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

ENVIRONMENTAL ASSESSMENT

ORAL VACCINATION TO CONTROL SPECIFIC RABIES VIRUS VARIANTS IN RACCOONS, GRAY FOXES, AND COYOTES IN THE UNITED STATES

July 2001

Prepared By:
United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services
4700 River Road, Unit 87
Riverdale, MD 20737-1234

TABLE OF CONTENTS

EXECUTIVE SUMMARY iv

1.0 CHAPTER 1: PURPOSE OF AND NEED FOR ACTION . . . . . 1 - 1
1.1 BACKGROUND . . . . . 1 - 1
1.1.1 Public health importance of rabies. . . . . 1 - 1
1.1.2 Raccoon Rabies in the Eastern U.S. . . . . 1 - 1
1.1.3 Gray fox and coyote rabies in Texas. . . . . 1 - 3
1.1.4 Primary Need for Action. . . . . 1 - 3
1.1.5 Development of Oral Rabies Vaccine Programs. . . . . 1 - 4
1.1.6 Previous Rabies Control Activities by APHIS-WS. . . . . 1 - 6
1.2 DESCRIPTION OF THE PROPOSED ACTION . . . . . 1 - 6
1.3 AUTHORITIES . . . . . 1 - 9
1.3.1 Federal Authorities . . . . . 1 - 9
1.3.2 State and Local Authorities . . . . . 1 - 10
1.4 OTHER RELEVANT FEDERAL LAWS AND REGULATIONS . . . . . 1 - 10
1.5 RELATIONSHIP TO OTHER ENVIRONMENTAL DOCUMENTS . . . . . 1 - 11
1.6 EXECUTIVE ORDER ON ENVIRONMENTAL JUSTICE . . . . . 1 - 12
1.7 EXECUTIVE ORDER ON PROTECTION OF CHILDREN FROM ENVIRONMENTAL HEALTH AND SAFETY RISKS . . . . . 1 - 12
1.8 DECISION TO BE MADE . . . . . 1 - 13
1.9 GOALS . . . . . 1 - 13
1.10 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS . . . . . 1 - 13
1.10.1 Actions Analyzed. . . . . 1 - 13
1.10.2 Period for Which this EA is Valid. . . . . 1 - 13
1.10.3 Site Specificity. . . . . 1 - 13
1.11 SUMMARY OF PUBLIC INVOLVEMENT EFFORTS . . . . . 1 - 14

2.0 CHAPTER 2: ISSUES AND AFFECTED ENVIRONMENT . . . . . 2 - 1
2.1 ISSUES . . . . . 2 - 1
2.2 OTHER ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE . . . . . 2 - 1
2.2.1 Potential for drugs used in animal capture and handling to cause adverse health effects in humans that hunt and eat the species involved. . . . . 2 - 1
2.2.2 Potential for adverse impacts on wildlife from aircraft overflights conducted in ORV programs. . . . . 2 - 2
2.2.3 Potential for ORV bait distribution to affect organic farming. . . . . 2 - 3
2.2.4 Potential for ORV to cause abortions in cattle. . . . . 2 - 4
2.2.5 Potential human health impacts in the event of human consumption of vaccinated wildlife.. . . . . 2 - 4
2.3 AFFECTED ENVIRONMENT . . . . . 2 - 4

3.0 CHAPTER 3: ALTERNATIVES CONSIDERED, INCLUDING THE PROPOSED ACTION . . . . . 3 - 1
3.1 ALTERNATIVES CONSIDERED BUT NOT IN DETAIL, WITH RATIONALE . . . . . 3 - 1
3.1.1 Depopulation of target species. . . . . 3 - 1
3.1.2 Population Control Through Birth Control. . . . . 3 - 3
3.1.3 Employ other types of ORV instead of the genetically engineered V-RG vaccine. . . 3 - 3
3.2 MITIGATION IN STANDARD OPERATING PROCEDURES FOR RABIES ORV PROGRAMS . . . . . 3 - 4

4.0 CHAPTER 4: ENVIRONMENTAL CONSEQUENCES . . . . . 4 - 1
4.1 Alternative 1 -- Proposed action . . . . . 4 - 1

4.1.1 Potential for adverse effects on people that become exposed to the vaccine or the baits. . . . . 4 - 1
4.1.2 Potential for adverse effects on target wildlife species populations. . . . . 4 - 4
4.1.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species. . . . . 4 - 5
4.1.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits. . . . . 4 - 9
4.1.5 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals. . . . . 4 - 9
4.1.6 Potential for the Raboral V-RG® vaccine to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals. . . . . 4 - 10
4.1.7 Potential for aerially dropped baits to strike and injure people or domestic animals. . . . . 4 - 11
4.1.8 Cost of the program in comparison to perceived benefits. . . . . 4 - 11
4.1.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans. . . . . 4 - 12
4.2 Alternative 2 -- No action . . . . . 4 - 13
4.2.1 Potential for adverse effects on people that become exposed to the vaccine or the baits. . . . . 4 - 13
4.2.2 Potential for adverse effects on target wildlife species populations. . . . . 4 - 14
4.2.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species. . . . . 4 - 15
4.2.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits. . . . . 4 - 15
4.2.5 Potential for aerially dropped baits to strike and injure people or domestic animals. . . . . 4 - 15
4.2.6 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals. . . . . 4 - 15
4.2.7 Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals. . . . . 4 - 15
4.2.8 Cost of the program in comparison to perceived benefits. . . . . 4 - 16
4.2.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans. . . . . 4 - 16
4.3 Alternative 3 -- Live-capture-vaccinate-release programs. . . . . 4 - 16
4.3.2 Potential for adverse effects on target wildlife species populations . . . . . 4 - 17
4.3.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species. . . . . 4 - 17
4.3.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits. . . . . 4 - 18
4.3.5 Potential for aerially dropped baits to strike and injure people or domestic animals . . . . . 4 - 18
4.3.6 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals. . . . . 4 - 18
4.3.7 Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals. . . . . 4 - 18
4.3.8 Cost of the program in comparison to perceived benefits. . . . . 4 - 18
4.3.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans. . . . . 4 - 19
4.4 Alternative 4 -- Provide funds to purchase and distribute ORV baits without animal specimen

collections or lethal removal of animals under contingency plans. . . . . 4 - 19
4.4.1 Potential for adverse effects on people that become exposed to the vaccine or the baits. . . . . 4 - 20
4.4.2 Potential for adverse effects on target wildlife species populations. . . . . 4 - 20
4.4.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species. . . . . 4 - 21
4.4.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits. . . . . 4 - 21
4.4.5 Potential for aerially dropped baits to strike and injure people or domestic animals. . . . . 4 - 21
4.4.6 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals. . . . . 4 - 22
4.4.7 Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals. . . . . 4 - 22
4.4.8 Cost of the program in comparison to perceived benefits. . . . . 4 - 22
4.4.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans. . . . . 4 - 22
4.5 CUMULATIVE IMPACTS . . . . . 4 - 22
4.6 SUMMARY OF IMPACTS OF ALTERNATIVES FOR EACH ISSUE . . . . . 4 - 23

APPENDIX A – LIST OF PREPARERS, REVIEWERS AND PERSONS/AGENCIES CONSULTED . . . . . A - 1

APPENDIX B – LITERATURE CITED . . . . . B - 1

APPENDIX C – Species Listed as Threatened or Endangered and species proposed or candidates for listing under the Endangered Species Act . . . . . C - 1

APPENDIX D – Summary of species listed as threatened, endangered, or special status under state laws . . . . . D - 1

APPENDIX E – ECOREGION DESIGNATIONS WITHIN STATES AFFECTED BY APHIS-WS CONTINUED OR EXPANDED INVOLVEMENT IN RABIES ORAL VACCINATION PROGRAMS . . . . . E - 1

APPENDIX F – AMERICAN INDIAN TRIBES LOCATED IN STATES THAT MAY BE AFFECTED BY APHIS-WS CONTINUED OR EXPANDED INVOLVEMENT ORV PROGRAMS . . . . . F - 1

EXECUTIVE SUMMARY

This Environmental Assessment (EA) documents the analysis of the potential environmental effects of a proposal to continue and expand the involvement of the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services (APHIS-WS) program in oral rabies vaccination (ORV) programs in a number of states. The states where APHIS-WS involvement would be continued or expanded include New York, Ohio, Texas, Vermont and West Virginia. A small portion of northwestern New Hampshire and the western counties in Pennsylvania that border Ohio could also be included in these control efforts. In addition, APHIS-WS may cooperate in smaller scale ORV projects in the states of Florida, Massachusetts, Maryland, New Jersey, Virginia, and Alabama as part of the proposed action. The programs' primary goals are to stop the spread of specific raccoon (eastern states), gray fox (Texas) and coyote (Texas) rabies variants or "strains" of the rabies virus. If not stopped, these strains could potentially spread to much broader areas of the U.S. and Canada and cause substantial increases in public and domestic animal health costs because of increased rabies exposures.

The oral rabies vaccine used in these programs is the genetically engineered recombinant vaccinia-rabies glycoprotein (Raboral V-RG® MERIAL, Inc.) vaccine currently licensed for use in raccoons in the U.S. and Canada and approved for experimental use in gray fox and coyotes in Texas. It has been used extensively and successfully in Europe to combat fox rabies. This vaccine is contained in baits which are distributed by aircraft and by ground placement and then are picked up and consumed by the target species. It has been found to be safe for use in a number of animal species.

The proposed action would involve use of federal funds by APHIS-WS to purchase ORV baits and cooperate with programs in the above states in the distribution of such baits to create zones of vaccinated target species that then serve as barriers to further advancement of the particular rabies virus variants. ORV baits could also be used in other areas where the particular rabies virus variants are known to occur with the goal of eliminating those variants from such areas. The proposed action would also include APHIS-WS assistance in monitoring and surveillance activities involving the capture and release or lethal collection of the targeted animal species in the above states to take biological samples for testing to determine the effectiveness of the ORV programs. APHIS-WS could also assist the states in implementing contingency plans that include the localized population reduction of the target species in areas where rabies outbreaks occur beyond ORV barriers.

The EA analyzes a number of environmental issues or concerns with the oral rabies vaccine and with activities associated with ORV programs such as capturing and handling of animals for monitoring and surveillance purposes, as well as the potential implementation of contingency actions to address rabies outbreaks such as more concentrated localized ORV use or localized suppression of target species populations. The EA also analyzes several alternatives to the proposed action, including No Action (i.e., no federal funding or participation by APHIS-WS), Live-capture-vaccinate-release programs (trapping animals followed by administration of injectable vaccines and then release), and ORV Bait Distribution without animal specimen collections or localized lethal removal of target species under state contingency plans (i.e., no capturing or lethal removal of animals by APHIS-WS for monitoring or surveillance purposes or to address localized rabies outbreaks).

