.
Molecular Formula: Not applicable.
Appearance: Ingredients housed in an aluminum or copper shell.
Odour: Odourless.
pH: Not applicable.
Vapour Pressure (mm Hg at 20°C/68°F): Not applicable.
Vapour Density (Air=1): Not applicable.
Boiling Point: Not applicable.
Melting Point: PETN melts at 140°C (284°F)
Solubility (Water): (Negligible)
Solubility (Other): Not applicable.
Specific Gravity: Not applicable.
Evaporation Rate: Not applicable.

SECTION 10 - STABILITY AND REACTIVITY

Hazardous Decomposition Products: Thermal decomposition products are toxic and may include hydrocarbons, oxides of carbon, sulphur, lead and nitrogen.
Chemical Stability: Unstable. Can explode on impact.
Conditions to Avoid: Keep away from heat, sparks and flame. Keep away from heat, impact and friction.
Incompatibility with other Substances: Strong oxidizing agents.
Hazardous Polymerization: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICOLOGICAL DATA:
PRODUCT:
None established for product.
INGREDIENTS:
None established for hazardous ingredients.
POTENTIAL HEALTH EFFECTS:
Inhalation: Detonation decomposition products may be toxic.
Skin Contact: No evidence of irritant effects from normal handling and use.
Eye Contact: No evidence of irritant effects from normal handling and use.
Ingestion: Highly unlikely under normal industrial use.
Sub chronic Effects: None known.
Chronic Effects: None known.
Carcinogenicity: The ingredients of this product are not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).
Mutagenicity: There is no evidence of mutagenic potential.
Reproductive Effects: No information is available and no adverse reproductive effects are anticipated.
Teratogenicity and Fetotoxicity: No information is available and no adverse teratogenic/embryotoxic effects are anticipated.
Synergistic Materials: None known.

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicological Information: None known.
Environmental Effects: By considering the production and use of the substance, it is unlikely that significant environmental exposure will arise.

SECTION 13 - DISPOSAL CONSIDERATIONS

Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in bore holes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an Orica Canada Inc. or Orica USA Inc. Technical Representative.

SECTION 14 - TRANSPORT INFORMATION

TDG Name: Detonator assemblies, non-electric.
Proper Shipping Name: Detonator assemblies, non-electric.
Class/Division: Type A: 1.1B. **Type B:** 1.4B. **Type C** - 1.4S. (**"Type"** explained in Alternate Name, Section 9)
Product Identification Number (PIN): Type A: UN0360 **Type B:** UN0361 **Type C:** UN0500 (**"Type"** explained in Alternate Name, Section 9)
Packing Group: II

Transportation Emergency Telephone Number: Canada: 1-877-561-3636. U.S.: 1-800-424-9300.
DOT Class: 1.1 - Explosive.

SECTION 15 - REGULATORY INFORMATION

CANADIAN CLASSIFICATION:
This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.
Controlled Products Regulations (WHMIS) Classification: This product is an explosive and is not regulated by WHMIS.
CEPA / Canadian Domestic Substances List (DSL): The substance(s) in this product is/are on the Canadian Domestic Substances List (CEPA DSL).
IARC Classification: None of the components of this product are listed on IARC.
USA CLASSIFICATION:
OSHA Classification:
Physical: Explosive.
Health: Not regulated.
Target Organ: None identified.
SARA Regulations Sections 313 and 40 CFR 372: This product does not contain any chemicals subject to reporting requirements.
Ozone Protection and 40 CFR 42: This product does not contain nor is it manufactured with ozone depleting substances.
Other Regulations/Legislation which apply to this product: None known.

SECTION 16 - OTHER INFORMATION

MATS Index: 58594

REFERENCES:
RTECS-Registry of Toxic Effects of Chemical Substances, CCINFOdisc, Canadian Centre for Occupational Health and Safety, National Institute of Occupational Safety and Health, U.S. Dept. of Health & Human Services, Cincinnati, 1998.

Supplier's Material Safety Data Sheets.

Prepared by: Safety, Health and Environment (905) 405-5617.

The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica Canada Inc. or Orica USA Inc. will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

Material Safety Data Sheet

Energetic Solutions Inc.
9781 South Meridian Blvd., Englewood, CO 80112-5911 USA
Telephone: (303) 268-5000

EMERGENCY CONTACTS

FOR CHEMICAL EMERGENCIES (24 HOURS) INVOLVING TRANSPORTATION, SPILL, RELEASE, FIRE OR ACCIDENTS: CHEMTREC (800) 424-9300. FOR LOST, STOLEN OR MISPLACED EXPLOSIVES: BATF (800) 424-9555.

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Bulk Tubing** (EXEL Silent Lead-In-Line, EXEL Shocktube (Bulk), NONEL Lead-In-Line, NONEL Shocktube (Bulk)
MATS Index: 60930
MSDS Number: 20015 **Date Issued: 28-OCT-99**

Product Use: Signal line.

SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENT(S)	% (w/w)	ACGIH TWA	CAS NO.
Cyclotetramethylenetetranitramine	0.1-1	Not Listed.	2691-41-0
Aluminum	0-0.1	2 mg/m3	7429-90-5
Colour Master Batch	0.1-1	Not Listed.	Not Listed.

SECTION 3 - HAZARD IDENTIFICATION

Emergency Overview: The following information is the potential hazards associated with the pure ingredient of this product. It is our belief that, under conditions of normal occupational exposure, this product should not pose such hazards to the worker. Low acute toxicity. Read the entire MSDS for a more thorough evaluation of the hazards.

SECTION 4 - FIRST AID MEASURES

General: If you feel unwell seek medical advice (show the product label where possible).
Inhalation: If respiratory problems arise, move the victim to fresh air. Give artificial respiration ONLY if breathing has stopped. *Giver cardiopulmonary resuscitation (CPR) if there is no breathing AND no pulse. Obtain medical advice IMMEDIATELY>*
Skin Contact: Wash immediately with water followed by soap and water.
Eye Contact: Immediately flush eyes thoroughly for 5 minutes with running water. Hold eyelids open during flushing. If irritation persists, repeat flushing and obtain medical attention.
Ingestion: If victim is alert and not convulsing, rinse mouth out and give 200-300 mL (1 cup) of water to dilute material. DO NOT induce vomiting. If spontaneous vomiting occurs, have victim lean forward with head positioned to avoid breathing in of vomitus, rinse mouth and administer more water. Obtain medical attention IMMEDIATELY.
Note to Physicians: Symptomatic. Treatment and supportive therapy as indicated.

SECTION 5 - FIRE-FIGHTING MEASURES

Flash Point: This product does not flash.
Flammable Limits (Lower): Not applicable.
Flammable Limits (Upper): Not applicable.
Auto Ignition Temperature: 349°C (660.2°F).
Decomposition Temperature: 300°C (572°F).
Rate of Burning: Not available.
Explosive Power: Not applicable.
Sensitivity to Mechanical Impact: Not expected to be sensitive to low velocity mechanical impact. High velocity impacts may cause initiation. Elastic recoil following stretching line to breaking point can cause ignition of the tube. See case inset for more information.
Sensitivity to Static Discharge: Not expected to be sensitive to static discharge.
Hazardous Reactions: See 'Fire and Explosion Hazards'.
Fire and Explosion Hazards: Explodes on overheating when contained, and thus, fires involving large quantities of the material should not be fought.
Extinguishing Media: Water may be used on small fires. Do not attempt to fight large fires.

Fire Fighting Procedures: As appropriate for surrounding materials/equipment.
Fire Fighting Protective Equipment: Use self-contained breathing apparatus and special protective clothing.
NOTE: Also see "Section 10 - Stability and Reactivity".

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spills, Leaks, or Releases: Collect for disposal
Deactivating Chemicals: Not required.

SECTION 7 - HANDLING AND STORAGE

Handling: This product is an explosive and should only be used under the supervision of trained personnel. Keep away from incompatibles. Use normal good industrial hygiene and housekeeping practices.
Storage Requirements: Keep containers in a well-ventilated place. Store in a cool, dry, well-ventilated area, away from food or feed.
Storage Temperature: Ideal storage temperature is 10-27°C (50-80°F).

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

PREVENTIVE MEASURES: Recommendations listed in this section indicate the type of equipment which will provide protection against overexposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: General exhaust is acceptable.

PERSONAL PROTECTIVE EQUIPMENT:
Eye Protection: Safety glasses with side shields are recommended to prevent eye contact.
Skin Protection: Not required.
Respiratory Protection: A NIOSH/MSHA-approved respirator, if required.
EXPOSURE GUIDELINES:
PRODUCT:
None established for product.
HAZARDOUS INGREDIENT(S):
Aluminum:

ACGIH TLV	2 mg/m3
OSHA PEL	2 mg/m3

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Alternate Name(s): Not available.
Chemical Name: Not available.
Chemical Family: Initiating explosive.
Molecular Formula: Not available.
Appearance: Solid with unspecified colour.
Odour: None.
pH: (Neutral).
Vapour Pressure (mm Hg at 20°C): 0
Vapour Density (Air=1): Not applicable.
Boiling Point: Not applicable.
Melting Point: 115.6°C (240.1°F).
Solubility (Water): (Negligible).
Solubility (Other): Soluble in common organic solvents.
Specific Gravity: 0.9
Evaporation Rate: Not applicable.
Additional Properties:
Bulk Density: 0/9 g/cu.cm.

SECTION 10 - STABILITY AND REACTIVITY

Hazardous Decomposition Products: Thermal decomposition products are toxic and may include oxides of carbon and nitrogen.
Chemical Stability: Stable at room temperature.
Conditions to Avoid: High temperatures, sparks, open flames and all other sources of ignition.
Incompatibility with other Substances: Strong oxidizing agents.
Hazardous Polymerization: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

Summary: The following information is the potential hazards associated with the pure ingredient of this product. It is our belief that, under conditions of normal occupational exposure, this product should not pose such hazards to the worker. This is a manufactured article and may release hazardous products during detonation.

TOXICOLOGICAL DATA:

PRODUCT:

None established for product.

INGREDIENTS:

Polyethylene:

Inhalation LC50 (mouse) = 12 g/m3/30M

POTENTIAL HEALTH EFFECTS:

Inhalation: Detonation products may be irritating. Detonation of large volumes of product in circumstances of confined space or poor ventilation may product toxic levels of detonation products.

Skin Contact: No evidence of irritant effects from normal handling and use.

Eye Contact: No evidence of irritant effects from normal handling and use.

Ingestion: Highly unlikely under normal industrial use. Irritant and can cause nausea and vomiting.

Subchronic Effects: None known.

Chronic Effects: None known.

Carcinogenicity: The ingredient(s) of this product is (are) not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).

Mutagenicity: There is no evidence of mutagenic potential.

Reproductive Effects: No information is available and no adverse reproductive effects are anticipated.

Teratogenicity and Fetotoxicity: No information is available and no adverse tertaogenic/embryotoxic effects are anticipated.

Synergistic Materials: None known.

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicological Information: No information on this formulation.

Persistence and Degradation: Insufficient data.

SECTION 13 - DISPOSAL CONSIDERATIONS

Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in boreholes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an Energetic Solutions Technical Representative.

SECTION 14 - TRANSPORT INFORMATION

Proper Shipping Name: ARTICLES, EXPLOSIVE, N.O.S.

Class/Division: 1.4S

Product Identification Number (PIN): UN0349

Packing Group: II

Transportation Emergency Telephone Number: 1-800-424-9300.

DOT Class: Class C Explosive.

SECTION 15 - REGULATORY INFORMATION

CANADIAN CLASSIFICATION:

This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.

Controlled Products Regulations (WHMIS) Classification: This product is explosive and is not regulated by WHMIS.

CEPA / Canadian Domestic Substances List (DSL): The substance(s) in this product is/are on the Canadian Domestic Substances List (CEPA DSL).

IARC Classification: None of the components of this product are listed on IARC.

USA CLASSIFICATION:

OSHA Classification:

Physical: Not regulated.

Health: Not regulated.

Target Organ: None identified.