The analysis in the EA indicates no significant impacts on the quality of the human environment are expected from APHIS-WS's continued or expanded involvement in these programs.

1.0 CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

1.1 BACKGROUND

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 animal 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*). Red foxes (*Vulpes vulpes*) account for less than 10% of the reported rabies cases, with domestic cats, dogs and cattle among those most often reported (CDC 2001a). Two canine rabies epizootics (epidemics in animals) emerged in Texas in 1988, one involving coyotes and dogs in South Texas and the other in gray foxes in West/Central Texas. The South Texas epizootic alone has resulted in two human deaths and caused over 3,000 people to receive postexposure rabies treatment (TDH 2001).

1.1.1 Public health importance of rabies.

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/year in the 1990s. Modern day prophylaxis, which is the series of vaccine injections given to people who have been potentially or actually exposed, has proven nearly 100% successful in preventing mortality when administered promptly (CDC 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 these 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). In Massachusetts during 1991-95, the median cost for PEP was $2,376 per person (CDC 2001b). Also, as epizootics spread in wildlife populations, the risk of "mass" human exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increases – one case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for a total of 71 persons (CDC 2001b). The total cost of this single incident exceeded $160,000 based on the median cost for PEPs in that state cited above. Perhaps 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 postexposure rabies vaccinations at a total cost of more than $1.1 million (Noah et al. 1995).

1.1.2 Raccoon Rabies in the Eastern U.S.

Rabies in raccoons was virtually unknown prior to the 1950s. It was first described in Florida and spread slowly during the next three decades into Georgia, Alabama, and South Carolina. It was unintentionally

introduced into the mid-Atlantic states, probably by translocation of infected animals (Krebs et al. 1999). 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 (48.3 km/yr). It was also first confirmed in northeastern Ohio in 1996 (Krebs et al. 1998). In 1999, the first three cases of raccoon rabies were confirmed in southern Ontario (Rosatte et al. 2001) and the strain has recently been reported in New Brunswick.

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. To date, there have been no known cases of rabies in humans attributable to raccoon rabies. 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 an area. Human and financial resources allocated to rabies-related human and animal health needs also increase, often at the expense of other important activities and services.

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. In northeast Ohio, an oral rabies vaccination (ORV) program has established an “immune barrier” along its border with Pennsylvania from Lake Erie to the Ohio River near East Liverpool, Ohio that has slowed if not stopped the westward expansion of raccoon rabies. If raccoon rabies breaches this barrier, current live trapping results in Ohio (A. Montoney, APHIS-WS, pers. comm. cited in Kemere et al. 2001) as well as the status of raccoons in the Midwest (Sanderson and Hubert 1981, Glueck et al. 1988, Hasbrouck et al. 1992, Mosillo et al. 1999) suggest that raccoon populations are sufficient for rabies to spread westward along a front at a rate similar to or greater (Rupprecht and Smith 1994) than the rate at which this rabies strain has spread in the eastern U.S. Figure 1-1 shows the potential for spread of this rabies variant across the central portion of the U.S. if it is not stopped.

1.1.3 Gray fox and coyote rabies in Texas.

In 1988, a strain of rabies that had previously been confined to urban domestic dogs became established in coyotes (*Canis latrans*) along the U.S.-Mexico border in south Texas (Clark and Wilson 1995). This canine strain of rabies is readily transmitted from coyotes to domestic dogs and, subsequently, between domestic dogs (Clark et al. 1994). Rabies outbreaks involving domestic animals greatly increase the risk of human exposure which heightened the seriousness of this particular epizootic from a public health standpoint (Clark and Wilson 1995). By 1994, this strain had advanced 255 km (158 miles) north of the U.S.-Mexico border. Two human deaths from this strain occurred during this time - one in 1991 and another in 1994 (Clark and Wilson 1995).

Prior to 1988, a gray fox (*Urocyon cinereoargenteus*) strain of rabies was enzootic or prevalent in West Texas. From a starting point near Sonora, Texas in Sutton County in 1988, an epizootic of gray fox rabies cases expanded 130 km northward and 255 km eastward. This particular strain was readily transmitted to raccoons and to livestock, especially cows and goats (Clark and Wilson 1995).

The south Texas canine rabies epizootic alone has resulted in over 3,000 people receiving postexposure rabies treatment. In 1994, the public health threat created by these two expanding epizootics prompted the Governor of Texas to declare rabies a public health emergency in the state (Clark and Wilson 1995).

1.1.4 Primary Need for Action.

If new rabies strains such as those transmitted by raccoons, gray foxes, and coyotes are not prevented from spreading to new areas of the U.S., the health threats and costs associated with rabies are expected to increase substantially as broader geographic areas of the U.S. are affected. In the area that stretches west

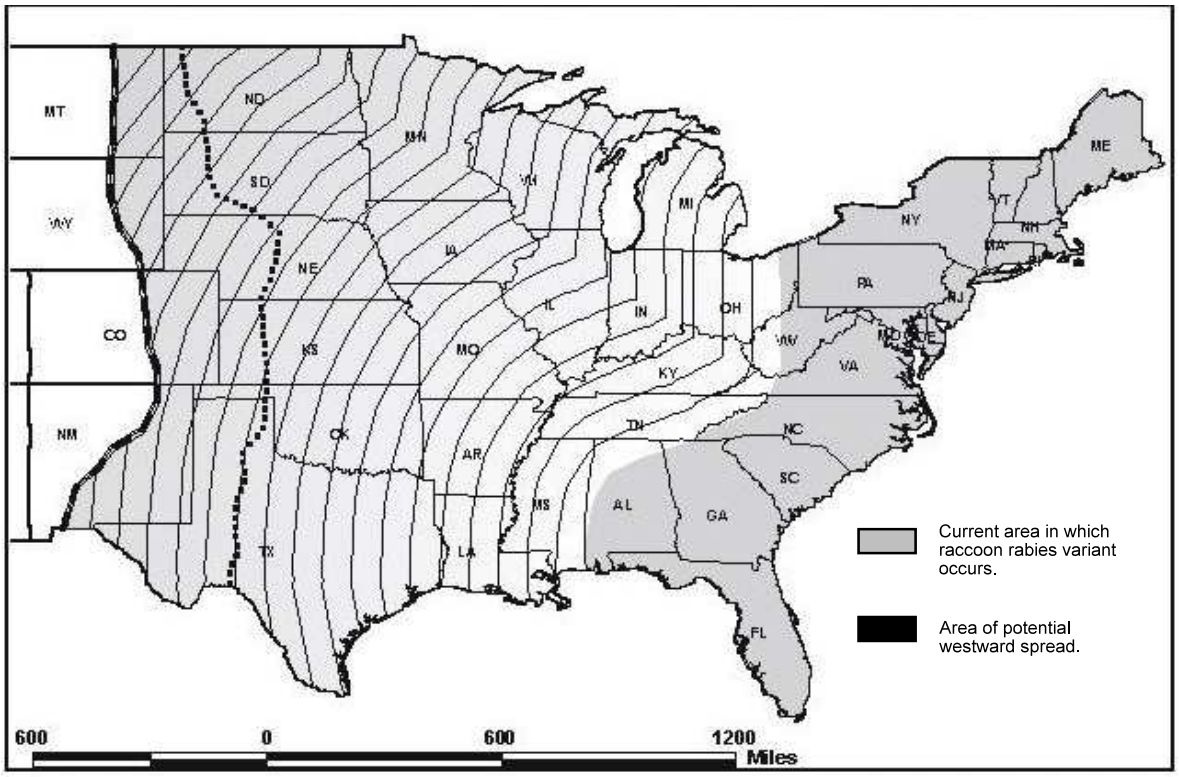

Figure 1-1. Potential areas of the U.S. into which raccoon rabies could spread if not stopped by rabies management programs. From Kemere et al. (2001).

from the leading edge of the current distribution of raccoon rabies (which stretches from Alabama northeastward along the Appalachian Mountains through coastal Maine) to the Rocky Mountains, and north from the distribution of gray fox and coyote rabies in Texas, there are more than 111 million livestock animals -- including cattle, horses, mules, swine, goats, and sheep - - valued at $42 billion (65 FR 76606-76607, December 7, 2000). If raccoon, gray fox, or coyote rabies were to spread into the above described area, many of these livestock would be at risk to these specific rabies variants. More importantly, human health care concerns would be expected to increase substantially as well if raccoon, coyote and gray fox strains of rabies infect a much broader geographic area which would add to the current high costs of living with these strains.

1.1.5 Development of Oral Rabies Vaccine Programs.

Although the concept of ORV to control rabies in free-ranging wildlife populations originated in the U.S. (Baer 1988), it has a longer history of implementation in Europe and Canada. The emergence of raccoon rabies in the U.S. during the 1970s heightened interest in the application of ORV to raccoons. Due to biological and ecological differences among the types of animals that transmit rabies, development of specific vaccine and bait combinations was needed. One of the main difficulties was the development of a safe and effective vaccine for raccoons. In contrast to red foxes, which were the primary subjects of ORV programs in Europe and Canada, raccoons were not readily immunized by the oral route with the modified live rabies virus vaccines that worked well in foxes (Rupprecht et al. 1988). In addition, modified "live virus" vaccines pose a small risk of causing vaccine-induced rabies, and have resulted in some cases of vaccine-induced rabies in animals (but no cases in humans) during oral baiting programs in Europe and Canada (Wandeler 1991). However, vaccinia-rabies glycoprotein (V-RG) vaccine has proven to be orally effective in raccoons, coyotes and foxes. This genetically engineered vaccine was extensively evaluated in the laboratory for safety in more than 50 vertebrate species with no adverse effects regardless of route or dose. As a consequence of field safety testing in the early 1990's, V-RG was conditionally licensed in 1995 and fully licensed in 1997 in the U.S. for vaccination of free-ranging raccoons. It remains the only effective vaccine licensed for use in the U.S. and Canada for raccoons. It has also been approved for experimental use to vaccinate wild gray foxes and coyotes in Texas.

The vaccinia-rabies glycoprotein vaccine is commercially available from MERIAL, 115 Transtech Drive, Athens, GA 30601 under the registered name Raboral V-RG®. It is currently the only licensed oral vaccine available for rabies control in some wild carnivores in the U.S. (CDC 2000). Throughout the remainder of this document, Raboral V-RG® is referred to as "V-RG". As a recombinant vaccine, the letter "V" is used to denote vaccinia, the self-replicating pox virus that serves as the vector (i.e., carrier) for the rabies virus gene that is responsible for the production of rabies glycoprotein. The letters "RG" stand for rabies glycoprotein which is the protective sheath around the bullet-shaped rabies virus core. The glycoprotein by itself is noninfective and cannot cause rabies, but it serves as an "antigen" which means it elicits an immune response to rabies when the vaccine is swallowed by raccoons, foxes, or coyotes.

A number of studies have been conducted to determine the best bait formulations and strategies for delivery of ORV vaccines to raccoons (Hanlon et al. 1989a, Hable et al. 1992, Hadidian et al. 1989, Linhart et al. 1991, Linhart et al. 1994), gray fox (Steelman et al. 1998, 2000), and coyotes (Linhart et al. 1997, Farry et al. 1998a, 1998b). When raccoons, foxes or coyotes eat oral rabies baits and puncture a sachet[1] containing the vaccine, the vaccine is swallowed and bathes the lymphatic tissue in the throat area and initiates the immunization process. The baits are small blocks of fishmeal (for coyotes and raccoons) or dog food (for gray foxes) that are held together with a polymer binding agent (Figure 1-2). The sachet containing the liquid vaccine is contained in the middle of the bait (Figure 1-3). "Coated" sachets with a simple fishmeal attractant coating have also been field tested with effectiveness that appears to be

[1] A thin plastic packet much like those in which condiments (e.g., catsup, mustard) are provided at fast food restaurants.

comparable to fishmeal polymer baits containing the sachet (Linhart et al. *unpublished* 2001). Using the "coated" sachet may be equal in effectiveness at lower cost per vaccinated target wild animal. All baits are marked with a warning label that includes a phone number to call for additional information.

Figure 1-2. Fishmeal polymer block oral rabies vaccine bait showing warning label and toll-free telephone number to call for information (photo by K. Nelson, APHIS-WS, Vermont).

There is no possibility of vaccine-induced rabies with V-RG because the vaccine only contains the non-infective surface protein of the rabies virus; none of the viral nuclear material (i.e., RNA) which would be required for the rabies virus to replicate is present in the vaccine. Over 23 million doses have been distributed in the U.S. since 1990 with only one case of vaccinia virus infection reported in humans (resulting in localized skin rashes) to date (Rupprecht et al. *unpublished* 2000). This vaccine has been tested in more than 50 wild mammalian and avian species without adverse effects. In addition, a domestic animal's annual rabies vaccination can be safely administered even if it recently ingested a dose of oral rabies vaccine.

Oral wildlife vaccination for raccoon rabies control has been under field evaluation in the U.S. since 1990. A limited field release of the recombinant vaccine occurred on Parramore Island, VA, prior to wider spread use in the U.S. for control of raccoon rabies (Hanlon et al. 1998). A major objective of this field trial was to evaluate the free-ranging raccoon population for adverse effects after the distribution of V-RG vaccine-laden baits. With the development and field testing of the V-RG vaccine, a potential method of rabies control now exists for some rabies variants to complement methods of control which include public education, domestic animal vaccination, and human PEP.

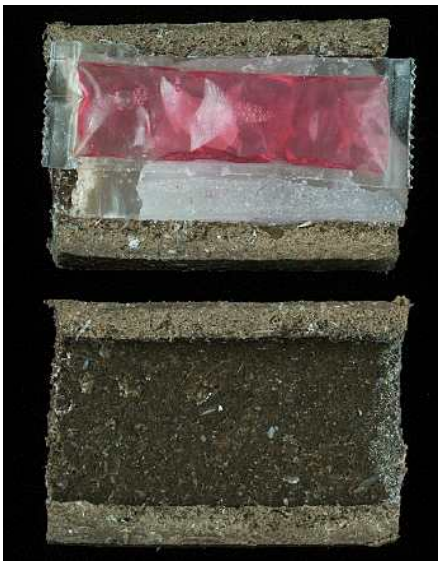

Figure 1-3. Fishmeal polymer block oral rabies vaccine bait broken open to show the sachet containing the vaccine liquid.

Since the first field release of the V-RG vaccine in 1990, the number of vaccine-laden baits that were distributed annually in the U.S. rose exponentially to a total of over 800,000 by 1997. Eleven subsequent field projects have been conducted or are in progress in Pennsylvania (1991-1992), New Jersey (1992-1994, with further projects reinitiated in the last couple of years), Massachusetts (1994-present), Florida (1995-present), New York (1994-present), Vermont (1997-present), Ohio (1997-present), Maryland (1998), and Virginia (2000-present). Since 1995, over 13.25 million individual doses of oral rabies vaccine have been distributed over 196,000 square miles of south and west-central Texas for control of rabies strains in coyotes and gray foxes (TDH 2001).

Several projects have been conducted to evaluate the effect of oral vaccination on raccoon rabies. Raccoon rabies has been prevented from invading the Cape Cod peninsula since 1995 through intensive baiting

efforts at the peninsular neck (Robbins et al. 1998). A recently completed project in Albany and Rensselaer Counties of New York State demonstrated that raccoon rabies may be virtually eliminated from an area where the disease had been present for a number of years by use of ORV. In Ohio, along the Pennsylvania border from Lake Erie to West Virginia, twice yearly baiting has been successful to date in preventing the westward spread of raccoon rabies (K. Smith, pers. comm. 2001). Annual vaccination projects in the Lake Champlain Valley in Vermont and New York have shown promise in preventing the northward spread of raccoon rabies. Raccoon rabies has moved through much of the St. Lawrence River Valley in northern New York with the appearance of two raccoon rabies foci (i.e., point locations of rabies cases) in southern Ontario. Cooperative efforts with Ontario and the implementation of point infection control strategies in Ontario around these foci are under evaluation to determine if the raccoon variant of the rabies virus can be contained and eliminated (L. Bigler, pers. comm. 2001).

1.1.6 Previous Rabies Control Activities by APHIS-WS.

APHIS-WS's previous involvement in rabies prevention and control has been to provide technical and operational assistance to a number of state health departments in experimental and operational distribution of ORV baits and in collection of animal specimens for monitoring purposes in a number of the above states. APHIS-WS's recent funding actions towards this need have been as follows:

- 1993/1994 – a total of $1.5 million in APHIS contingency funds provided for ORV programs in TX.
- 1997 – $50,000 authorized for ORV programs in OH and VT.
- 1998 – $1.255 million directed for ORV programs in TX, OH, NY, and VT.
- 1999 – $1.5 million directed for ORV programs in TX, OH, NY, and VT; $225,000 in APHIS contingency funds provided for ORV in OH and VT.
- 2000 – $1.5 million for ORV programs in TX, OH, NY, and VT; $63,000 in additional APHIS funds provided to VT.
- 2001 – $3.5 million of Congressionally directed funds; $4.1 million in CCC funds.

1.2 DESCRIPTION OF THE PROPOSED ACTION

In accordance with the provisions of the Act of September 25, 1981, as amended (7 U.S.C. 147b), the Secretary of Agriculture declared that there is an emergency that threatens the agricultural production industry in the U.S., and authorized the transfer and use of $4.1 million from the Commodity Credit Corporation of the USDA for the continuation of ORV programs to address rabies problems in the states of New York, Ohio, Texas, Vermont and West Virginia (65 FR 76606-76607, December 7, 2000). The APHIS-WS program is proposing to continue or expand federal cooperation through funding and direct involvement in these programs. A small portion of northwestern New Hampshire and the western counties in Pennsylvania that border Ohio could also be included in these control efforts. In addition, APHIS-WS may cooperate in smaller scale ORV projects in the states of Florida, Massachusetts, Maryland, New Jersey, Virginia, and Alabama. Figure 1-4 shows the states involved in the proposed action.

The emergency federal funds authorized above, along with other federal funds would be used to: 1) purchase ORV baits and participate in the distribution of ORV baits by air and ground placement; 2) provide other forms of

Figure 1-4. States in which APHIS-WS is proposing to continue or expand assistance to and participation in oral rabies vaccination programs.

assistance in monitoring rabies and determining the effectiveness of the ORV programs through collection and testing of samples from wild animal specimens; and, 3) if necessary, participate in implementing contingency plans that may involve the localized reduction of target species populations through lethal means.

The ORV that would be used is the V-RG vaccine in any of several types of baits as described in section 1.1.5. The individual baits may also contain a biomarker (e.g., tetracycline, iophenoxic acid). The purpose of the biomarker is to aid in determining whether animals collected for monitoring purposes have eaten one or more baits. The effectiveness of the vaccine can be assessed by determining the proportion of animals that have eaten baits that have also been successfully vaccinated against rabies.

The intent of the bait distribution is to orally vaccinate wild raccoons in portions of the above states with the exception of Texas. Similar programs would be directed at gray foxes in west-central Texas and coyotes in southern Texas. The primary goals of the program are to: 1) stop the forward advance of these strains of rabies from areas where they now occur by immunizing portions of target species populations along the leading edges of the rabies fronts; and 2) reduce the incidence of rabies cases involving wild and domestic animals and rabies exposures to humans in the areas where the ORV programs are conducted. If the ORV program is successful in stopping the forward advance of these strains, then the ultimate goal could include elimination of these rabies variants.

The areas over which the ORV baits would be distributed and from which animal specimens would be collected could be anywhere in the above listed states. The ORV zones would be delineated based on the most current

distribution of rabies cases and the expected direction of disease spread. Vaccination zones would be determined in cooperation with state rabies task forces, state health departments, and/or other state agencies with jurisdiction over vaccine use and application in wildlife and domestic animal species. Figures 1-5 and 1-6 show the current areas anticipated to be treated or to continue treatment with ORV baits in the involved states. Pending the verification of legal authorities to do so, ORV baits would be distributed by the states over a variety of classes of land ownership, including private, public, tribal, and other state and federal lands. Each individual bait would have a warning label advising persons not to handle or disturb the bait along with a toll-free telephone number to call for further information.