SARA Regulations Sections 313 and 40 CFR 372: This product does not contain any chemicals subject to reporting requirements.

Ozone Protection and 40 CFR 42: This product does not contain nor is it manufactured with ozone depleting substances.

Other Regulations/Legislation which apply to this product: New Jersey Right-to-Know.

SECTION 16 - OTHER INFORMATION

MATS Index: 60930

REFERENCES:

"CHEMINFO", through "CCINFOdisc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada.
"HSDB", through "CCINFOdisc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada.
"ChemAdvisor", through "CCINFOdisc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada. 1997

Prepared by: Safety, Health and Environment (905) 405-5617.

The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Energetic Solutions Inc. will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

ORICA

Material Safety Data Sheet

Orica Canada Inc.
6275 Northam Dr. Unit 1, Mississauga, Ont. L4V 1Y8
For MSDS Requests: (905) 405-5617

EMERGENCY CONTACTS

FOR EMERGENCIES INVOLVING CHEMICAL SPILL OR RELEASE, CALL THE ORICA CANADA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT 1-877-561-3636.

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Detonating Cords - All Types**
MSDS Number: 400040

MATS Index: 58587
Date Issued: 29-NOV-98
(Amended Section 5 and 7, 12-FEB-99)
(Amended Section 9, 05-JUN-00)

Product Use: Used for initiation of explosive mixtures.

SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

A cord containing a Pentaerythritol Tetranitrate (PETN) core (CAS 115-77-5).

SECTION 3 - HAZARD IDENTIFICATION

Emergency Overview: Risk of explosion by shock, friction, fire or other sources of ignition. Read the entire MSDS for a more thorough evaluation of the hazards.

SECTION 4 - FIRST AID MEASURES

General: Not applicable; this is a packaged product that will not result in exposure to the contents under normal conditions of use. In the event of contact, administer first aid appropriate for burns, lacerations and bruises.

SECTION 5 - FIRE-FIGHTING MEASURES

Flash Point: Not applicable.
Flammable Limits (Lower): Not applicable.
Flammable Limits (Upper): Not applicable.
Auto Ignition Temperature: PETN explodes at 190-210°C (374-410 °F). Heating of detonating cord under confinement may cause decomposition at lower temperature.
Decomposition Temperature: The product should not be stored or used at temperatures above 70°C (158 °F).
Rate of Burning: Product burns if ignited, with possible transition to detonation.
Explosive Power: Not available.
Sensitivity to Mechanical Impact: Sensitive to mechanical impact.
Sensitivity to Static Discharge: Relatively insensitive to electrostatic discharge.
Hazardous Reactions: None known.
Fire and Explosion Hazards: May ignite or explode if heated under confinement.
Extinguishing Media: See below.
Fire Fighting Procedures: DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against re-entry.
Fire Fighting Protective Equipment: Not applicable.
NOTE: Also see "Section 10 - Stability and Reactivity"

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spills, Leaks, or Releases: Pick up by hand. Use normal precautions taken for handling explosives.
Deactivating Chemicals: Not required. If detonators are broken, contact the product advisor.

SECTION 7 - HANDLING AND STORAGE

Handling: This product is an explosive and should only be used under the supervision of trained personnel. Avoid rough handling. Keep upwind from discharging unit.
Storage Requirements: Store under moderate temperatures recommended by a technical service respresentative. Store under dry conditions in a well ventilated magazine that has been approved for explosive storage. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, sparks and flames. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials, combustibles, and sources of heat. Keep away from incompatibles.
Storage Temperature: The product should not be stored or used at temperatures above 70°C (158°F).

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

PREVENTIVE MEASURES:
Recommendations listed in this section indicate the type of equipment which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.
Engineering Controls: Full handling precautions should be taken at all times.
PERSONAL PROTECTIVE EQUIPMENT:
Eye Protection: Not required.
Skin Protection: Not required.
Respiratory Protection: Not required.
EXPOSURE GUIDELINES:
PRODUCT:
None established for product.
HAZARDOUS INGREDIENT(S):
None established for hazardous ingredients.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Alternate Name(s): Uniline, B-line, Trunkline, Powercord (#), Booster Cord, Primaflex, Anoline, X-245, X-247, Cordtex 7.5, Cordtex SHD, Cordtex 15, Cordtex LT, Cordtex AP, Cordtex 18, Cordtex 25, Cordtex Premium, Cordtex40, Cordtex TL, Cordtex 50, Cordtex TLX, Cordtex 60, T-line (#), Special (#), 4400 M/S, Poly
Chemical Name: Not applicable
Chemical Family: Explosive.
Molecular Formula: Not applicable.
Appearance: Cords covered with PVC or polyethylene plastic and/or wax. and textiles.
Odour: Odourless.
pH: Not applicable.
Vapour Pressure (mm Hg at 20 deg. C): Not applicable.
Vapour Density (Air=1): Not applicable.
Boiling Point: Not applicable.
Melting Point: Not applicable.
Solubility (Water): (Negligible)
Solubility (Other): Not applicable.
Specific Gravity: Not applicable.
Evaporation Rate: Not applicable.

SECTION 10 - STABILITY AND REACTIVITY

Hazardous Decomposition Products: Thermal decomposition products are toxic and may include hydrocarbons, oxides of carbon and nitrogen.
Chemical Stability: Unstable. Can explode with impact, heat or friction.
Conditions to Avoid: Keep away from heat, sparks, flame, impact and friction. Keep away from heat, impact, and friction. Some cords have limited tensile strength and abrasion resistance. Refer to the Product Bulletin for proper applications and use procedures. Damaged cords can lead to misfired holes - potentially, the most hazardous of all blasting situations. Avoid abrasion of cord on hole collars or casing pipes.
Incompatibility with other Substances: Strong oxidizing agents. The PVC/polyethylene plastic or wax covering will, in time, by affected by diesel oil.
Hazardous Polymerization: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICOLOGICAL DATA:
PRODUCT:
None established for product.
INGREDIENTS:
None established for hazardous ingredients.
POTENTIAL HEALTH EFFECTS:
Inhalation: Decomposition products may be toxic.
Skin Contact: No evidence of irritant effects from normal handling and use.
Eye Contact: No evidence of irritant effects from normal handling and use.
Ingestion: Highly unlikely under normal industrial use.
Subchronic Effects: None known.
Chronic Effects: None known.
Carcinogenicity: The ingredients of this product are not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).
Mutagenicity: There is no evidence of mutagenic potential.
Reproductive Effects: No information is available and no adverse reproductive effects are anticipated.
Teratogenicity and Fetotoxicity: No information is available and no adverse teratogenic/embryotoxic effects are anticipated.
Synergistic Materials: None known.

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicological Information: None known.
Environmental Effects: By considering the production and use of the substance, it is unlikely that significant environmental exposure will arise.

SECTION 13 - DISPOSAL CONSIDERATIONS

Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in boreholes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an Orica Canada Inc. Technical Representative.

SECTION 14 - TRANSPORT INFORMATION

TDG Name: Cords, Detonating
TDG Class/Division: 1.1D
Product Indentification Number (PIN): UN0065
Packing Group: II
Transportation Emergency Telephone Number: 1-877-561-3636.
DOT Class: 1.1 - Explosive.

SECTION 15 - REGULATORY INFORMATION

CANADIAN CLASSIFICATION:
This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.
Controlled Products Regulations (WHMIS) Classification: This product is an explosive and is not regulated by WHMIS.
CEPA / Canadian Domestic Substances List (DSL): The substance(s) in this product is/are on the Canadian Domestic Substances List (CEPA DSL).
IARC Classification: None of the components of this product are listed on IARC.
USA CLASSIFICATION:
OSHA Classification:
Physical: Explosive.
Health: Not regulated.
Target Organ: None identified.
SARA Regulations Sections 313 and 40 CFR 372: This product does not contain any chemicals subject to reporting requirements.
Ozone Protection and 40 CFR 42: This product does not contain nor is it manufactured with ozone depleting substances.
Other Regulations/Legislation which apply to this product: None known.

SECTION 16 - OTHER INFORMATION

MATS Index: 58587

REFERENCES:

RTECS-Registry of Toxic Effects of Chemical Substances, CCINFOdisc, Canadian Centre for Occupational Health and Safety, National Institute for Occupational Safety and Health, U.S. Dept. of Health & Human Services, Cincinnati, 1998.

Supplier's Material Safety Data Sheets.

Prepared by: Safety, Health and Environment (905_405-5617.

The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica Canada Inc. will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein. This Material Safety Data Sheet is valid for three years from the date issued.

Material Safety Data Sheet

U.S. Department of Labor

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
Safety,Fuse	

Section I

Manufacturer's Name Nu-Tec Linear Fuse	Emergency Telephone Number 610-385-3086
Address *(Number, Street, City, State, and ZIP Code)* *P.O. Box 6*	Telephone Number for Information 610-385-3086
242 Sycamore Rd	Date Prepared 5-16-00
Douglassville, PA 19518	Signature of Preparer *(optional)*

Section II - Hazard Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	%*(optional)*
Black Powder-(Potassium Nitrate, Charcoal, Sulfur)				
Note: The Black powder is enclosed in thread wrapping and coated with a water resistant lacquer.				
No Pyrotechnic composition is exposed.				
Safety Fuse is classed as a 1.4S explosive by D.O.T.				

Section III - Physical/Chemical Characteristics

Boiling Point	NA	Specific Gravity (H_2O = 1)	NA
Vapor Pressure (mm Hg.)	NA	Melting Point	NA
Vapor Density (AIR = 1)	NA	Evaporation Rate (Butyl Acetate = 1)	NA

Solubility in Water
SLIGHT

TWISTED THREAD COATED WITH GREEN/RED LAQUER

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used) IGNITION TEMP 330°C	Flammable Limits NA	LEL	UEL

Extinguishing Media
FLOOD WITH WATER

Special Fire Fighting Procedures
SUFFOCATION METHODS WILL NOT WORK. DO NOT CONFINE BULK AMOUNTS OF BURNING FUSE. ALLOW IT TO BURN IN THE OPEN

Unusual Fire and Explosion Hazards
THE END OF A SECTION OF FUSE CAN BE IGNITED BY A MATCH , CIGGARETTE, OR OTHER BURNING OBJECT

(Reproduce locally) OSHA 174, Sept. 1985

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid NO SMOKING OR OPEN FLAMES IN VICINITY OF REELS OF FUSE
	Stable	X	

Incompatibility *(Materials to Avoid)*
EXPLOSIVE MATERIALS

Hazardous Decomposition or Byproducts
BURNING FUSE PRODUCES CARBON DIOXIDE & SOME CARBON MONOXIDE

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	X	

Section VI - Health Hazard Data

Route(s) of Entry:	Inhalation?NO	Skin?NO	Ingestion?NO

Health Hazards *(Acute and Chronic)*

Carcinogenicity:	NTP?NO	IARC Monographs?NO	OSHA Regulated? NO

Signs and Symptoms of Exposure NA

Medical Conditions NONE
Generally Aggravated by Exposure

Emergency and First Aid Procedures
NA

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
FUSE CAN BE PICKED UP & REWOUND. AVOID SMOKING OR OPEN FLAMES IN VICINITY OF ANY FUSE

Waste Disposal Method
BURN IN COMPLIANCE WITH FEDERAL & LOCAL REGULATIONS

Precautions to Be taken in Handling and Storing
AVOID SMOKING OR OPEN FLAMES. KEEP FUSE DRY TO ENSURE PROPER FUNCTIONING.
Other Precautions

Section VIII - Control Measures

Respiratory Proctection *(Specify Type)*		
NONE REQUIRED		
Ventilation	Local Exhaust NONE REQUIRED	Special
	Mechanical *(General)* NONE REQUIRED	Other
Protective Gloves NA		Eye Protection NA
Other Protective Clothing or Equipment NA		
Work/Hygienic Practices NO SMOKING, MATCHES, OR FLAMES IN VICINITY OF FUSE		

* U.S.G.P.O.: 1986 - 491 - 529/45775

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29CFR 1910. 1200. Standard must be consulted for specific requirements.

SHELLCRACKER

QUICK IDENTIFIER
Common Name (used on label and list)

Articles, Explosive n.o.s.
(Bird Scaring Device)
1.4E, UN0471, PGII EX-8906032

SECTION 1 -

Manufacturer's Name	STONECO, INC.		
Address	P.O. BOX 765	Emergency Telephone No.	800-833-2264
City, State, and ZIP	TRINIDAD, CO 81082	Other Information Calls	719-846-2853
Signature of Person Responsible for Preparation (Optional)		Date Prepared	JANUARY 03, 2002

SECTION 2 - HAZARDOUS INGREDIENTS/IDENTITY

Hazardous Component(s) (chemical & common name(s))	OSHA PEL	ACGIH TLV	Other Exposure Limits	% (optional)	CAS NO.
FLASH POWDER					
SMOKELESS POWDER					
SHOTGUN SHELL PRIMER					

SECTION 3 - PHYSICAL & CHEMICAL CHARACTERISTICS

Boiling Point	N/A	Specific Gravity (H_2O=1)	N/A	Vapor Pressure (mm Hg)	N/A
		Vapor Density (Air = 1)			
Solubility in Water	NONE	Reactivity in Water	NONE		
Appearance and Odor	12 GA. SHOTGUN SHELL, ODORLESS	Melting Point	N/A		

SECTION 4 - FIRE & EXPLOSION DATA

Flash Point N/A F. C.	Method Used	N/A	Flammable Limits in Air % by Volume	LEL Lower	N/A	UEL Upper	N/A
Auto-Ignition Temperature	N/A	Extinguisher Media	WATER		

Special Fire Fighting Procedures: USE WATER TO EXTINGUISH

Unusual Fire and Explosion Hazards: WHEN ON FIRE: FIRE BRANDS AND EXPLOSIVE PATRICLES MAY BE THROWN FROM THE CONTAINER.

SECTION 5 – PHYSICAL HAZARDS (REACTIVITY DATA)

Stability: Unstable ☐ / Stable ☒ — Conditions to Avoid: DO NOT STORE ABOVE 110°F.

Incompatability (Materials to Avoid): NONE

Hazardous Decomposition Products: SULFUR DIOXIDE, CHLORINE DIOXIDE, CHLORINE GAS

Hazardous Polymerization: May Occur ☐ / Will Not Occur ☒ — Conditions to Avoid: N/A

SECTION 6 – HEALTH HAZARDS

1. Acute: NONE
2. Chronic: NONE

Signs and Symptoms of Exposure: N/A

Medical Conditions Generally Aggravated by Exposure: NONE

Chemical Listed as Carcinogen or Potential Carcinogen: NONE

National Toxicology Program: Yes ☐ No ☒

I.A.R.C. Monographs: Yes ☐ No ☒

OSHA: Yes ☐ No ☒

Emergency and First Aid Procedures: NONE

ROUTES OF ENTRY

1. Inhalation: NONE
2. Eyes: NONE
3. Skin: NONE
4. Ingestion: NONE

SECTION 7 – SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be Taken in Handling and Storage: STORE IN COOL DRY AREA, AVOID SEVERE IMPACT OR CRUSHING OF CONTAINER. KEEP FIRE AND OPEN FLAME AWAY.

Other Precautions: EYE, EAR AND HAND PROTECTION SHOULD BE WORN WHEN USING THIS PRODUCT.

Steps to be Taken in Case Material is Released or Spilled: NONE

Waste Disposal Methods (Consult federal, state, and local regulations): CONSULT MANUFACTURER AND STATE AND LOCAL REGULATIONS.

SECTION 8 – SPECIAL PROTECTION INFORMATION/CONTROL MEASURES

Respiratory Protection (Specify Type): NONE

Ventilation: NONE

Local Exhaust: NONE

Mechanical (General): NONE

Special: NONE

Other: NONE

Protective Gloves: YES

Eye Protection: YES

Other Protective Clothing or Equipment: EAR PROTECTION

Work/Hygienic Practices: NONE

IMPORTANT

Do not leave any blank spaces. If required information is unavailable, unknown, or does not apply, so indicate.

Reed-Joseph International Company
1953 — Celebrating 50 Years — 2003
Post Office Box 894
Greenville, Mississippi 38702-0894
Telephone (662) 335-5822 • Facsimile (662) 335-8850
Toll Free 800-647-5554

MATERIAL SAFETY DATA SHEET PEST CONTROL DEVICES & SIGNAL FLARES 15 MM SCREAMER SIRENS, 15 MM BIRD BANGERS, & COMET SIGNAL FLARES

HAZARDOUS INGREDIENTS/IDENTIFY INFORMATION:

HAZARDOUS CONTENTS: These items are classified as 1.4S, 1.4E, & 1.4G Explosives by the Department of Transportation. No chemical composition is exposed during normal handling and storage.

PHYSICAL/CHEMICAL CHARACTERISTICS

Solubility in water, slight appearance and odor; all pyrotechnic composition is contained in a cardboard casing with plastic outer case.

FIRE AND EXPLOSION HAZARD DATA

Extinguishing media: Flood with water if a small amount of pest control items are involved.

Special fire fighting procedures: Do not use suffocation methods. Devices contain their own oxygen. If a large amount of pest control or flare signals are involved, allow them to burn and prevent spread of fire. Unusual fire and explosion hazards, pest control devices, and signal flares burn rapidly in event of fire.

Reactivity data:

Stability:	Stable
Conditions to avoid:	Open flames and smoking
Incompatibility (materials to avoid):	Exposure to water may cause items to deteriorate
Hazardous decomposition of byproducts:	Smoke, nitrogen oxides, and sulfur oxides may be produced in a fire.

HEALTH HAZARD DATA

Health hazards: Exposure to finished item does not pose any health hazard.

Precautions for safe handling and use: Steps to be taken in case material is released or spilled; no smoking or open flames should be in vicinity of spilled material. Carefully pick up and place spilled items in cardboard fiber cartons. Sweep up any exposed chemical composition with a natural fiber brush.

Precautions to be taken in handling and use: Steps to be taken in case material is released or spilled, put in a cardboard box.

Waste disposal method: Dispose by burning in compliance with state, federal, and local regulations or by soaking in water for 24 hours.

Precautions to be taken in handling and storage: Avoid open flames, smoking and high temperatures (above 150 degrees F). Keep shipping cartons in cool and dry place.

Control measures: Respiratory protection and protective gloves are not required when handling finished items or products.

Work/Hygienic practices: NO SMOKING IN VICINITY OF PEST CONTROL DEVICES AND SIGNAL FLARES.

EMERGENCY RESPONSE INFORMATION PEST CONTROL DEVICES AND SIGNAL FLARES (CLASS 1.4S, 1.4E, & 1.4G) EXPLOSIVES.

Pest control devices and signal flares contain limited quantities of explosives and pyrotechnic composition; and are classed as 1.4S, 1.4E, & 1.4G Explosives by the U.S. Department of Transportation. No chemical composition is released or exposed during normal handling, storage, and transportation. In the event of a vehicle fire or intense heat that reaches the cargo area, pest control devices and signal flares are likely to ignite. They will burn spreading burning particles over a limited area. A mass explosion is not expected. Smoke potentially irritating gases will be produced in a fire. If the pest control device or signal flares are spilled as the result of an accident, but do not ignite, they can safely be picked up and repackaged. The area should be kept safely cleared of unnecessary people while this is being done.

Emergency Action: In case of fire, stop traffic, isolate the immediate area, and deny entry. Keep unnecessary people away. Fire in cargo area can be fought with water spray if necessary. Although disposal and site clean up will be other types of fire from reaching the cargo area. Self contained breathing apparatus (SCBA) and structural firefighters protective clothing will provide some limited protection. Firefighters should retreat if fire approaches cargo area and use unmanned hose holder to direct water spray on fire. For additional information, call the shipper by using the emergency telephone number listed on the shipping papers.

Fire: Truck fire other than cargo area, flood with water. Tire fires may start again. Unhook and separate tractor from trailer if possible. Remove vehicle that is not involved in the fire from fire area if you can do so without risk. If cargo area is exposed to heat and flames, direct water spray on outside of container to cool it down. Continue spray until well after the fire is out.

Cargo fire: DO NOT move cargo or vehicle if cargo has been exposed to heat. Withdraw from area if and when fire reaches cargo and let fire burn. If situation allows, if fire must be fought, flood with water spray. Use firefighting team to prevent spread of fire to adjacent structures and materials. Promptly isolate the scene by removing all persons from the vicinity of the incident. Obtain more information from competent authorities listed on the shipping papers.

Spill of Cargo: Shut off all ignition sources. There should be no flares, smoking, or tools capable of producing sparks or flames in the vicinity of the spilled material. Cautiously pick up the spilled devices and place them in cardboard or fiber board cartons.

FIRST AID

Call emergency medical care personnel. Use first aid treatment according to the nature of the injury.

SELLIER & BELLOT, Joint Stock Company
Lidická 667
258 13 Vlašim
CZECH REPUBLIC

START 6mm Sellier Bellot Cartridges

The cartridges must comply with our internal standard of NP 39.89 and the C.I.P. regulation in line with the 16/85 Authorisation. The testing is being performed according to ČSN 39 5105 Standard.

DESCRIPTION

1) In principle, the cartridges of Start 6mm-SB are closed cases (with asterisk-formed closure), having a fulminating composition in their hollow perimeter edges.

USAGE

2) The cartridges are used:
a) - to imitate fire like in theatres and films, in dog training, etc.
b) - for sporting purposes like racer starting (sound effect) and time measurements (flash of light).

TECHNICAL REQUIREMENTS

3) The cartridges are being manufactured in line with the initial documentation which must comply with the technical requirements of this standard.

MATERIAL AND QUALITY OF COMPONENTS

4) The cartridges are made of the Ms 90 brass as per ČSN 42 3201 Standard.

5) As the fulminating composition the NEROXIN S is used, based on the TNRO, antimony trisulphide, and barium nitrate. The composition is protected inside by a layer of polypropylene powder.

OUTER APPEARANCE AND WORKMANSHIP

6) Slight surface damages, arisen due to the necessary technological handling and tool traces, will have no impact on function and on-fire safety, they are permissible. The cartridges with their surface in various shades of colour (different from the basic material) are permissible.

The fulminating composition must be evenly distributed inside the cartridge edge gap and must not be powdered out.

DIMENSIONS

For the maximum dimensions in mm see the promotional drawing.

STRIKE FUNCTION AND LOUDNESS

8) When fired from a proper gun, the cartridges must be reliable in function. No failures, cracked cartrideeeeges, or bottom breakage can be tolerated.

9) The individual strike minimum acoustical pressure, measured 30 cm from the gun, must be at least 105 dB.

PRODUCT DATA

10) Every cartridge shall have the manufacturer's trademark stamped in its bottom.

TESTING

11) Within the manufacturing procedures, the following inspections and checks must be carried out, including the frequency tests for the product reliability.

APPEARANCE AND WORKMANSHIP CHECKING

12) A cartridge overall outlook and workmanship are subject to checking as under ČSN 39 5105 - test 1.

GAUGING

13) Carried out in line with ČSN 39 5105 - test No.

An overall shape is tested with a special gauge and is matched against the minimum cartridge chamber dimensions.

FUNCTIONAL AND LOUDNESS TESTING

14) Carried out at the same time according to ČSN 39 5105 - test No. by firing from the RG-2s pistol (German provenance) or other suitable gun.

SUPPLY RECEIPT TESTS

15) The cartridge outlook and dimensions are subject to a double-pick statistical checking.

The functional and loudness test is being carried out from two fool magazines, i.e. 12 rounds.

16) The manufacturer is liable to its customers for correct and safe function of the cartridges for two years from the successful receipt day, provided thet the storage conditions are observed by the customers.

STORAGE

17) The cartridges may be store only in a dry and well-aired room with temperature from 5 to 35 centigrade and relative humidity not exceeding 65%, protected from direct sunrays. The most suitable storage is in original wrappers.