Wild animal collections for purposes of monitoring would be conducted using a variety of live capture or lethal

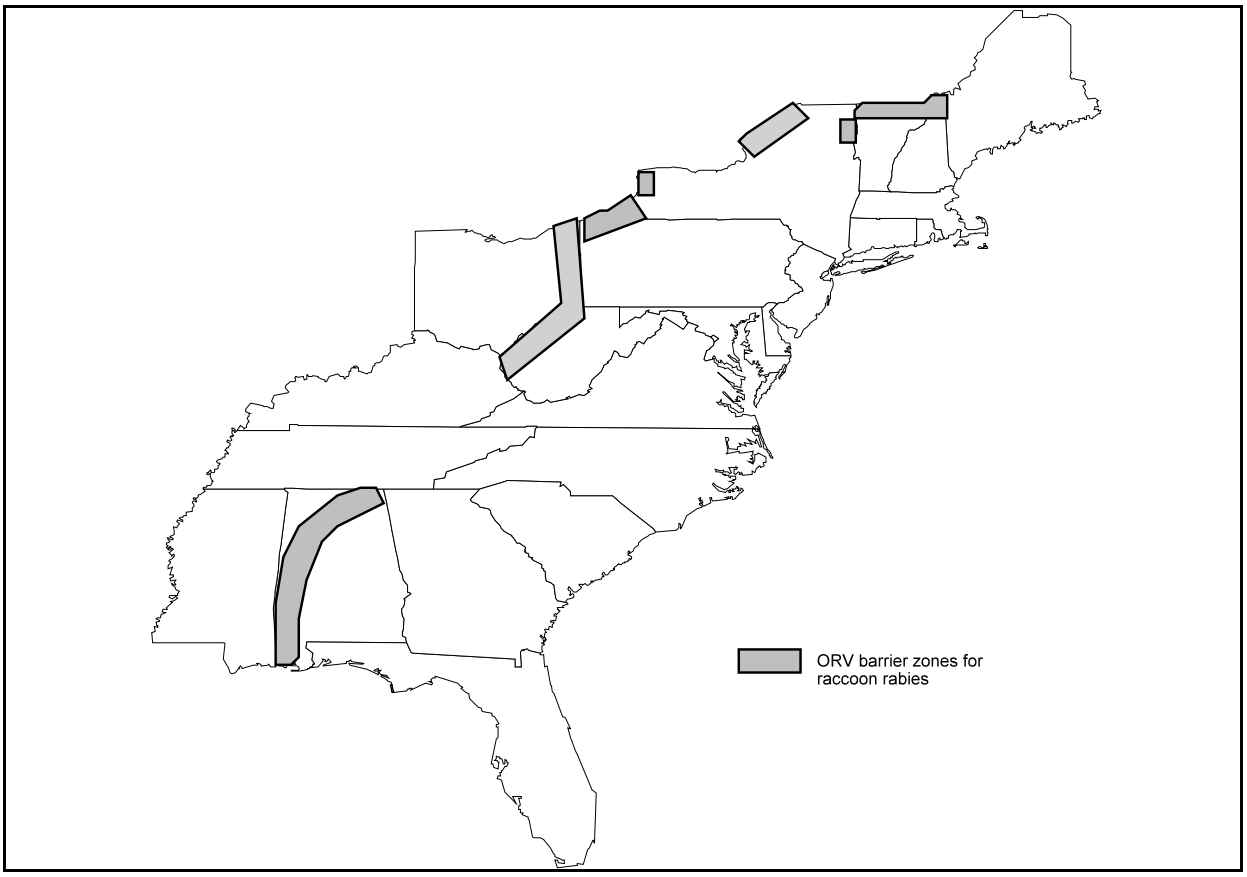

Figure 1-5. Examples of anticipated oral rabies vaccination barrier zones where APHIS-WS would continue or expand participation in and assistance to ORV programs to stop the westward spread of raccoon rabies. ORV baits would be distributed in these and perhaps other zones under the proposed action to vaccinate wild raccoons and form barriers to further spread of the disease.

methods. Information from raccoons would be predominantly collected from cage-trapped individuals that, if apparently healthy, would be released at or near their site of capture. The requisite sample from coyotes would be obtained primarily by aerial or ground-based shooting from sample areas within the ORV zones. Gray fox samples would be obtained by ground shooting and various capture methods including leghold traps, cage traps, foot snares and wire cable neck snares. Only legally approved methods would be used in all animal sample collection areas to provide critical data for the evaluation of project effectiveness. Project effectiveness would be based in large part on the percentage of ORV baits consumed in populations of target species, the presence of sufficient levels of serum neutralizing antibodies in a large enough percentage of the population to resist the spread of rabies, and the absence of the rabies strain targeted for control with ORV beyond the vaccination barrier established to prevent spread of the virus.

In the event that the targeted rabies strains advance beyond the barriers created by the ORV zones, contingency

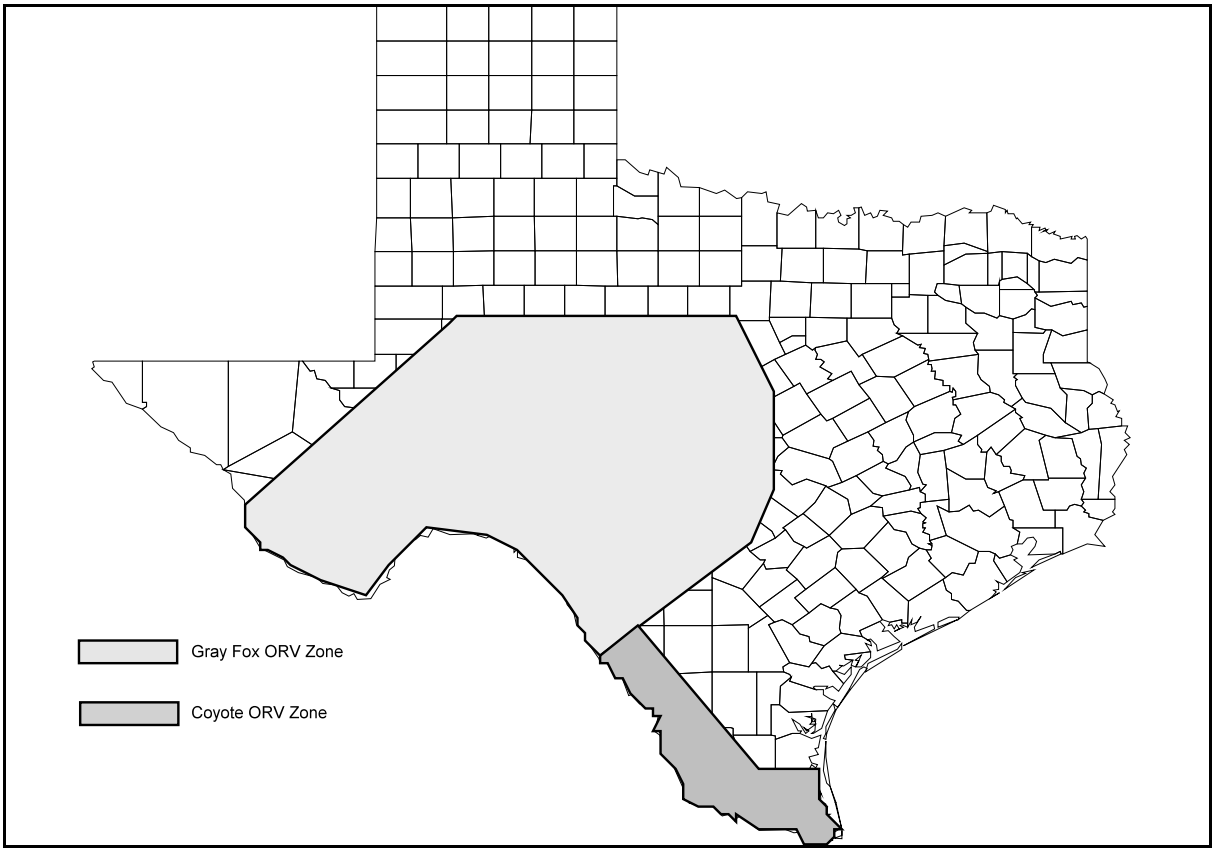

Figure 1-6. Anticipated oral rabies vaccination (ORV) zones where APHIS-WS is proposing to continue or expand assistance to and participation in ORV programs in Texas to stop the spread of gray fox and coyote rabies. These are anticipated areas of need; actual areas treated with ORV baits may include other areas of the state where coyote or gray fox rabies outbreaks occur.

plans may be implemented by the involved states that could include local population reduction of the target wildlife species using lethal means combined with the distribution of higher densities of ORV baits in and around such areas. Any localized lethal population reduction efforts that would occur would likely be integrated with hand or aerial placement of ORV baits in and around the population reduction area to restore the integrity of the ORV barrier and prevent further spread of rabies. APHIS-WS may, as part of the proposed action, assist in such efforts by providing funds, personnel, or equipment to capture and kill target species. Should this occur, methods used would involve any of those described above for the collection of wild animal specimens. In Texas, an additional method that could be used to remove gray foxes and coyotes would be sodium cyanide in the M-44 device which is approved by the U.S. Environmental Protection Agency for this purpose. The need for APHIS-WS involvement in contingency plans that employ localized lethal population suppression of raccoons is considered to be unlikely. In Texas, APHIS-WS has in the past been involved in several localized efforts to reduce coyote numbers around small towns and cities to reduce rabies risks and could be called upon to conduct similar activities in the future.

1.3 AUTHORITIES

1.3.1 Federal Authorities

Act of March 2, 1931 (7 U.S.C. 426-426b and 426c). APHIS-WS is authorized to conduct programs to address wildlife-caused disease problems, including the suppression of rabies in wildlife, by the Act of March 2, 1931, as amended.

7 U.S.C. Sec. 147b. This law authorizes the Secretary of Agriculture, in connection with emergencies which threaten any segment of the agricultural production industry of the U.S., to transfer from other appropriations or funds available to the agencies or corporations of USDA such sums as the Secretary may deem necessary, to be available only in such emergencies for the arrest and eradication of contagious or infectious diseases of animals. It is under this authority that funds from the federal Commodity Credit Corporation have been transferred to APHIS-WS to expend for the continuation and expansion of ORV programs in the states identified herein (65 FR 76606-76607, December 7, 2000).

Virus-Serum-Toxin Act (21 U.S.C. 151 et seq.). The oral rabies vaccine (Raboral V-RG®) is licensed for treatment of raccoons by the USDA under the Virus-Serum-Toxin Act (VSTA). Animal vaccines shipped in or from the U.S. must be prepared under a USDA license. Animal vaccines may not be imported without a USDA license. Federal regulations implementing the VSTA (9 CFR 103.3) require authorization by APHIS before an experimental biological product can be shipped for the purpose of treating limited numbers of animals as part of an evaluation process. The license for Raboral V-RG® requires that it be restricted for use in State or Federal rabies control programs.

Public Health Service Act. The Centers for Disease Control and Prevention(CDC) located in Atlanta, Georgia, is an agency of the U.S. Department of Health & Human Services. CDC's Mission is to promote health and quality of life by preventing and controlling disease, injury, and disability. CDC is authorized under 42 U.S.C. 241 to render assistance to other appropriate public authorities in the conduct of research, investigations, demonstrations, and studies relating to the causes, diagnosis, treatment, control, and prevention of physical and mental diseases and impairments of man. In addition, under 42 U.S.C. 243(a), the Secretary of Health & Human Services, may assist states and their political subdivisions in the prevention and suppression of communicable diseases.