Sellier & Bellot
akciová společnost
250 03 VLAŠIM

REED-JOSEPH INTERNATIONAL COMPANY

MATERIAL SAFETY DATA SHEET

Emergency phone 1-800 647-5554

Section I - Identification

Chemical Name & Synonyms: Explosive Pest Repellent Devices

Chemical Family: Not Applicable

Formula: Mixture

Trade Name: Shot Tell

Description: Pest Scaring Pyrotechnics

Gas No: Not Applicable - Mixture

Section II - Normal Handling Procedures

Precautions To Be Taken In Handling and Storage: Do not take contents internally. If cartridge is damaged, avoid contact of contents with eyes, skin or clothing. Upon contact with skin or eyes, wash off with water. Avoid breathing dust. Avoid breathing fumes during discharge. Store in a cool, dry, well ventilated place away from all sources of ignition. Do not subject the material to percussion or shock in handling, storage or use.

Protective Equipment:		
	Eyes	Goggles
	Gloves	None normally required
	Other	Hearing protection recommended during discharge

Ventilation Requirements: Local mechanical exhaust ventilation recommended to keep airborne concentrations below P.E.L. in confined space discharging.

Section III - Hazardous Ingredients

Basic Material - See attached sheet

Section IV - Fire and Explosion Hazard Data

Flash Point Method: Not Applicable

ASHA Classification: Class "C" Explosive

Flammable Explosive Limits: Lower - N/A Upper - N/A

Extinguishing Media: Water deluge. Flood with water to fight fire and cool exposed casings

Chemical Name & Synonyms: Explosive Pest Repellent Devices

Chemical Family: Not Applicable

Formula: Mixture

Trade Name: Shot Tell

Description: Pest Scaring Pyrotechnics

Gas No: Not Applicable - Mixture

Section IV - Fire and Explosion Hazard Data - Cont'd.

Special Fire Hazard & Fire Fighting Procedures: Fight fire fron an explosion resistant location. In advanced or massive fires the area should be evacuated. Use NIOSH/MSHA approved positive pressure self-contained breathing apparatus when any material is involved in a fire. This article is an explosive one.

Section V - Health Hazard Data

Threshold Limit Value - Not Applicable

Symptons of Over Exposure: Skin, eye, musous membrane irritation. In halation of dust or fumes affects nervous, uninary, reproductive and hematology systems, and developmental toxicity to the fetus.

Emergency First-Aid Procedures

Skin: If exposed to contents, immediately flush with water. If an irritation develops, call a physician.

Eyes: If exposed to contents or content decomposition products, immediately flush with water. If eye irritation develops, call a physician.

Ingestion: For contents, immediately drink large quantities of water. Induce vomiting by sticking finger down throat. Call a physician.

Chemical Name & Synonyms: Explosive Pest Repellent Devices

Chemical Family: Not Applicable

Formula: Mixture

Trade Name: Shot Tell

Description: Pest Scaring Pyrotechnics

Gas NO: Not Applicable - Mixture

Section III - Hazardous Ingredients (Continued from Page 1)

BASIC MATERIAL	OSHA PEL	LD 50	LC 50	SIGNIFICANT EFFECTS
Not more than 35 grains of a mixture of aluminum, sulfer and potassium perchlorate Not more than 6.0 grains of standard smokeless shot gun powder.	Not Established	No Data	No Data	Headache, nausea, irritation, cyanosi if ingested

APPENDIX E

FEDERAL AND STATE THREATENED AND ENDANGERED SPECIES WHICH OCCUR IN TENNESSEE

Federal T&E Listing - Tennessee -- 100 listings

Animals -- 81

Status	Listing
E	Acornshell, southern (*Epioblasma othcaloogensis*)
E	Bat, gray (*Myotis grisescens*)
E	Bat, Indiana (*Myotis sodalis*)
E	Bean, Cumberland (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Villosa trabalis*)
XN	Bean, Cumberland (pearlymussel) AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Villosa trabalis*)
E	Bean, purple (*Villosa perpurpurea*)
E	Blossom, green (pearlymussel) (*Epioblasma torulosa gubernaculum*)
E	Blossom, tubercled (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Epioblasma torulosa torulosa*)
XN	Blossom, tubercled (pearlymussel) AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Epioblasma torulosa torulosa*)
E	Blossom, turgid (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Epioblasma turgidula*)
XN	Blossom, turgid (pearlymussel) AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Epioblasma turgidula*)
E	Blossom, yellow (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Epioblasma florentina florentina*)
XN	Blossom, yellow (pearlymussel) AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Epioblasma florentina florentina*)
E	Catspaw (=purple cat's paw pearlymussel) Entire Range; Except where listed as Experimental Populations (*Epioblasma obliquata obliquata*)
XN	Catspaw (=purple cat's paw pearlymussel) AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Epioblasma obliquata obliquata*)
T	Chub, slender (*Erimystax cahni*)
XN	Chub, spotfin Tellico River, TN (*Cyprinella monacha*)
T	Chub, spotfin Entire (*Cyprinella monacha*)
E	Combshell, Cumberlandian Entire Range; Except where listed as Experimental Populations (*Epioblasma brevidens*)
XN	Combshell, Cumberlandian AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Epioblasma brevidens*)
E	Combshell, upland (*Epioblasma metastriata*)
XN	Crane, whooping U.S.A.(AL, AR, GA, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, OH, SC, TN, VA, WI, WV) (*Grus americana*)
E	Crayfish, Nashville (*Orconectes shoupi*)
T	Dace, blackside (*Phoxinus cumberlandensis*)
E	Darter, amber (*Percina antesella*)
E	Darter, bluemask (=jewel) (*Etheostoma /*)
XN	Darter, boulder Shoal Creek (*Etheostoma wapiti*)
E	Darter, duskytail Entire (*Etheostoma percnurum*)
XN	Darter, duskytail Tellico River, TN (*Etheostoma percnurum*)
T	Darter, slackwater (*Etheostoma boschungi*)
T	Darter, snail (*Percina tanasi*)
T	Eagle, bald lower 48 States (*Haliaeetus leucocephalus*)
E	Elktoe, Appalachian (*Alasmidonta raveneliana*)
E	Elktoe, Cumberland (*Alasmidonta atropurpurea*)
E	Fanshell (*Cyprogenia stegaria*)
E	Kidneyshell, triangular (*Ptychobranchus greenii*)
E	Lampmussel, Alabama Entire Range; Except where listed as Experimental Populations (*Lampsilis virescens*)
E	Lilliput, pale (pearlymussel) (*Toxolasma cylindrellus*)
E	Logperch, Conasauga (*Percina jenkinsi*)
E	Madtom, pygmy (*Noturus stanauli*)
E	Madtom, smoky Entire (*Noturus baileyi*)
XN	Madtom, smoky Tellico River, TN (*Noturus baileyi*)
XN	Madtom, yellowfin Holston River, VA, TN (*Noturus flavipinnis*)
XN	Madtom, yellowfin Tellico River, TN (*Noturus flavipinnis*)
T	Madtom, yellowfin except where XN (*Noturus flavipinnis*)
E	Mapleleaf, winged Entire; except where listed as experimental populations (*Quadrula fragosa*)
E	Marstonia, royal (snail) (*Pyrgulopsis ogmorhaphe*)
E	Moccasinshell, Coosa (*Medionidus parvulus*)
E	Monkeyface, Appalachian (pearlymussel) (*Quadrula sparsa*)
E	Monkeyface, Cumberland (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Quadrula intermedia*)
XN	Monkeyface, Cumberland (pearlymussel) AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert

and Lauderdale Counties, AL (*Quadrula intermedia*)
E Mucket, pink (pearlymussel) (*Lampsilis abrupta*)
E Mussel, oyster Entire Range; Except where listed as Experimental Populations (*Epioblasma capsaeformis*)
XN Mussel, oyster AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Epioblasma capsaeformis*)
E Pearlymussel, birdwing Entire Range; Except where listed as Experimental Populations (*Conradilla caelata*)
E Pearlymussel, cracking Entire Range; Except where listed as Experimental Populations (*Hemistena lata*)
E Pearlymussel, dromedary Entire Range; Except where listed as Experimental Populations (*Dromus dromas*)
E Pearlymussel, littlewing (*Pegias fabula*)
E Pigtoe, Cumberland (*Pleurobema gibberum*)
E Pigtoe, finerayed Entire Range; Except where listed as Experimental Populations (*Fusconaia cuneolus*)
XN Pigtoe, finerayed AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Fusconaia cuneolus*)
E Pigtoe, rough (*Pleurobema plenum*)
E Pigtoe, shiny Entire Range; Except where listed as Experimental Populations (*Fusconaia cor*)
XN Pigtoe, shiny AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Fusconaia cor*)
E Pigtoe, southern (*Pleurobema georgianum*)
E Pimpleback, orangefoot (pearlymussel) (*Plethobasus cooperianus*)
T Pocketbook, finelined (*Lampsilis altilis*)
E Puma (=cougar), eastern (*Puma (=Felis) concolor couguar*)
E Rabbitsfoot, rough (*Quadrula cylindrica strigillata*)
E Riffleshell, tan (*Epioblasma florentina walkeri (=E. walkeri)*)
E Ring pink (mussel) (*Obovaria retusa*)
E Riversnail, Anthony's Entire Range; Except where listed as Experimental Populations (*Athearnia anthonyi*)
XN Riversnail, Anthony's AL; Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, AL (*Athearnia anthonyi*)
T Shiner, blue (*Cyprinella caerulea*)
T Snail, painted snake coiled forest (*Anguispira picta*)
E Spider, spruce-fir moss (*Microhexura montivaga*)
E Squirrel, Carolina northern flying (*Glaucomys sabrinus coloratus*)
E Sturgeon, pallid (*Scaphirhynchus albus*)
E Tern, least interior pop. (*Sterna antillarum*)
E Wartyback, white (pearlymussel) (*Plethobasus cicatricosus*)
XN Wolf, red U.S.A. (portions of NC and TN_see 17.84(c)(9)) (*Canis rufus*)

Plants -- 19

StatusListing
T Potato-bean, Price's (*Apios priceana*)
E Rock-cress, Braun's (*Arabis perstellata*)
E Sandwort, Cumberland (*Arenaria cumberlandensis*)
T Fern, American hart's-tongue (*Asplenium scolopendrium* var. *americanum*)
E Ground-plum, Guthrie's (=Pyne's) (*Astragalus bibullatus*)
T Rosemary, Cumberland (*Conradina verticillata*)
E Prairie-clover, leafy (*Dalea foliosa*)
E Coneflower, Tennessee purple (*Echinacea tennesseensis*)
E Avens, spreading (*Geum radiatum*)
E Lichen, rock gnome (*Gymnoderma lineare*)
E Bluet, Roan Mountain (*Hedyotis purpurea* var. *montana*)
T Pogonia, small whorled (*Isotria medeoloides*)
E Bladderpod, Spring Creek (*Lesquerella perforata*)
E Aster, Ruth's golden (*Pityopsis ruthii*)
E Pitcher-plant, green (*Sarracenia oreophila*)
T Skullcap, large-flowered (*Scutellaria montana*)
T Goldenrod, Blue Ridge (*Solidago spithamaea*)
T Spiraea, Virginia (*Spiraea virginiana*)
E Grass, Tennessee yellow-eyed (*Xyris tennesseensis*)

Appendix E

Online Hunting/ Fishing Licenses & Boat Renewals

Forms & Publications

Information & Education

Hunting

Hunter Education Classes

Fishing

Boating

Non-game Program

Geographic Information System (GIS)

Link to TWRA Rules & Regulations

Tennessee Wildlife Resources Foundation

Endangered/Threatened Species

Pursuant to the authority granted by Tennessee Code Annotated, Sections 70-8-105 and 70-8-107, the Tennessee Wildlife Resources Commission does hereby declare the following species to be endangered or threatened.

MOLLUSKS

Mussels - Endangered

Common Name	Scientific Name	Fed*
Cumberland elktoe	Alasmidonta atropurpurea	E
Appalachian elktoe	Alasmidonta raveneliana	E
Birdwing pearly mussel	Conradilla caelata (=Limiox rimosus)	E
Fanshell Mussel	Cyprogania stegaria (=irrorata)	E
Dromedary pearly mussel	Dromus dromas	E
Cumberlandian combshell	Epioblasma brevidens	E
Oyster mussel	Epioblasma capsaeformis	E
Yellow-blossom pearly mussel	Epioblasma (=Dysnomia) florentina florentina	E
Upland combshell	E. metastriata	E
Southern acornshell	E. othcaloogensis	E
Green-blossom pearly mussel	E. (=Dysnomia) torulosa Gubernaculums	E
Tuberculed-blossom pearly mussel	E. (=Dysnomia) torulosa Torulosa	E
Turgid-blossom pearly mussel	E. (=Dysnomia) turgidula	E
Tan riffleshell	E. (=Dysnomia) walkeri	E
Purple Cat's Paw Pearlymussel	E. (=Dysnomia) obliquata obliquata (=E. sulcata sulcata)	E
Fine-rayed pigtoe	Fusconaia cuneolus	E
Shiny pigtoe	F. cor (=edgariana)	E
Cracking pearly mussel	Hemistena (=Lastena) lata	E
Pink mucket pearly mussel	Lampsilis abrupta (=orbiculata)	E
Alabama lamp pearly mussel	L. virescens	E
Coosa moccasinshell	Medionidus parvulus	E
Ring pink mussel	Obovaria retusa	E
Little-wing pearly mussel	Pegias fabula	E

White warty-back pearly mussel	Plethobasus cicatricosus	E
Orange-footed (=pimpleback) pearly mussel	P. cooperianus	E
Clubshell	Pleurobema clava	E
Southern clubshell	P. decisum	E
Southern pigtoe	P. georgianum	E
Cumberland pigtoe (=Cumberland pigtoe mussel)	P. gibberum	E
Ovate clubshell	P. perovatum	E
Rough pigtoe pearly mussel	P. plenum	E
Triangular kidneyshell	Ptychobranchus greeni	E
Rough rabbitsfoot	Quadrula cylindrica strigillata	E
Cumberland monkeyface pearly mussel	Quadrula intermedia	E
Winged mapleleaf mussel	Q. fragosa	E
Appalachian monkeyface pearly mussel	Q. sparsa	E
Pale lilliput pearly mussel	Toxolasma (=Carunculina) cylindrella	E
Cumberland bean pearly mussel	Villosa (=Micromya) trabalis	E
Purple bean	Villosa perpurpurea	E

Snails - Endangered

Common Name	Scientific Name	Fed*
Painted snake coiled forest snail	Anguispira picta	T
Anthony's riversnail	Athearnia anthonyi	E
Royal Snail	Pyrgulopsis (=Marstonia) ogmorhaphe	E

Mussels - Threatened

Common Name	Scientific Name	Fed*
Alabama moccasinshell	Medionidus acutissimus	T
Fine-lined pocketbook	Lampsilis altilis	T

FISH

Fish - Endangered

Common Name	Scientific Name	Fed*
Lake Sturgeon	Acipenser fulvescens	MC
Blue Shiner	Cyprinella (=Notropis) caerulea (=caeruleus)	T
Tuckasegee Darter	Etheostoma blennioides gutselli	----

Appendix E

Bluemask (=jewel) Darter	E. (Doration) sp	E
Duskytail Darter	E. (=Catonotus sp.)	E
Crown Darter	E. (=Catonotus sp.) corona	MC
Barrens Darter	E. (=Catonotus sp.) forbesi	MC
Cumberland johnny darter	Etheostoma nigrum susanae	----
Egg-mimic Darter	E. (=Catonotus) pseudovulatum--	MC
Boulder Darter	E. (Nothonotus) wapiti	E
Barrens Topminnow	Fundulus julisia	MC
Laurel Dace	Phoxinus sp.	----
Palezone Shiner	Notropis sp. (cf. N. procne)	E
Smoky Madtom	Noturus baileyi	E
Yellowfin Madtom	Noturus flavipinnis	T
Chucky Madtom	Noturus (Rabida) sp.	MC
Pygmy Madtom	Noturus stanauli	E
Amber Darter	Percina antesella	E
Conasauga (=Reticulate)Logperch	P. jenkinsi	E
Pallid Sturgeon	Scaphirhynchus albus	E

Fish - Threatened

Common Name	Scientific Name	Fed*
Western Sand Darter	Ammocrpta clara	----
Blue Sucker	Cycleptus elongatus	MC
Spotfin chub	Cyprinella (=Hybopsis) cahni	T
Slender Chub	Erimystax (=Hybopsis) cahni	T
Slackwater Darter	Etheostoma boschungi	T
Ashy Darter	Etheostoma cinereum	MC
Striated Darter	Etheostoma striatulum	MC
Coldwater Darter	Etheostoma.ditrema	MC
Trispot Darter	E. trisella	MC
Coppercheek Darter	E. aquali (cf. E.maculatum)	MC
Holliday (=Ellijay) Darter	E. (=Ulocentra) sp.	----
Silverjaw Minnow	Notropis (=Ericymba) buccata	----
Frecklebelly Madtom	Noturus munitus	MC
Duck River Saddled Madtom	Noturus sp. (=elegans)	MC
Longhead Darter	Percina macrocephala	MC
Snail Darter	P. tanasi	T
Blackside Dace	Phoxinus cumberlandensis	T

AMPHIBIANS

Threatened

Common Name	Scientific Name	Fed*
Tennessee Cave Salamander	Gyrinophilus palleucus	MC

REPTILES

Threatened

Common Name	Scientific Name	Fed*
Bog Turtle	Clemmys muhlenbergi	MC
Northern Pine Snake	Pituophis m. melanoleucus	MC
Western Pigmy Rattlesnake	Sistrurus miliarius streckeri	----

BIRDS

Birds - Endangered

Common Name	Scientific Name	Fed*
Bachman's Sparrow	Aimophila aestivalis	MC
Peregrine Falcon	Falco peregrinus	----
Least Tern	Sterna antillarum	E
Bewick's Wren	Thryomanes bewickii	MC

Birds - Threatened

Common Name	Scientific Name	Fed*
Saw-whet Owl	Aegolius acadicus	MC
Golden Eagle	Aquila chrysaetos	----
Lark Sparrow	Chondestes grammacus	----
Northern Raven	Corvus corax	----

MAMMALS

Endangered

Common Name	Scientific Name	Fed*
Carolina Northern Flying Squirrel	Glaucomys sabrinus coloratus	E
Gray Myotis	Myotis grisescens	E
Indiana Myotis	M. sodalis	E

CRUSTACEANS

Crayfish - Endangered

Common Name	Scientific Name	Fed*
Big South Fork Crayfish	Cambarus bouchardi	----
----	Cambarus cymatilis	MC
Valley Flame Crayfish	Cambarus deweesae	----
----	Cambarus pristinus	MC
----	Cambarus williami	----

Hatchie Burrowing Crayfish	Fallicambarus hortoni	----
Tennessee Cave Crayfish	Orconectes incomptus	MC
Nashville Crayfish	Orconectes shoupi	E
----	Orconectes wrighti	MC

Crayfish - Threatened

Common Name	Scientific Name	Fed*
Chickamauga Crayfish	Cambarus extraneus	MC
Obey Crayfish	Cambarus obeyensis	MC

*Fed Status: E = Federally Endandered, T = Federally Threatened, MC = Management Concern, an unofficial indication that this species has been brought to federal attention for review for possible future federal listing.

Tennessee.gov Home | Search Tennessee.gov | A to Z Directory | Policies | Survey | Help | Site Map | Contact

Tennessee Wildlife Resources Agency
PO Box 40747
Nashville, TN 37204
615.781.6500