1.3.2 State and Local Authorities

Each of the states involved in this proposed action has a state agency or agencies with authority under state law to approve, conduct or coordinate rabies control programs. APHIS-WS involvement in rabies control in each state has previously occurred and, under the proposed action, would only occur in complete cooperation with the appropriate state agency(ies) and in accordance with state authorities as identified by those agencies.

With regard to ORV programs, it is the various cooperating states that exercise their authorities under state law to propose or approve the distribution of ORV baits onto lands owned or managed by a variety of entities including private persons, federal land management agencies (e.g., USDA Forest Service, USDI National Park Service, and others), state, county, and city governments, and American Indian Tribes. It is critical to the success of establishing and maintaining ORV barriers and, potentially, to the eventual elimination of targeted rabies strains in many areas, that all lands containing substantial amounts of habitat for the targeted carnivore species be included. APHIS-WS would not be making the decision to distribute baits on the various land ownerships. Those decisions would be made by the states. The proposed action assumes that ORV baits would be distributed under state authorities, consistent with pertinent property rights laws and regulations and would include acquiring permission from public land managers and American Indian Tribes when appropriate.

1.4 OTHER RELEVANT FEDERAL LAWS AND REGULATIONS

National Environmental Policy Act (NEPA)(42 U.S.C. 4321 et seq.). APHIS-WS prepares analyses of the environmental impacts of program activities to meet procedural requirements of this law. APHIS has previously prepared a number of EAs to address the environmental effects of experimental programs using V-RG ORV baits and covering the approval of licensing of the vaccine for use in raccoons (see Section 1.5). APHIS-WS determined that, because of increased federal involvement in ORV programs in recent years, and because of the current proposal to continue or expand federal involvement in such programs, further NEPA documentation is appropriate. Therefore, this EA is intended to meet the NEPA requirement for the proposed action by clearly communicating the

scope of federal involvement by APHIS-WS and by determining if there are any substantive new issues or alternatives that should be analyzed.

Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.). It is federal policy, under the ESA, that all federal agencies shall seek to conserve threatened and endangered (T&E) species and shall utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). For actions that "may affect" listed species, APHIS-WS conducts Section 7 consultations with the U.S. Fish & Wildlife Service (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 shall use the best scientific and commercial data available*" (Sec.7(a)(2)). APHIS-WS has analyzed the potential for effects on listed species in this EA and has concluded that the proposed action would not affect any listed species (see Section 4.1.3.2).

National Historical Preservation Act (NHPA) of 1966 as amended (16 U.S.C. 470). The NHPA and its Implementing regulations (36 CFR 800) require federal agencies to: 1) determine whether activities they propose constitute "undertakings" that can result in changes in the character or use of historic properties and, 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources, and 3) consult with appropriate American Indian tribes to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings. Activities described under the proposed action do not cause major ground disturbance or other adverse impacts on historic resources and are not undertakings as defined by the NHPA.

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.

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.

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.

1.5 RELATIONSHIP TO OTHER ENVIRONMENTAL DOCUMENTS

A number of other NEPA documents have been prepared that analyzed the potential environmental effects of ORV programs and the methods used in rabies monitoring and surveillance. Pertinent information from those analyses has been incorporated by reference into this EA.

Wildlife Services Programmatic EIS. APHIS-WS has issued a final Environmental Impact Statement (EIS) (USDA 1997j) and Record of Decision on the National APHIS-WS program.

EA and Finding of No Significant Impact – Proposed Issuance of a Conditional United States Veterinary

Biological Product License to Rhone Merieux, Inc., for Rabies Vaccine, Live Vaccinia Vector. This EA and its FONSI dated April 7, 1995 was prepared by APHIS and concluded there would be no significant impact on the quality of the human environment from the decision to issue the conditional license referred to above (USDA 1995a). The conditional license approved the use of V-RG in raccoon rabies control programs administered under the direction of State or Federal Government Agencies. Mitigative measures required under the decision included public education and notification efforts prior to distributing the baits, and the placement of warning labels on each vaccine-laden bait.

EA and Finding of No Significant Impact – Proposed Field Application of an Experimental Rabies Vaccine, Live Vaccinia Vector, in South Texas. This EA and its FONSI completed in 1995 analyzed the environmental effects of experimental distribution of ORV baits containing V-RG to eradicate and stop the spread of coyote rabies in South Texas (USDA 1995b). APHIS determined the action would not have any significant impact on the quality of the human environment.

EAs and Findings of No Significant Impact on proposed field trials/tests of live experimental vaccinia-vector recombinant rabies vaccine for raccoons. APHIS analyzed the potential environmental impacts of six separate field trials or tests of the recombinant V-RG vaccine in several northeastern states. In EAs and FONSIs covering those actions, (USDA 1991, 1992, 1993, 1994a, 1994b, 1994c), APHIS determined that none of the actions would have any significant impact on the quality of the human environment.

Risk Analyses for ORV using the V-RG recombinant virus. Two formal risk analyses on the rabies vaccine -- live vaccinia vector (i.e., the recombinant V-RG vaccine) have been prepared previously by APHIS (USDA undated *a*, USDA undated *b*). Both analyses concluded the risk of adverse animal safety, human safety, or other environmental effects to be low.

(Nine) EAs and Findings of No Significant Impact - Predator Damage Management in (Brownwood, Canyon, College Station, Fort Stockton, Fort Worth, Kerrville, Kingsville, San Angelo, and Uvalde) District(s) of the Texas Animal Damage Control Program. These EAs and their FONSIs signed in March 1997 evaluated the environmental impact of implementing various methods of predator damage management in nine districts in Texas, including methods proposed herein for collection of gray foxes and coyotes as part of rabies ORV program monitoring and surveillance activities. APHIS determined that none of the district programs would have any significant impact on the quality of the human environment (USDA 1997a, 1997b, 1997c, 1997d, 1997e, 1997f, 1997g, 1997h, and 1997i).

1.6 EXECUTIVE ORDER ON ENVIRONMENTAL JUSTICE

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations requires Federal agencies to analyze disproportionately high and adverse environmental effects of proposed actions on minority and low-income populations. APHIS-WS has analyzed the effects of the proposed action and determined that implementation would not have adverse human health or environmental impacts on low-income or minority populations.

1.7 EXECUTIVE ORDER ON PROTECTION OF CHILDREN FROM ENVIRONMENTAL HEALTH AND SAFETY RISKS

Executive Order 13045 was passed to help protect children who may suffer disproportionately from environmental health and safety risks for many reasons. ORV activities as proposed in this EA would only involve legally available and approved methods that have been subjected to safety evaluations and testing. The vaccinia virus used as a carrier of the rabies glycoprotein is the same type of virus that was used in smallpox eradication, although more attenuated or weakened (USDA 1991, p. 39). The analysis in Section 4.1.1 of this EA supports a conclusion of very low to no risk of adverse effects on children from the ORV baiting strategy. Implementation of the proposed action would not increase environmental health or safety risks to children, but would in fact reduce such risks by minimizing the potential for children to contract rabies. Children are particularly at risk from rabies because they are more prone to experiencing "undetected" or "unappreciated" exposures (Huntley et al. *unpublished* 1996) that

do not lead to post-exposure vaccine treatments. Therefore, federal involvement in ORV programs is consistent with and helps to achieve the goals of EO 13045.

1.8 DECISION TO BE MADE

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

- Should APHIS-WS continue or expand its involvement in ORV programs in the states listed above?
- If not, should APHIS-WS attempt to implement one of the alternatives as described in the EA?
- Would implementing the proposed action or one of the other alternatives have significant impacts on the quality of the human environment requiring preparation of an EIS?

1.9 GOALS

As stated in the description of the proposed action, the primary goals of the program are to:

- stop the forward advance of these strains of rabies from areas where they now occur by immunizing portions of target species populations along the leading edges of the rabies fronts; and
- reduce the incidence of rabies cases involving wild and domestic animals and rabies exposures to humans in the areas where the ORV programs are conducted.

The states that would be involved in the proposed action have established, or are in the process of establishing, plans for the implementation of ORV programs. The proposed action would be consistent with such plans and any statements of goals and objectives as they are developed by the involved states.

1.10 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS

1.10.1 Actions Analyzed. This EA evaluates the environmental effects of continued or expanded APHIS-WS funding of and participation in ORV programs to eliminate or stop the spread of raccoon rabies in a number of eastern states and gray fox and coyote rabies in Texas.

1.10.2 Period for Which this EA is Valid. This EA will remain valid until APHIS-WS determines that new needs for action, new unforeseen significant issues, or new alternatives having different environmental effects must be analyzed. At that time, this analysis and document will be supplemented or revised pursuant to NEPA. Review of the EA will be conducted each year by APHIS-WS to ensure that the EA and the analyses contained herein are still appropriate.

1.10.3 Site Specificity. This EA analyzes potential impacts of continued or expanded APHIS-WS participation in ORV programs in the states described in Section 1.2. Because the proposed action is to assist the affected states in accordance with plans, goals, and objectives developed by those states, the proposed action could involve APHIS-WS participation in ORV bait distribution and monitoring/surveillance or local population reduction of target species anywhere in those states where the need has been identified by the appropriate State agencies. The EA identifies as much as possible the typical habitat areas and the specific areas that are currently known to be in need of ORV program action. However, the location of every wildlife rabies outbreak that will occur and necessitate ORV actions cannot be predicted. Planning for the management of rabies epizootics must be viewed as being conceptually similar to federal or other agency actions 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 wildlife rabies outbreaks will occur can be predicted, all specific locations or times where such

outbreaks will occur in any given year cannot be predicted. Thus, the EA addresses the substantive environmental issues that pertain to ORV use and monitoring/surveillance activities, and, if necessary, localized target species population reduction wherever these activities might occur in the states identified herein. 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.

1.11 SUMMARY OF PUBLIC INVOLVEMENT EFFORTS

Issues related to the proposed action were identified through involvement and planning/scoping meetings with state health departments, other state and local agencies, academic institutions, the Ontario Ministry of Natural Resources, and the CDC. Additional efforts to determine further issues that the public might have with this action were made through a Federal Register Notice (66 FR 13696-13700, March 7, 2001) and by a second Federal Register Notice (66 FR 27489, May 17, 2001) making the EA available to the public for review and comment prior to an agency decision. A letter was sent to potentially affected or interested American Indian Tribes to assure their opportunity to be involved in the EA process. Comments received were reviewed to identify any substantive new issues or alternatives not already identified for analysis.