APPENDIX F

SUMMARY INFORMATION REGARDING T&E MUSSEL SPECIES FOUND IN TENNESSEE

Appendix F

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Alasmidonta atropurpurea CUMBERLAND ELKTOE	LE/ S1,S2	Fentress, Grundy, Morgan, Scott	Upper Cumberland, Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Collins. The habitat ranges from small creeks to medium-sized rivers. The mussel is most common in smaller stream habitats. Preferred habitat appears to be shallow flats or pools with slow current and sand substrate with scattered cobble/boulder material, although it will occur in mud or rocky substrates and faster currents	May be locally abundant at particular sites, distribution is fragmented and often restricted to relatively short stream sections.	Acid mine run-off, Siltation from logging, agriculture, and other poor land-use practices
Alasmidonta raveneliana APPALACHIAN ELKTOE	LE/S1	Unicoi	Upper French Broad, Pigeon, Nolichucky, Upper Little Tennessee, Tuckasegee, Lower Little Tennessee. This mussel has been found in gravelly substrate, often mixed with cobble and boulder, or in cracks in bedrock. Water depths typically have been shallow, and current velocities have varied from moderate to fast.	Historically, this species is endemic to the upper Tennessee River system in western North Carolina and eastern Tennessee. Presently known only from a short section of the Little Tennessee River between the headwaters of Fontana Reservoir and below Emory Reservoir at Franklin, North Carolina. Another population is restricted to a short reach of the Toe River and the mainstem of the Nolichucky River in North Carolina and Tennessee. A single specimen was also found in the Cane River in North Carolina (U.S. Fish and Wildlife Service, 1996).	Development, pollution, and siltation in the vicinity of Franklin, and a proposed hydropower dam between Franklin and Fontana Reservoir threaten the Little Tennessee River populations. Logging and mining are potential threats to the Yancey Co. population. Other populations have been inundated by reservoirs or have succumbed to various forms of pollution (e.g., municipal, agricultural, mine run-off, paper mill effluent). Competition from the invasive zebra mussel could also pose a threat to the remaining populations.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Conradilla caelata Birdwing pearly mussel	LE,XN S1	Anderson, Claiborne, Giles, Grainger, Hancock, Hawkins, Knox, Lincoln, Marshall, Maury, Sullivan	North Fork Holston, Holston, Upper Clinch, Powell, Lower Clinch, Upper Elk, Upper Duck, Lower Duck. Found in riffle areas with sand and gravel substrates in moderate to fast currents.	Currently known from the Clinch, Powell, Elk, and Duck Rivers in Tennessee and Virginia. Historical throughout Tennessee River drainage, absent from Cumberland River A 1980 survey in Virginia reported nine EOs. At least one good population exists on the Duck River in Tennessee. Populations in the Clinch and Powell drainages may have fallen below viable levels.	Threats are pollution, habitat alteration (impoundments, siltation from mining, channelization); introduced Asian clam (southwestern Virginia); The largest population in the Duck River is threatened by the Tennessee Valley Authorities Columbia Dam Project; is extirpated from impounded sections of other rivers.
Cyprogania stegaria Fanshell mussel	LE/S1	Anderson, Decatur, DeKalb, Hancock, Hardin, Meigs, Putnam, Rhea, Smith	Middle Allegheny-Redbank, Lower Allegheny, Upper Ohio, Upper Ohio-Shade, Upper Kanawha, Big Sandy, Little Scioto-Tygarts, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, South Fork Licking, Upper Kentucky, Lower Kentucky, Upper Green, Barren, Middle Green, Upper Wabash, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower White, Upper East Fork White, Lower East Fork White, Upper Cumberland-Lake Cumberland, Caney, Lower Cumberland, Red., Silver-Little Kentucky, Salt, Rolling Fork, Lower Ohio-Little Pigeon, Upper Clinch, Lower Clinch, Middle Tennessee-Chickamauga, Lower Tennessee-Beech, Lower Tennessee. Characteristic habitat is medium to large streams. It has been found in river habitats with gravel substrates and a strong current, in both deep and shallow water.	Only three reproducing populations known: The Green and Licking rivers in Kentucky and the Clinch River in Tennessee.	Siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Dromus dromas Dromedary pearly mussel	LE,XN S1	Anderson, Claiborne, Clay, DeKalb, Giles, Grainger, Hamilton, Hancock, Jackson, Jefferson, Knox, Marion, Putnam, Rhea, Smith, Trousdale	Obey, Upper Cumberland-Cordell Hull, Caney , Lower Cumberland-Old Hickory Lake. A riffle dwelling species occurring at shoals with sand and gravel and moderate current velocities, but also found in deeper, slower moving water in Tennessee.	At least prehistorically, Dromus was one of the most abundant species in the TN River. Apparently declining at 4 remaining populations, only older individuals found in Tennessee River. A 1980 survey by Virginia Tech and TVA found nine occurrences in Virginia. Currently the dromedary is reduced to possibly three reproducing populations.	Impoundments, siltation and pollution leading to water quality and habitat deterioration, inadequate sewage treatment, coal mining, oil and gas drilling and poor land-use practices.
Epioblasma brevidens Cumberlandian combshell	LE,XN S1	Claiborne, Davidson, DeKalb, Hancock, Marshall, Maury, Putnam, Scott, Smith, Trousdale, Wilson	Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Caney, Lower Cumberland-Old Hickory Lake, Lower Cumberland-Sycamore. The habitat ranges from large creeks to large rivers, in substrates ranging from coarse sand to mixtures of gravel, cobble, and boulder-sized particles.	Populations are restricted to limited areas of five river drainages and some of these may no longer be reproducing. All populations are in decline due to pollution, particularly from mining activities, and the inundation of habitat by reservoirs.	Much of its former habitat has been inundated by reservoirs and considerable other portions have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g., siltation) threaten survival of remaining EOs.
Epioblasma capsaeformis Oyster mussel	LE,XN S1	Claiborne, Cocke, DeKalb, Hancock, Marshall, Maury, Putnam, Smith	Claiborne. Inhabits moderate to swift currents in large creeks and rivers in substrates composed of coarse sand to boulder-sized particles, rarely mud. It may be associated with beds of *Justicia Americana* (water willow) bordering the main channel of the riffle.	Post 1985 records are in nine tributaries, some of these occurrences (Clinch and Duck rivers and the Big South Fork River) are relatively healthy.	Much of its former habitat has been inundated by reservoirs and considerable other portions of its range have been devastated by acid mine run-off. Various forms of pollution and poor land use practices (e.g. siltation) threaten survival of remaining EOs.
Epioblasma florentina florentina Yellow-blossom pearly mussel	LE,XN SX	Anderson, Bedford, Cheatham, Claiborne, Clay, Franklin, Grainger, Hancock, Jackson, Knox, Lincoln, Maury, Monroe, Pickett, Rutherford (471 49), Smith (47159)	Obey, Upper Cumberland-Cordell Hull, Lower Cumberland-Old Hickory Lake, Stones, Lower Cumberland. Found in riffle and shoal areas of small to medium-sized streams.	No population records available for Tennessee. Possibly extinct.	No information.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Epioblasma florentina walkeri Tan Riffleshell	LE/S1	Davidson, Marshall, Maury, Polk, Rutherford Scott, Sullivan	South Fork Cumberland, Stones, Harpeth. Found in headwaters, riffles, and shoals in sand and gravel substrates.	A new population was found in the Upper Clinch River and Indian Creek. The other population from the Middle Fork Holston River in Virginia may no longer be extant.	No information.
Epioblasma haysiana ACORNSHELL	LE/SX	No information	No information	Presumed Extirpated	No information
Epioblasma metastriata UPLAND COMBSHELL	LE/SH	Polk	No locations listed in within Watershed Regions 05 or 06. It has been located in shoals in rivers and large streams, above the fall line, on stable subrates in moderate to swift currents.	No population information given for Tennessee. If it is still extant, there are likely fewer than five occurrences.	Threatened by habitat modification, sedimentation, and other forms of water quality degradation. Potential habitat is locally impacted by carpet mill and other industrial discharge, sewage treatment plant discharge, urban and agricultural runoff, and surface mine drainage.
Epioblasma obliquata obliquata CATSPAW	LE,XN S1	Smith, Trousdale	Ohio Brush-Whiteoak, Middle Ohio-Laughery, Upper Green, Middle Green, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Lower Ohio-Little Pigeon. Inhabits large river systems in sand and gravel substrates in runs and riffles.	Three extant populations of E. *obliquata obliquata* are thought to exist; one in the Green River in Kentucky, the Cumberland River in Tennessee, and the Killbuck Creek in Ohio. Has been extirpated from a large portion of its range.	Problems associated with land-use in the Killbuck Creek watershed threaten the *E. obliquata obliquata* population.
Epioblasma othcaloogensis SOUTHERN ACORNSHELL	LE/SH	No information listed.	No locations listed in within Watershed Regions 05 or 06. Historically known from the Coosa and Cahaba river drainages in Alabama, Georgia and Tennessee.	No population information given for Tennessee. If it is still extant, there are likely fewer than five occurrences.	Threatened by habitat modification, sedimentation, and other forms of water quality degradation. Potential habitat is locally impacted by carpet mill and other industrial discharge, sewage treatment plant discharge, urban and agricultural runoff, and surface mine drainage (U.S. Fish and Wildlife Service 1997).
Epioblasma torulosa gubernaculu GREEN BLOSSOM	LE/SX	Anderson, Campbell, Claiborne, Grainger, Hamblen, Hawkins, Jefferson, Knox, Sullivan, Union	North Fork Holston, South Fork Holston, Holston, Nolichucky, Upper Clinch, Powell, Lower Clinch. Found in riffle or shoal areas with fast flowing water that contain firm rubble, gravel, and sand substrates.	Extinct. This subspecies has been extirpated throughout its range. A live individual was last observed in 1984 in the Clinch River. Repeated visits to the site have produced only relicts. The only remaining subspecies of *E. torulosa* is *E. torulosa rangiana* found in the upper Ohio drainage.	Was extremely sensitive to changing water quality & disturbance.

Species/ Common name	ESA Status/ Conser vation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Epioblasma torulosa torulosa TUBERCLED BLOSSOM	LE,XN SX	Greene, Hamblen, Hamilton, Hawkins, Knox, Lincoln, Marshall, Smith, Sullivan	Upper Kanawha, Middle Wabash-Deer, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower White, Upper East Fork White, Lower East Fork White, Lower Cumberland-Old Hickory Lake. Habitat is characterized by riffles or shoals in shallow water with sandy gravel substrate and rapid currents.	Extinct.	No information given.
Epioblasma turgidula TURGID BLOSSOM	LE,XN SX	Bedford, Coffee, Franklin, Grainger, Hawkins, Jefferson, Knox, Maury, Roane, Shelby	Holston, Emory, Upper Elk, Upper Duck, Lower Duck. Required clear, unpolluted water; typically found buried in sand and gravel substrates of shallow, fast-flowing streams.	Last reported in the mid-1960s from the Duck River in Tennessee. This site is now impounded or affected by the operation of the Normandy Dam. Considered extinct by some researchers.	Impoundments, siltation, pollution.
Fusconaia cor SHINY PIGTOE	LE,XN S1	Anderson, Claiborne, Franklin, Grainger, Hancock, Hawkins, Jefferson, Knox, Lincoln, Moore, Roane, Sullivan	North Fork Holston, South Fork Holston, Holston, Upper Clinch, Powell, Lower Clinch, Guntersville Lake, Wheeler Lake, Upper Elk, Pickwick Lake. Found in shoals and riffles in clear streams with moderate to fast current . It is typically well burrowed in sand and cobble substrates. It does not appear tolerant of deeper water or reservoirs.	: Historically occurred throughout the Tennessee River drainage as far south as Mussel Shoals. Its current distribution is scattered over five rivers: the North Fork of the Holston in Virginia, the Clinch (from the Virginia-Tennessee border upstream to Nash Ford), the Powell (from the Virginia-Tennessee border upstream to Lee County, Virginia), it has not been seen in the Elk River in Tennessee since 1980 and it is uncommon in the Paint Rock River in Alabama.	Threatened by habitat alteration and pollution from strip mine runoff and coal washing. Populations in the North Fork of Holston and Clinch rivers were reduced by toxic discharges and spills prior to 1972. Some sizable populations in the Elk River were destroyed by impoundment of Tims Ford Reservoir. The invasion of the Asian clam, and the possible invasion of the zebra mussel, also threatens remaining populations.
Fusconaia cuneolus FINERAYED PIGTOE	LE,XN S1	Anderson, Blount, Claiborne, Franklin, Grainger, Hamblen, Hancock, Hawkins, Knox, Lincoln, Roane, Sullivan, Union	North Fork Holston, Holston, Nolichucky, Watts Bar Lake, Upper Clinch, Powell, Lower Clinch, Emory, Wheeler Lake, Upper Elk, Lower Elk. Inhabits clear, high gradient streams in firm cobble and gravel substrates (Neves, 1984).	Only one large population remains (Clinch River) and it is threatened by declining water quality and isolated populations.	Has declined due to impoundments, siltation, and pollution. The remnant population in the Powell River may be threatened by oil and gas drilling and coal mining (Neves, 1991). The Clinch River population was reduced by toxic discharges and spills prior to 1972. The invasion of the Asian clam, and the possible invasion of the zebra mussel, also threatens remaining populations.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties/ Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Hemistena lata CRACKING PEARLY MUSSEL	LE,XN S1	Anderson Claiborne, Giles, Grainger, Hancock, Hardin, Lincoln, Maury, Wayne	Lower Wabash, Upper Clinch, Powell, Lower Clinch, Upper Elk, Lower Tennessee-Beech, Lower Duck, Buffalo. Abundant in sand, gravel, and cobble substrates in swift currents or mud and sand in slower currents	Originally inhabited the Ohio, Cumberland, and Tennessee river systems. It has been extirpated from most of its former range but some viable populations may persist in the upper Clinch River in Tennessee. Reduced to possibly 3 reproducing populations in the Tennessee River system in VA and TN.	Impoundments, siltation and pollution leading to water quality and habitat deterioration. Inadequate sewage treatment, coal mining, oil and gas drilling and poor land-use practices.
Lampsilis orbiculata PINK MUCKET	LE/S2	Anderson, Benton, Claiborne, Clay, Decatur, DeKalb, Grainger, Greene, Hamilton, Hancock, Hardin, Humphreys, Jefferson, Knox, Loudon, Marion, Meigs, Putnam, Rhea, Stewart, Trousdale, Wilson	Middle Allegheny-Redbank, Lower Monongahela, Upper Ohio, Upper Ohio-Shade, Upper Kanawha, Elk, Raccoon-Symmes, Little Scioto-Tygarts, Ohio Brush-Whiteoak, Middle Ohio-, Licking , Upper Green, Barren, Lower Wabash, Upper Cumberland-Lake Cumberland, Obey, Caney, Lower Cumberland-Old Hickory Lake, Lower Cumberland, Silver-Little Kentucky, Salt, Lower Ohio-Little Pigeon, Lower Ohio, Holston, Lower French Broad, Nolichucky, Watts Bar Lake, Upper Clinch, Lower Clinch , Middle Tennessee-Chickamauga, Guntersville Lake, Wheeler Lake, Pickwick Lake, Lower Tennessee-Beech, Kentucky Lake, Lower Tennessee. Characterized as a large river species, although in recent years it has been able to survive and reproduce in impoundments with river-lake conditions but never in standing pools of water. Found in waters with strong currents, rocky substrates, with depths up to about 1 m. Also found in deeper waters with slower currents and sand and gravel substrates.	Considered as an Interior Basin species in origin. Formerly scattered throughout the Mississippi, Tennessee, Ohio and Cumberland river systems. This species has never been collected in large numbers from any one site or drainage. Most surveys only find one to five individuals.	Known threats include modification of habitat (e.g., dams and dredging), degradation of water quality, and over harvest by commercial mussel industry.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Lampsilis altilis FINELINED POCKETBOOK	LT/S1S2	Polk	No locations listed in within Watershed Regions 05 or 06.	Currently, it is limited to eight Element Occurrences which are scattered throughout the historic range.	Habitat modification, sedimentation and water quality degradation represent the major threats to this species. The species may also be threatened by overutilization for commercial, recreational, scientific or educational purposes as well as disease and predation.
Lampsilis virescens ALABAMA LAMPMUSSEL	LE,XNS1	Anderson, Franklin, Morgan, Roane	Lower Clinch, Emory, Wheeler Lake, Pickwick Lake. Found in sand and gravel substrates in shoal areas.	It has only been seen alive once in recent years. It was found alive in the Estill Fork in Jackson County, Alabama near the Tennessee state line by Jeff Garner in 1995. Is found only in the mainstem of the Paint Rock River and its three major tributaries. The most extensive survey of the Paint Rock River drainage in history failed to find the species alive.	Is threatened by sedimentation, runoff from pesticides used for agriculture, poor silviculture practices in the region and unrestricted cattle access). At least one site on the Estill Fork is affected by four wheel recreational vehicle use in the stream. Still another site on the Estill Fork was recently impacted by unpermitted habitat alteration which resulted in the mortality of several mussel species. Dead shells of *L. virescens* were found crushed just below this site. It was undetermined if this unpermitted construction was the cause of their mortality. The reluctance of federal and state authorities to act in these situations may jeopardize the species at these sites.
Lemiox rimosus BIRDWING PEARLY MUSSEL	LE,XNS1	Anderson, Claiborne, Giles, Grainger, Hancock, Hawkins, Knox, Lincoln, Marshall, Maury, Sullivan	North Fork Holston, Holston, Upper Clinch, Powell, Lower Clinch, Upper Elk, Upper Duck, Lower Duck. Found in riffle areas with sand and gravel substrates in moderate to fast currents.	One of the last sizable populations (Lillard Mill, Duck River) was surveyed in August of 1997 and 59 males, 23 females, and 11 juveniles were found. At least one good population exists on the Duck River in Tennessee. Populations in the Clinch and Powell drainages may have fallen below viable levels.	Threats are pollution, habitat alteration (impoundments, siltation from mining, channelization).