2.0 CHAPTER 2: ISSUES AND AFFECTED ENVIRONMENT

2.1 ISSUES

From public input received in response to a Federal Register Notice (66 FR 13696-13700, March 7, 2001), and from interactions and planning/scoping meetings held with state and local departments of health and the CDC, the following issues were determined to be germane to the proposed action and were considered in detail:

- Potential for adverse effects on people that become exposed to the vaccine or the baits.
- Potential for adverse effects on target wildlife species populations.
- Potential for adverse effects on nontarget wildlife species, including threatened or endangered species.
- Potential for adverse effects on pet dogs or other domestic animals that might consume the baits.
- Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals.
- Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals.
- Potential for aerially dropped baits to strike and injure people or domestic animals.
- Cost of the program in comparison to perceived benefits.
- Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans.

2.2 OTHER ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

2.2.1 Potential for drugs used in animal capture and handling 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 raccoons, which are hunted and sometimes consumed by people as food. Drugs used in capturing and handling raccoons for surveillance and monitoring purposes in rabies management programs include ketamine hydrochloride, xylazine (Rompun), and a mixture of tiletamine and zolazepam (Telazol). Meeting the requirements of the AMDUCA (see section 1.4) 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 followed in each state include:

- All drug use in capturing and handling raccoons and other animals 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), ORV 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.

- In general, most animals administered drugs would be released 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 sampling 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, rabies management programs would avoid any significant impacts on human health with regard to this issue.

2.2.2 Potential for adverse impacts on wildlife from aircraft overflights conducted in ORV programs.

The concern here is that certain wildlife species such as bald eagles and trumpeter swans (A. Montoney, APHIS-WS, pers. comm. 2001) might be disturbed by the aircraft used in ORV bait distribution to the point that they are adversely affected.

USDI (1995) reviewed studies on the effects of aircraft overflights on wildlife. The report revealed that a number of studies have documented responses by certain wildlife species that suggest adverse impacts could occur. Few if any studies have proven that aircraft overflights cause significant adverse impacts on populations, although the report stated it is possible to draw the conclusion that impacts to wildlife populations are occurring. It appears that some species will frequently or at least occasionally show adverse responses to even minor overflight occurrences. In general, it appears that the more serious potential impacts occur when overflights are *chronic*, i.e., they occur daily or more often over long periods of time. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. ORV program aerial bait distribution activities are not chronic, but typically occur only once or twice per year. They are typically conducted at about 500 feet above ground level and only fly momentarily over any one point on the ground during any given bait distribution flight. The aircraft do not circle over areas repeatedly, but fly in straight "transect" lines for purposes of bait distribution.

Some examples of species or species groups that have been studied with regard to this issue and WS determination of potential impacts from ORV aerial overflights are as follows:

- Colonial Waterbirds. Kushlan (1979) reported that low level (390 feet followed by a second flight at 200 feet) overflights of 2-3 minutes in duration by a fixed-wing airplane and a helicopter produced no "drastic" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up. ORV program overflights typically occur at about 500 feet above ground and would only fly momentarily over any one point on the ground. Thus, it appears that ORV program overflights would result in little or no disturbance to colonial waterbirds.

- Greater Snow Geese. Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance. They observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse impacts. ORV program overflights typically occur at about 500 feet above ground and would only fly momentarily over any one point on the ground. Thus, it appears that ORV program overflights

would result in little or no disturbance to snow geese or other waterfowl species.

- Raptors. Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period. Their results also showed similar nesting success between hawks subjected to such overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but showed that ferruginous hawks (*Buteo regalis*) are sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, and neither were they alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that 5 species of hawks, 2 falcons, and golden eagles were "incredibly tolerant" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and never limiting to productivity. These studies indicate that overflights by ORV program aircraft should have no significant adverse impacts on raptor populations by affecting nesting success.

Thus, the duration, frequency, and intensity of flights over any given area are low enough, and wildlife in general are tolerant enough of such activity, that there would be no significant environmental impact on wildlife as a result of ORV program overflights.

2.2.3 Potential for ORV bait distribution to affect organic farming.

This issue concerns the potential for ORV baits dropped on farms certified as "organic" under federal regulations to affect the status of the organic certification of such farms. In particular, this concern was raised by a producer of organically raised venison in Ohio (R. Krogwold, Ohio Dept. of Health, pers. comm. 2001).

The ORV baits are comprised of a matrix of fishmeal and an ethylene copolymer which is a plastic material. The purpose of the polymer is to hold the fishmeal attractant together in a block that can withstand being dropped from an airplane and that will not dissolve or crumble apart readily when and if it is exposed to rain or melting snow. The process for producing the bait blocks eliminates all potentially reactive compounds (such as ethylene and vinyl acetate) that might have the potential for uptake by plants or absorption into the tissues of animals that consume the baits. Thus, the inorganic polymer in the ORV baits is totally nonreactive and cannot be absorbed by plants or animals (M. Smith, Bait-Tek, pers. comm. 2001). It is also among the types of materials approved by the Food and Drug Administration for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food (21 CFR Part 177). Therefore, the fishmeal polymer baits should pose no risk of contaminating crops or animals raised for food and, consequently, should have no effect on the ability of certified organic farms to maintain their status.

Field baiting studies suggest deer are not generally attracted to the ORV baits. Out of more than 4,300 baits exposed to target and nontarget animals in field bait acceptance studies in Georgia, Ohio, and Texas, none were observed to have been taken or consumed by deer, despite the prevalence of deer in the areas where the bait studies were conducted (Linhart et al. *unpublished* 2001). Sulfur compounds are a biproduct of the breakdown of animal proteins, including those found in fish meal (D. Nolte, APHIS-WS, NWRC, pers. comm. 2001) and are generally repellent to herbivores (Nolte et al. 1994). Therefore, the ORV baits used to address coyote and raccoon rabies problems are probably at least somewhat repellent to deer, which probably accounts in part for the lack of observed bait take by deer in the studies reported in Linhart et al. (*unpublished* 2001). For these reasons, it is unlikely that the ORV baits would be consumed by deer on venison farms that are certified as organic producers.

2.2.4 Potential for ORV to cause abortions in cattle.

This issue was raised by a cattle producer in Ohio who reported an increase in abortions of pregnant cows following an ORV bait distribution project. V-RG vaccine was tested in a number of wild and domestic animal species, including cattle, and produced no adverse effects (see section 4.1.3.1). Although pregnant cattle have not been specifically tested, V-RG has produced no adverse effects on gestation in pregnant female raccoons (C. Rupprecht, CDC, pers. comm. to K. Smith, Ohio Dept. of Health 2001). Recently, a woman who was 18 weeks pregnant in Ohio was exposed to the vaccine when she took a bait away from her dog and later delivered a healthy 10-lb. baby boy (see section 4.1.1.2). ORV program administrators with the Texas Department of Health have not received any reports of this nature despite the distribution of millions of ORV baits in cattle and other livestock production areas since 1995 (E. Oertli, TX Dept. of Health, pers. comm. 2001). In the U.S., over 23 million doses of V-RG have been distributed to date without any other reported concerns of this nature being raised. Therefore, the reported increase in cattle abortions was determined to be coincidental and not related to ORV. The Ohio producer was provided with further information and advice on determining which of a number of other known possible causes of abortions in cattle might be responsible (R. Hale, Ohio Dept. of Health, pers. comm. 2001).

2.2.5 Potential human health impacts in the event of human consumption of vaccinated wildlife.

The issue expressed here is the potential to develop a vaccinia infection from eating a vaccinated raccoon or some other animal that has eaten one or more ORV baits. Dr. Carolin Schumacher of Merial, Inc. was consulted to obtain information on this issue. Mahnel (1987) reported results of experiments to determine the stability of poxviruses (which include vaccinia used in the V-RG vaccine). "Naked" vaccinia (i.e., vaccinia found outside of host cells) will be inactivated within minutes by heat above 56 degrees Celsius (133 degrees Fahrenheit), by ultra-violet irradiation (sunlight), or by exposure to acid with a pH of 3 or less[2] (e.g., similar to the acid environment found in the stomach of raccoons which is where the bulk of V-RG vaccine would end up). In contrast, however, poxviruses can be relatively stable for years in dry dust or in dried lesion crusts.

The vaccinia from V-RG would generally only bind to animal tissues in the mucous membrane of the oral cavity, pharynx and oesophagus since V-RG does not have the tendency to spread throughout the animal. Those particular tissues are rarely consumed by humans, but if they were, they would most likely be cooked which would kill the virus. Also, concentrations of vaccinia in those tissues should be low because mucosa is not considered a tissue where the virus tends to accumulate (C. Schumacher, Merial, Inc., pers. comm. 2001).

Although cell-bound vaccinia is generally more resistant than free virus, humidity and cellular enzyme activity in the tissues as well as bacterial decomposition (e.g., in the gut of ruminants), normally results in inactivation of the virus. In the environment, inactivation of pox viruses is accelerated by temperature changes (C. Schumacher, Merial, Inc., pers. comm. 2001).

The above information suggests that possible sources of contamination with vaccinia would be V-RG dried onto the fur of an animal, ingested virus in the stomach, or cell-bound virus in mucous membranes. However, with the combined activity of sunlight and ultraviolet light, humidity, stomach pH and/or bacteria/enzymes, temperature fluctuations, and cooking heat, the risk to human health should be small, especially when taking into consideration the attenuated or weakened condition of the vaccinia in the V-RG vaccine. Therefore, the potential for adverse health effects from consuming animals that have eaten ORV baits should be low.

2.3 AFFECTED ENVIRONMENT

---

[2]pH is the measure of acidity or alkalinity of a solution with numbers below 7 representing a progressively more acidic solution. A pH of 3 is highly acidic.

This section presents some descriptive information on the environment of the areas that would be affected by the proposed action. Other descriptive aspects of the affected environment are included in Chapter 4 in the analysis of effects which is based on the environmental and other types of issues identified in section 2.1.

The area of the proposed action includes the states of New York, Ohio, Vermont and West Virginia where raccoon rabies outbreaks are expected to occur, as well as in Texas where rabies occurs in gray foxes and coyotes. Additional areas where raccoon rabies outbreaks may be addressed include the states of Florida, Massachusetts, Maryland, New Hampshire, New Jersey, Pennsylvania, Virginia, and Alabama. The potential areas involved are extensive and may cover several land ownership types and diverse land uses, including: cultivated agricultural lands, forests, meadows, wetlands, rangelands and pastures representing diverse wildlife habitats. Aerial distribution of ORV baits would avoid urban and suburban areas that support high human population densities, as well as lakes and rivers. Aerial distribution of baits will primarily target rural areas as well as known areas of habitat suitable for the target species. When aerial distribution by fixed-wing or helicopter aircraft is not practical, baits would be distributed by careful hand placement to help to minimize contact by humans, pets and other domestic animals.

Figure 1-4 in Chapter 1 shows the states where APHIS-WS would continue or expand assistance to and participation in ORV programs under the proposed action. Figures 1-5 and 1-6 in Chapter 1 show the approximate ORV bait drop areas anticipated for 2001 and beyond. It must be kept in mind, however, that ORV baiting activities might be needed, and might therefore be conducted, in other areas within the involved states as part of the proposed action. The ORV bait drop areas are also the primary expected areas where assistance by APHIS-WS is expected to be requested to collect blood, tooth and other biological samples from target animals for monitoring and surveillance. However, monitoring or surveillance activities by APHIS-WS could also occur anywhere in the respective states where state health or other appropriate agency officials determine there is a need to insure project effectiveness. Implementation of contingency plans that involve localized population suppression of target species could similarly be needed anywhere in the involved states where outbreaks of the targeted rabies strains occurs.

"Major Habitat Types" as described by Ricketts et al. (1999) that encompass the states that would be affected by ORV programs under the proposed action are: Temperate Broadleaf and Mixed Forests (NH, VT, NY, PA, OH, NJ, MD, VA, WV, AL), Temperate Coniferous Forests (AL, FL), Flooded Grassland (FL), Temperate Grasslands/Savannah/Shrub (TX), and Xeric Shrublands/Deserts (TX). Appendix E shows the "ecoregions" (i.e., broad level ecosystems) that occur in the potentially affected states (Bailey 1995). Ecoregions range from dry desert and grassland-shrub communities in Texas, to humid tropical areas and southern pine and hardwood forest areas in the Southeast, to broadleaf deciduous forest, mixed-deciduous forest and coniferous forest, and boreal forest types in the East and Northeast.

Table 2-1 shows some descriptive statistics for the states proposed for federal assistance by APHIS-WS in ORV programs. The states contain about 40% of the U.S. resident population and have average (on a statewide basis) population densities that range from about 64 to nearly 1,100 per sq mile. The percentage of total area that is rural (i.e., nondeveloped) in each state ranges from about 62% in New Jersey to more than 90% in Texas. Population densities in rural areas are much lower than the statewide average figures shown. The percentage of federal land in each state ranges from 0.6 to nearly 13% and averages 3% of the total area of the affected states.

Table 2-1. Some descriptive statistics of states proposed for federal assistance by APHIS-WS in oral rabies vaccination programs (data from USDC 1999).

State	Resident population (1000s)	Population per sq mile	% of popn. in nonmetro-politan areas 1996	Popn. of nonmetro-politan areas 1996 (1000s)	Total area (1000 acres)	Developed area (1000 acres)	Rural area (1000 acres)	% rural area	Land in farms (1000 acres) 1997	% area in farms	National Forest Land (1000 acres)	Total area owned by federal gov't. (1000 acres)	% area in federal govt. ownership
AL	4,352	85.8	32.3%	1,406	32,678	2,000	29,100	89.1%	8,700	26.6%	665.0	1,080	3.3%
FL	14,916	276.2	7.1%	1,059	34,721	4,600	25,800	74.3%	10,500	30.2%	1,147.0	2,645	7.6%
MD	5,135	525.3	7.2%	370	6,319	1,100	4,900	77.5%	2,200	34.8%	0.0	157	2.5%
MA	6,147	784.3	3.9%	240	5,035	1,300	3,500	69.5%	500	9.9%	0.0	52	1.0%
NH	1,185	132.1	40.2%	476	5,769	600	4,400	76.3%	400	6.9%	725.0	734	12.7%
NJ	8,115	1,093.8	0	0	4,813	1,600	3,000	62.3%	800	16.6%	0.0	102	2.1%
NY	18,175	384.9	8.2%	1,490	30,681	3,000	26,800	87.4%	7,300	23.8%	0.0	197	0.6%
OH	11,209	273.7	18.9%	2,119	26,222	3,600	22,100	84.3%	14,100	53.8%	227.0	280	1.1%
PA	12,001	267.8	15.4%	1,848	28,804	3,400	24,400	84.7%	7,200	25.0%	513.0	623	2.2%
VT	591	63.9	72.3%	427	5,937	300	5,200	87.6%	1,300	21.9%	366.0	377	6.4%
VA	6,791	171.5	22.1%	1,501	25,496	2,200	20,600	80.8%	8,200	32.2%	1,657.0	2,279	8.9%
WV	1,811	75.2	58.2%	1,054	15,411	700	13,400	87.0%	3,500	22.7%	1,033.0	1,077	7.0%
TX	19,760	75.4	15.8%	3,122	168,218	8,200	155,500	92.4%	131,300	78.1%	755.0	2,008	1.2%
Total	110,188	7,291.5	13.7%	15,112	390,104	32,600	338,700	86.8%	196,000	50.2%	7,088.0	11,611	3.0%
US	270,299	76.4	20.1%	54,330	2,271,343	92,400	1,390,800	61.2%	931,800	41.0%	191,785	563,081	24.8%

A number of American Indian Tribes are located in the states that would be involved in the proposed action and are shown in Appendix F. State agencies that conduct ORV programs involving the use of APHIS-WS funds or assistance would be responsible for obtaining agreements as appropriate from Tribes.

Chapter 4 contains further affected environment information with respect to target and nontarget species and threatened/endangered species.

3.0 CHAPTER 3: ALTERNATIVES CONSIDERED, INCLUDING THE PROPOSED ACTION

Alternative 1. Proposed action (this is the preferred alternative). This alternative would involve the continued or expanded use of federal funds by APHIS-WS to purchase V-RG oral vaccine baits and to participate in their distribution under the authorities of the appropriate state agencies in selected areas of the several states listed in section 1.2 to stop or prevent raccoon, gray fox, and coyote rabies, and to assist with monitoring and surveillance efforts by capturing and releasing or killing target species for purposes of obtaining biological samples. APHIS-WS assistance could also include participation in implementing state contingency plans that involve target species population reduction or concentrated ORV baiting in localized areas if rabies outbreaks occur beyond the designated ORV vaccination barriers to stop such outbreaks from spreading.

Alternative 2. **No action**. This would involve no involvement by APHIS-WS in rabies prevention or control in the states identified in section 1.2. The "No Action" alternative is a procedural NEPA requirement (40 CFR 1502), is a viable and reasonable alternative that could be selected, and serves as a basis for comparison with the other alternatives. The states could still conduct ORV programs without APHIS-WS assistance.

Alternative 3. **Live-capture-vaccinate-release programs**. This alternative would involve the live capture of species being targeted (e.g., raccoon, gray fox, coyotes) followed by administration of rabies vaccines by injection and release back into the wild. This strategy has been used in certain localized areas for reducing the incidence and spread of rabies in raccoons (Brown and Rupprecht 1990; Rosatte et al. 1990; Rosatte et al. 1992; Rosatte et al. 1993) and skunks (Rosatte et al. 1990; Rosatte et al. 1992; Rosatte et al. 1993). The method has not been attempted for vaccination of foxes and coyotes because they are much more difficult to capture in cage traps (Baker and Timm 1998) and it is difficult to live capture and release a high enough proportion of the population with other traps such as leghold traps and snares (Rosatte et al. 1993; C. MacInnes, Ontario Ministry of Natural Resources pers. comm. 2001; personal observation of APHIS-WS personnel). Currently, no vaccine is specifically licensed for this type of use (CDC 2000). However, certain injectable vaccines may be used "off-label" under the direction of veterinarians to vaccinate wild animal species in certain situations (J. Mitzel, APHIS-Veterinary Services, pers. comm. 2001). This method generally results in a higher percentage of a raccoon population being vaccinated than ORV, but takes much longer to accomplish in a given area; for example, in Ontario, 7 trappers working from July to October were required to trap and vaccinate 50-85% of the raccoons in an area less than 700 km.^{2}, whereas the same area could have been treated with aerially dropped ORV baits in half a day (C. MacInnes, Ontario Ministry of Natural Resources, pers. comm. 2001).

Alternative 4. **Provide funds to purchase and distribute ORV baits without animal specimen collections or lethal removal of animals under contingency plans.** Under this alternative, APHIS-WS would provide resources for and assistance in ORV bait distribution only and would not engage in or provide funds for the collection of wild animal specimens by APHIS-WS for monitoring and project evaluation purposes or for implementation of localized lethal removal actions under state contingency plans. The states could still conduct these activities without APHIS-WS assistance.

3.1 ALTERNATIVES CONSIDERED BUT NOT IN DETAIL, WITH RATIONALE

3.1.1 Depopulation of target species.

This alternative would result in the lethal removal of raccoons (in the eastern states listed) and gray foxes and coyotes (in Texas) throughout the zones where outbreaks of the targeted strains of rabies are occurring or are expected to occur. The goal would be to achieve elimination of the rabies strains by severely suppressing populations of the target animal species over broad areas so that the specific strains of rabies could not be transmitted to susceptible members of the same species. This could theoretically stop the forward advance of the disease and potentially result in elimination of the particular rabies variants as infected animals die from rabies before they could transmit it to other members of the same species.

Localized population reduction has been proposed as part of local programs to address raccoon rabies outbreaks as they are just beginning (Rosatte et al. 1997). This was deemed necessary because by the time a suspected rabies case is confirmed through animal testing, there invariably are other raccoons in the area that have been infected and are incubating the disease, at which point vaccination would not be effective for those individuals (Rosatte et al. 1997).

Population reduction is often suggested as a method to control rabies in wildlife populations since the disease is density dependent (Debbie 1991). Bounty incentives, regulated hunting and trapping, ingestible poisons, and fumigation of dens have all been employed to control populations with varying levels of success. MacInnes (1998) reviewed some of the past efforts to control rabies with population reduction of carrier species and concluded that, with a couple of exceptions, most such efforts have failed. In some of the situations, it could not be determined whether an observed decline or disappearance of rabies cases was attributable to population control work or to the disease simply reaching some unexplainable geographical limitation or just dying out on its own (MacInnes 1998). Also, population control as a strategy can be questionable because the leading edges of rabies outbreaks do not necessarily coincide with the edge of the range of the principal "vectors" (e.g., raccoons, gray foxes, and coyotes), nor are they always necessarily related to the population density of such vectors (MacInnes 1998).