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Leptodea leptodon SCALESHELL	LE/SX	No information provided for Tennessee.	Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash. Occurs in riffles with moderate to high gradients in creeks to large rivers. Typically associated with riffles, relatively strong currents, and substrate of mud, sand , or assemblages of gravel, cobble, and boulder.	Historically known from 54 streams; currently restricted to 13 streams of which only three probably contain viable populations or occurrences.	Severely impacted by alteration and inundation of channels, siltation from agriculture and clear-cutting, chemical and organic pollution.
Medionidus acutissimus ALABAMA MOCCASINSHELL	LT/S1	Bradley, Polk	No information for Watershed Regions 05 or 06 provided. Is usually found in sand on the margins of streams with a typical sand and gravel substrate in clear water of moderate flow	Is not abundant anywhere, but is locally common in tributaries of the Sipsey Fork, upper Black Warrior River drainage, Alabama. Historically widespread throughout the Mobile basin; now sporadically in low numbers with the best populations occurring in the Sipsey Fork drainage.	Habitat modification, sedimentation, and water quality degradation represent the major threats to this species; may also be threatened by overutilization for commercial, recreational, scientific or educational purposes as well as disease and predation.
Medionidus parvulus COOSA MOCCASINSHELL	LE/S1	Bradley, Polk	No information for Watershed Regions 05 or 06 provided. The species is usually found in sand and gravel in highly oxygenated, clear streams with moderate flow.	The species is common in portions of the Conasauga River, Polk County, Tennessee; rare elsewhere. Population estimates are not known. Was widespread with sporadic distribution in the Mobile basin. Recent records are limited to three streams. The population in the Conasauga River appears to be stable at the present time. The species appears to be declining elsewhere.	Habitat modification, sedimentation and water quality degradation represent the major threats to this species. The species may also be threatened by overutilization for commercial, recreational, scientific or educational purposes as well as disease and predation. Unrestricted cattle access is a direct threat in portions on the Conasauga River in Bradley and Polk Counties, Tennessee.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Obovaria retusa RING PINK	LE/S1	Benton, Decatur, Hardin, Humphreys Per ry, Smith , Trousdale, Wilson	Upper Ohio, Little Scioto-Tygarts, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Lower Kentucky, Upper Green, Barren, Middle Wabash-Deer, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower White, Lower East Fork White, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Lower Cumberland, Red., Silver-Little Kentucky, Blue-Sinking, Lower Ohio-Little Pigeon, Lower Ohio, Lower Tennessee-Beech, Kentucky Lake, Lower Tennessee. Dennis characterized preferred habitat as large rivers. Gravel and sand bars are preferred. Because of reservoir construction on these large rivers, most historic occurrences have been inundated.	Known from five relic populations, but only two are likely viable. Loss of habitat due to impoundments is probably the primary cause for decline. Other threats include gravel dredging, channel maintenance, and incidental take from commercial mussel harvesting. The Green River population is threatened by diminished water quality due to oil and gas production.	Loss of habitat due to impoundments is probably the primary cause for decline. Other threats include gravel dredging, channel maintenance, and incidental take from commercial mussel harvesting.
Pegias fabula LITTLEWING PEARLYMUSSEL	LE/S1	Franklin, Rutherford, Scott, Sullivan, Van Buren, Warren	Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Collins, Caney, Stones, Red., North Fork Holston, South Fork Holston, Upper Little Tennessee, Upper Clinch, Powell, Upper Elk. Common at the head of riffles, but also found in and below riffles on sand and gravel substrates with scattered cobbles. Also inhabits sand pockets between rocks, cobbles and boulders, and underneath large rocks. It is restricted to small, cool streams.	In Tennessee, it is found in Cane Creek, Van Buren County.	Deterioration of water quality, especially from acid mine drainage is the primary threat to the species. It is also effected by domestic pollution and impoundments.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Plethobasus cicatricosus WHITE WARTYBACK	LE/S1	Anderson, Claiborne, Decatur, DeKalb, Hardin, Jefferson, Perry, Smith	Middle Wabash-Deer, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Caney , Lower Cumberland-Old Hickory Lake, Holston, Powell, Lower Clinch, Pickwick Lake, Lower Tennessee-Beech. Presumed to inhabit shoals and riffles in large rivers like the Tennessee.	No live specimens have been collected in over 30 years and no estimates of population size or abundance have been made. The only recent record was the collection of a fresh dead shell from a commercial shell pile in 1979 and 1982 below Pickwick Dam near Savannah, Tennessee. Both collections were older specimens.	Smith (1971) ranked the causes of extirpation or declines in fish species as follows: siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. All of these factors render habitats unsuitable, cause extirpations, and lead to the isolation of populations thereby increasing their vulnerability to extirpation for many aquatic species (including mussels) throughout North America. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat to this species and most freshwater mussels. Residential, mineral and industrial development also poses a significant threat.
Plethobasus cooperianus ORANGEFOOT PIMPLEBACK	LE/S1	Anderson, Claiborne, Decatur, Hamilton, Hardin, Humphreys , Knox, Loudon, Marshall, Maury, Meigs, Perry, Rhea, Roane, Sevier, Smith	Upper Ohio, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Upper Green, Rough, Lower Wabash, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Lower Cumberland , Silver-Little Kentucky, Salt, Lower Ohio-Little Pigeon, Lower Ohio, Lower French Broad, Watts Bar Lake, Powell, Lower Clinch, Middle Tennessee-Chickamauga, Guntersville Lake, Wheeler Lake, Lower Tennessee-Beech, Upper Duck, Lower Duck, Kentucky Lake, Lower Tennessee. Found in large rivers in sand, gravel, and cobble substrates in riffles and shoals in deep water and steady currents.	No estimates of population size or abundance have been made. Presently restricted to the Tennessee, Cumberland, and lower Ohio rivers where it is rare. Between 1979 and 1982 a large number of fresh-dead shells were collected from a shell buyer's cookout camp below Pickwick Dam. Juveniles also found in muskrat middens along the Tennessee River in Hardin County, Tennessee. Individuals are rare but regularly reported from the lower Ohio River near Metropolis, Illinois. Parmalee et al. (1980) reported finding live individuals near Bartlett's Bar on the Cumberland River in 1979 and represent the only live records in the river since Neel and Allen (1964).	Smith (1971) ranked the causes of extirpation or declines in fish species as follows: siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. All of these factors render habitats unsuitable, cause extirpations, and lead to the isolation of populations thereby increasing their vulnerability to extirpation for many aquatic species (including mussels) throughout North America. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat to this species and most freshwater mussels. Residential, mineral and industrial development also poses a significant threat.

Species/ Common name	ESA Status/ Conser vation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Pleurobema clava CLUBSHELL	LE,XN SH	DeKalb, Hardin, Putnam, Smith	Middle Allegheny-Tionesta, French, Middle Allegheny-Redbank, Conemaugh, Kiskiminetas, Lower Allegheny, West Fork, Cheat, Lower Monongahela, Upper Ohio, Shenango, Mahoning, Beaver, Connoquenessing, Little Muskingum-Middle Island, Little Kanawha, Elk, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, South Fork Licking, Lower Kentucky, Upper Green, Barren, Rough, Upper Wabash, Eel, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Little Vermilion, Vermilion , Middle Wabash-Busseron, Embarras, Lower Wabash, Upper White, Lower White, Driftwood, Flatrock-Haw, Upper East Fork White, Lower East Fork White, Caney, Lower Cumberland, Silver-Little Kentucky, Salt, Rolling Fork, Blue-Sinking, Lower Ohio-Bay, Lower Tennessee-Beech, Lower Tennessee.	No detailed abundance estimates have been done on this species. Known from short reaches of 12 streams.	Threatened by domestic and industrial waste and navigation developments in the upper Ohio and Wabash river watersheds. Stansbery believed that various pesticides were at least partially responsible for the overall decrease in the fauna of areas in which P. CLAVA was present. Proposed coal mining in the Elk River watershed may threaten that population. The introduced zebra mussel could also pose a significant threat.
Pleurobema decisum SOUTHERN CLUBSHELL	LE/S1	No information provided.	No information provided for Watershed Regions 05 or 06. Usually found in highly oxygenated streams with sand and gravel substrate; may be found in sand and gravel in the center of the stream or in sand along the margins of the stream.	It is most common in the Sipsey River, Tombigbee River drainage; Chewacla Creek, Tallapoosa River drainage; and the Conasauga River, the upper Coosa River drainage. It is usually rare where ever it is found.	It is most common in the Sipsey River, Tombigbee River drainage; Chewacla Creek, Tallapoosa River drainage; and the Conasauga River, the upper Coosa River drainage. It is usually rare where ever it is found.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Pleurobema georgianum SOUTHERN PIGTOE	LE/S1	Bradley, Polk	No information provided for Watershed Region 05 0r 06. Inhabits high quality rivers with stable gravel and sandy-gravel substrates.	Presumably a Coosa River system endemic found in Alabama, Georgia, and Tennessee. Museum records indicate its presence in the Coosa River, Shoal Creek, and the Chatooga and Conasauga rivers. Recently (1987-1991) known from just a handful of records. Less than five occurrences known.	Threats include habitat modification, sedimentation, and water quality degradation.
Pleurobema gibberum CUMBERLAND PIGTOE	LE/S1	Coffee, Grundy, Van Buren, Warren, White	Collins, Caney, Upper Elk. Inhabits small to medium rivers in riffle areas with sand and gravel substrates and relatively shallow depths.	Endemic to the Caney Fork River system in Tennessee. It may have once been widespread in the system. It now occurs in isolated sections of five tributaries: the Barren Fork, Calfkiller River, Cane Creek, Hickory Creek, and the Collins River. Five populations that are separated by impoundments and unsuitable habitat (USFWS, 1991).	Threats include impoundments and deterioration of water quality due to siltation by coal mining, poor land use practices, and other pollutants.
Pleurobema perovatum OVATE CLUBSHELL	LE/SH	Bradley	No information provided for Watershed Region 05 0r 06.	Rare throughout its range except for the Sipsey River and Chewacla Creek where it may be locally common. The species is currently extant at five sites compared with 23 historic sites.	Habitat modification, sedimentation, and water quality degradation are the major threats; may also be threatened by overutilization for commercial, recreational, scientific, and educational purposes.
Pleurobema plenum ROUGH PIGTOE		Anderson, Hardin, Humphreys , Meigs, Rhea, Smith, Trousdale	Middle Allegheny-Redbank, Upper Ohio, Ohio Brush-Whiteoak, Middle Ohio-Laughery, Licking, Lower Kentucky, Upper Green, Barren, Middle Green, Middle Wabash-Deer, Tippecanoe, Middle Wabash-Little Vermilion, Middle Wabash-Busseron, Lower Wabash, Lower East Fork White, Upper Cumberland-Lake Cumberland, Lower Cumberland-Old Hickory Lake, Upper Clinch, Lower Clinch, Middle Tennessee-Chickamauga, Wheeler Lake, Pickwick Lake, Lower Tennessee-Beech, Kentucky Lake. Found in medium to large rivers in sand, gravel, and cobble substrates in shoals.	Currently present in an undetermined number of miles below three Tennessee River mainstem dams (Pickwick, Wilson, and Guntersville) and the upper Clinch River between river miles 323 and 154. Although reported by Parmalee et al. (1980) from the middle Cumberland River between 1977 and 1979, it was not found in recent surveys by Tennessee Valley Authority (1976) or Sickel and Chandler (1996). Presently confined to under 20 sites in the Tennessee, Clinch, Cumberland, Barren and Green rivers.	Smith (1971) ranked the causes of extirpation or declines in fish species as follows: siltation, drainage of bottomland lakes, swamps, and prairie marshes, desiccation during drought, species introductions, pollution, impoundments, and increased water temperatures. All of these factors render habitats unsuitable, cause extirpations, and lead to the isolation of populations thereby increasing their vulnerability to extirpation for many aquatic species (including mussels) throughout North America. Pollution through point (industrial and residential discharge) and non-point (siltation, herbicide and fertilizer run-off) sources is perhaps the greatest on-going threat to this species and most freshwater mussels.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Ptychobranchus greenii TRIANGULAR KIDNEYSHELL	LE/SH	Bradley, Polk	No information provided for Watershed Region 05 0r 06.	Population estimates are not known. Numbers typically are low. Is believed to be extant at four sites. Numerous surveys have targeted this species.	Loss of habitat due to impoundments is the primary reason for the decline of the species. It may also be threatened by overutilization for commercial, recreational, scientific and educational purposes.
Quadrula cylindrica strigillata ROUGH RABBITSFOOT	LE/S2	Claiborne, Hancock, Roane	North Fork Holston, Upper Clinch, Powell, Lower Clinch. This subspecies has been noted to occur in small headwater tributaries of the Tennessee River, often near the banks, in shoals with clean water and gravel bottoms or in riffles in shallow water.	Extant EOs may be <20 in two states. Viability questionable at all sites.	Low population levels and few EOs make this species extremely vulnerable. Impacted by chemical and organic pollution, toxic mine run-off, channel alteration and inundation, siltation from agriculture and clear-cutting, and possibly by collecting (non-commercial). The populations in the lower Clinch, Powell, and Holston river systems were extirpated by reservoirs.
Quadrula fragosa WINGED MAPLELEAF	LE,XN SH	No information provided	No information provided for Watershed Region 05 0r 06. Appears to have inhabited medium-sized and large rivers.	Extant EOs are only known from one ten mile section of the lower St. Croix River the Ouachita River in Arkansas, and possibly in Oklahoma.	Chemical and organic pollution, alteration and inundation of river channels and siltation have, and continue to have, a severe negative impact on this species. Commercial harvest of shells may also be a threat. A single catastrophic event could possibly cause the extinction of this species.
Quadrula intermedia CUMBERLAND MONKEYFACE	LE,XN S1	Claiborne, Franklin, Hamilton, Hancock, Hawkins, Knox, Lincoln, Marshall, Maury, Monroe, Sullivan	North Fork Holston, South Fork Holston, Holston, Lower Little Tennessee, Upper Clinch, Powell, Middle Tennessee-Chickamauga, Upper Elk, Lower Elk, Upper Duck, Lower Duck. Shallow riffle and shoal areas of headwater streams and bigger rivers. Clean, fast-flowing water in shoal conditions. It has been found living in a sand and gravel substrate in 6 inches to 2 feet of water	Extant populations are scattered and have typically supported low numbers . An August 1997 survey of the Duck River population in Tennessee only found two individuals, previously one was found in 1995, and none in 1993 and 1994 surveys. There are very few recent records.	It is threatened by habitat alteration (pollution, impoundment, siltation, channelization).
Quadrula sparsa APPALACHIAN MONKEYFACE	LE/S1	Claiborne, Hancock, Monroe, Trousdale	Lower Cumberland-Old Hickory Lake, Lower Little Tennessee, Upper Clinch, Powell. Inhabits fast-flowing, headwaters sections of rivers in shallow riffles and runs.	Currently restricted to free-flowing reaches of the Powell and Clinch rivers above Norris Reservoir in Tennessee.	Threatened by impoundments, siltation and pollution.

Species/ Common name	ESA Status/ Conservation Rank	TN Counties Distribution	Watershed Distribution/ Habitat Watershed Region 05, 06*	Population Distribution/ Abundance	Threats
Toxolasma cylindrellus PALE LILLIPUT	LE/S1	Coffee, Franklin, Lewis, Marion, Marshall, Maury	Sequatchie, Guntersville Lake, Wheeler Lake, Upper Elk, Upper Duck, Lower Duck, Buffalo. Found buried in firm rubble, gravel, and sand substrates in shallow riffles and shoals. Water is clean and fast-flowing.	Formerly widespread throughout the Tennessee River drainage it is now believed to exist only in the Paint Rock River drainage in Alabama (one viable population) and in the Duck River of Tennessee (population may be extirpated).	The most imminent threat to the largest population is the practice of the locals to ride four-wheel recreational vehicles in the stream. This has occurred with some regularity at the site in recent years. The reluctance of state and federal authorities to intervene may well jeopardize this last viable population. Silviculture upstream of this site in Franklin County, Tennessee may also threaten his population.
Villosa perpurpurea PURPLE BEAN	LE/S1	Cumberland, Hawkins, Morgan, Roane	North Fork Holston, Holston, Upper Clinch, Powell, Emory. The habitat is creeks to medium-sized rivers and occasionally headwaters. The mussel is generally associated with riffles, but may be out of direct current, in pools, or flats in streams with season flows in riffles. It is not found in backwaters. Substrates range from silty-sand to boulder-sized rocks. Currents vary from fast to slight and water depths are typically shallow (< 0.5 m).	Currently all populations are small. In the Clinch River densities were calculated at 0.11 per square foot when sampled in both 1979 and 1988(over 11-14 sites). Sporadic occurrences in five tributaries in Virginia and Tennessee. Most historical populations extirpated and continued viability of extant EOs questionable.	Chemical and organic pollution, urban development, coal mine effluent, siltation from agriculture and clear-cutting, and damming continue to impact this species. The populations in the lower Clinch, Powell, and Holston rivers were extirpated by reservoirs.
Villosa trabalis CUMBERLAND BEAN	LE,XN S1	Clay, Cumberland, DeKalb, Greene, Hawkins, Morgan, Pickett, Polk, Putnam, Scott, Smith	Upper Cumberland, Rockcastle, Upper Cumberland-Lake Cumberland, South Fork Cumberland, Obey, Caney, North Fork Holston, Holston, Nolichuck, Upper Clinch, Emory, Hiwassee. Found in sand, gravel, and cobble substrates in waters with moderate to swift currents and depths less than 1 meter.	Population size estimates are unknown. Records are sporadic in the upper Cumberland drainage, yet is fairly common there and in the Hiwassee River, Polk County, Tennessee.	Habitat modification, sedimentation, and water quality degradation are the major threats to this species.

APPENDIX G

LETTER FROM USFWS REGARDING WS PROGRAM EFFECTS ON FEDERALLY LISTED T/E SPECIES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

September 2, 2005

Mr. Brett G. Dunlap
USDA - Animal and Plant Health Inspection Service
Wildlife Services
537 Myatt Drive
Madison, Tennessee 37115

Re: FWS #05-1652

Dear Mr. Dunlap:

Thank you for your e-mail of July 21, 2005, transmitting proposed revisions to the pre-decisional Environmental Assessment (EA) for Wildlife Services' (WS) mammal damage management program in the State of Tennessee. Based on information exchanged during our May 24, 2005 meeting, additional data for federally designated critical habitat and federally listed species in Tennessee were included in specific sections within the EA. Enhanced coordination procedures between our agencies for individual mammal damage management projects occurring in these areas were also proposed. Please consider the following comments.

The EA is adequate and supports your conclusion of "not likely to adversely affect" with which we concur. In view of this, we believe that you have fulfilled the requirements of section 7 of the Endangered Species Act. Obligations under section 7 must be reconsidered, however, if: (1) new information reveals that the proposed action may affect listed species in a manner or to an extent not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered during this consultation, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

These constitute the comments of the U.S. Department of the Interior, provided in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.). We appreciate your continued coordination. Should you have any questions or need further assistance, please contact Steve Alexander of my staff at 931/528-6481, ext. 210, or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

xc: Greg Masson, FWS, Washington
Joe Johnston, FWS, Atlanta

APPENDIX H

LETTER FROM TWRA REGARDING WS PROGRAM EFFECTS ON STATE LISTED T/E SPECIES

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

December 2, 2004

USDA/APHIS/Wildlife Services
Mr. Brett Dunlap, State Director
537 Myatt Dr.
Madison, TN 37115

Dear Mr. Dunlap:

We have reviewed the Draft Mammal Damage Management Environmental Assessment (EA) for the USDA's Wildlife Services (WS) program in Tennessee. We concur with your finding that the Proposed Action of continuing the current WS Mammal Damage Management program will not adversely affect State listed threatened and endangered species.

We request that our agencies continue to communicate and work cooperatively to address wildlife damage management issues involving State listed threatened and endangered species, as well as other wildlife species.

Sincerely,

Ed Warr
Assistant Chief, Wildlife Division

The State of Tennessee

AN EQUAL OPPORTUNITY EMPLOYER

APPENDIX I

LETTER SENT TO INTERESTED PARTIES REGARDING NOTIFICATION OF AVAILABILITY OF DRAFT EA

USDA

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

TN/KY State Office
537 Myatt Drive
Madison, TN 37115
(615) 736-5506
(615) 736-2768 FAX

January 24, 2005

Dear Interested Party,

The US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program in cooperation with the Tennessee Valley Authority (TVA) has developed a Pre-Decisional Environmental Assessment (EA) covering WS's involvement in managing mammal damage and conflicts throughout the State of Tennessee. The proposed action is for WS to implement an Integrated Wildlife Damage Management approach to reduce mammal damage and conflicts to property, agricultural and natural resources, and public health and safety on all lands in Tennessee where a need exists and a request for assistance is received. The Pre-Decisional EA analyzes potential environmental effects of conducting alternative strategies for reducing mammal damage, and identifies and analyzes issues and alternative strategies. Issues of concern addressed in the EA include, but are not limited to: effects on mammal populations, effects on plants and other wildlife species, effects on public safety, humaneness of methods to be used, effects on wetlands, aesthetic values of mammals, and economics losses to property. Alternatives evaluated include: integrated mammal damage management by WS, non-lethal management required before lethal, only technical assistance, no Federal WS mammal damage management program.

Interested parties may obtain copies of the pre-decisional EA by contacting, USDA APHIS Wildlife Services, 537 Myatt Drive, Madison, TN 37115 or by telephone at (615) 736-5506. Written comments should be sent to the above address and must be received by COB March 4, 2005 in order to receive full consideration prior to the decision.

Sincerely,

Brett G. Dunlap
State Director, TN/KY
USDA/APHIS/WS
537 Myatt Drive
Madison, TN 37115