Hanlon et al. (1999) reviewed historical efforts to control rabies through population reduction and evaluated the potential for success with this strategy. Information and conclusions they presented are summarized as follows:

> Skunk rabies was successfully controlled in Alberta, Canada by this strategy (Pybus 1988). Success was attributed to a high level of effort during several years, the well-defined behavior of skunks in prairie habitats, and access to an effective method (Pybus 1988). Compensatory changes in carnivore reproduction (i.e., the tendency for larger litters and larger percentages of adult females to have litters) and dispersal (i.e, immigration of animals from surrounding uncontrolled populations) can limit the effectiveness of controlling population numbers of other species in different conditions (Clark and Fritzell 1992; Thompson and Fleming 1994).
>
> Population reduction with toxicants as a broadscale control alternative for rabies is impractical. The only approved toxicant methods currently available are sodium cyanide in the M-44 device (registered for zoonotic disease control involving wild canids), and carbon monoxide-producing gas cartridges that can be used to kill skunks, coyotes, and red foxes in dens. Currently, these methods are primarily used in limited areas of the western U.S. for livestock protection. Presently, population reduction is most likely to be publicly accepted and effective in localized or site-specific scenarios in the U.S. (e.g., reducing the density of raccoon populations in parks where visitors may come in contact with potentially rabid animals).

Population reduction using strychnine baits has reportedly been used successfully to stop the spread of rabies in foxes in Denmark (Gaede 1992). Carcass recovery statistics indicated nontarget species (498 martens (*Martes* sp.) 12 European badgers (*Meles meles*), 4 domestic dogs) were killed in slightly greater numbers than the targeted red foxes (n=482). The number of rabies cases declined sharply and the country has reportedly remained free of terrestrial rabies since 1982 (Gaede 1992). Broadscale population control with toxicants is most likely politically infeasible in the U.S. due to opposition by the public and by state wildlife agencies.

This alternative was not considered in detail because it would be impractical to obtain approval from the many hundreds of thousands of landowners on whose properties the lethal control methods would have to be conducted. The greatest difficulty with population reduction as a strategy for reducing or eliminating rabies is that the high level of effort must be maintained almost indefinitely and would also undoubtedly be opposed by most members of the public as well (MacInnes 1998). Population suppression can be a challenge to maintain in many situations due to immigration (of other members of the same species from

surrounding populations) and compensatory reproduction (i.e., larger litters and greater percentages of females breeding following population reduction) (Clark and Fritzell 1992, Connolly and Longhurst 1975). These factors can mean local populations can recover to their previous levels within a few months or a year, thus requiring annual or more frequent suppression efforts to maintain such populations at low levels. Nevertheless, temporary localized population suppression activities could be conducted in an integrated program of ORV use as part of the proposed action, but such activities, if conducted at all, would be expected to occur as a part of contingency actions in response to a breach in a vaccination barrier. In Texas, localized population suppression of mammalian predator species for this purpose has been covered in other EAs (USDA 1997a, 1997b, 1997c, 1997d, 1997e, 1997f, 1997g, 1997h, and 1997i).

3.1.2 Population Control Through Birth Control.

Under this alternative, APHIS-WS would provide funds or operational assistance to implement one or more methods to control populations of the target species by reducing reproduction. Such methods could involve live capture and surgical sterilization (reviewed by Kennelly and Converse (1997)), the use of chemical reproductive inhibitors placed out in baits or delivery devices (Balser 1964; Linhart et al. 1968), or the application of *immunocontraception* strategies (i.e., vaccines that can cause infertility in treated animals).

The suppression of reproduction over time would eventually reduce the size of target species populations and lead to a reduction in the potential for the spread of the rabies by reducing the chances of contact between infected and healthy animals. However, this approach would do nothing in the immediate short term to reduce the risk of rabies spread in the existing populations, since those animals would continue to be present and capable of contracting and passing on the disease. Therefore, this type of strategy would be viewed as a longer term remedy for stopping rabies spread. It would probably not be useful in meeting the immediate needs for stopping a localized outbreak of rabies that occurs beyond designated ORV bait drop zones.

Live capture and surgical sterilization of whole local populations of animals would be extremely expensive, time-consuming, and difficult to achieve. Considerable expense would be involved in employing experienced and qualified veterinarians to perform large numbers of surgical procedures on captured animals. From a rabies control standpoint, if all or nearly all of a local population could be live captured, it would be more effective and less costly to administer rabies vaccinations by injection, which is already considered as Alternative 3.

Immunocontraception is a potentially useful concept for mammalian population suppression but is still in the early stages of research and development (Bradley 1995; Miller 1997). Genetically engineered vaccines that cause a target species to produce antibodies against its own sperm or eggs or that affect reproductive hormone functions have been produced (Miller 1997). Logistical concerns that still need to be addressed before this method could be applied successfully in the field include durability of the contraceptive vaccines in baits after distribution in the field, and the limitation of current vaccine designs that require baiting an animal population twice about one month apart to successfully treat individual wild animals (Miller 1997). Also, it is likely that a greater proportion of the population would have to be treated with contraceptive vaccines than with rabies vaccines in order to achieve effective rabies control; thus, achieving effective control would be more costly and difficult under this alternative than under ORV programs (C. MacInnes, Ontario Ministry of Natural Resources, pers. comm. 2001). Environmental concerns with this strategy that still need to be addressed include safety of the proposed genetically engineered vaccines to humans, other wildlife species, and even in nontarget members of the target species - e.g., juveniles that might consume baits (Miller 1997; Guynn 1997; Hanlon and Rupprecht 1997).

No contraceptive agents are currently registered for use on raccoons, gray foxes, or coyotes and are thus not legal for use. For all of the above reasons, birth control strategies to control rabies will not be considered further.

3.1.3 Employ other types of ORV instead of the genetically engineered V-RG vaccine.

Under this alternative, APHIS-WS would provide funds to purchase and use "modified-live-virus" (i.e., "attenuated" or weakened strains that have been shown to have little chance of causing rabies in treated animals) or perhaps "killed-virus" (i.e., "inactivated" virus) oral vaccines instead of the V-RG vaccine in ORV baits. Modified-live-virus vaccines include those that have been used in the past in the U.S. to vaccinate domestic animals by injection. Oral baits that employed several strains of these types of virus vaccines have been investigated and used in Europe to stop the spread of rabies in red foxes (Flamand et al. 1993, Artois et al. 1993, Artois et al. 1997). They have also been tested in red foxes in Canada (Lawson et al. 1989, Lawson et al. 1997), and in red foxes and raccoons in the U.S. (Rupprecht et al. 1989, Rupprecht et al. 1992c).

The primary concern with attenuated or "live" virus vaccines (e.g., SAD and ERA) is that they can sometimes cause rabies (Flamand et al. 1993, Pastoret et al. 1992). Flamand et al. (1993) reported that one strain used widely in oral baits in Europe to vaccinate wild red foxes in the 1970s could cause rabies in rodents when injected and that the ability to cause rabies in nontarget animals by other modes (i.e., oral administration) could not be ruled out. Previously used attenuated strains are also "heat sensitive" which can limit their use in warmer seasons or climates (Pastoret et al. 1992). These types of safety concerns with attenuated rabies virus vaccines have been sufficient to prevent their approval for use in the U.S. (Rupprecht et al. 1992c).

Inactivated or "killed" virus rabies vaccines are safer than "live" vaccines in that they cannot cause rabies. This type of vaccine was found to be less effective in causing immunity when delivered into the intestinal tract in foxes (only 30% effective in test animals) and took 2 doses to cause immunity in the foxes that were successfully immunized (Lawson et al. 1989). Also, the amounts of virus particles that would have to be ingested in oral baits by wild carnivores to effectively vaccinate them would be 100 to 1000 times the amount of the live-attenuated virus particles required (Rupprecht et al. 1992c). To manufacture vaccines with these amounts would probably be cost-prohibitive (Rupprecht et al. 1992c).

Currently, Raboral V-RG is the only vaccine licensed for use in raccoons or approved for experimental use in wild gray foxes and coyotes in the U.S. (CDC 2000). For all of the above reasons, this alternative was not considered further.

3.2 MITIGATION IN STANDARD OPERATING PROCEDURES FOR RABIES ORV PROGRAMS

Mitigation measures are any features of an action that serve to prevent, reduce, or compensate for impacts that otherwise might result from that action. Because of extensive public and interagency involvement in the development of ORV programs and strategies, a number of key mitigating measures are currently part of the standard operating procedures of state-operated ORV programs and include:

- Public information and education actions and media announcements to inform the public about ORV bait distribution activities before they occur.

- Toll-free telephone numbers advertised in the media and on web sites for people to call for answers to questions.

- In the unlikely event that an adverse vaccinia virus exposure in humans occurs (see recent example described in Section 4.1.1.2), the CDC can make vaccinia immune globulin available to a state on a case-by-case basis to provide a level of additional assurance that such a reaction would be successfully treated.

- Training of bait distribution navigators to avoid dropping baits on people or structures. During aerial bait drop operations, the bait dispensing equipment is temporarily turned off over human dwellings, cities, towns, greenhouses, certain sensitive domestic animal pens (e.g., ostrich and emu pens in Texas), and when people are observed below.

- Adherence of aircraft to air safety standards.

- Training of personnel in hand distribution of baits to avoid properties with greater risk of human or pet encounters with baits.

- Labels on each ORV bait instructing persons not to disturb or handle them and containing a toll-free telephone number to call for further information and guidance in the event of accidental exposure to the vaccine (see Figure 1-2 in Chapter 1).

- Methods used to capture raccoons would be limited to cage traps for the most part. Animals caught in cage traps that must be sacrificed (killed) for testing or for local depopulation would be euthanized in accordance with recommendations by the American Veterinary Medical Association.

- Field personnel involved in trapping and handling animals for monitoring and surveillance purposes would be immunized against rabies and tetanus.

- All drug use in capturing and handling raccoons and other animals would be under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and APHIS-WS.

- Ear tagging or other marking of animals that are drugged and released close to hunting/trapping seasons to alert hunters and trappers that they should contact state officials before consuming the animal.

- Most animals administered immobilizing drugs would be released well before 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.

4.0 CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This section analyzes potential environmental consequences using Alternative 1 (the proposed action) as the baseline for comparison with the other alternatives to determine if the real or potential impacts are greater, lesser or the same. Table 4-1 at the end of this chapter summarizes a comparison of the issues and impacts to each Alternative.

The following resource values in the states involved in the proposed action would not be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range.

4.1 Alternative 1 -- Proposed action (provide APHIS-WS funds to purchase and participate in the distribution of ORV baits in several states; assist in monitoring, surveillance and project evaluation by capturing and releasing or killing target species of carnivores for the collection of blood serum, biomarker and other biological samples; potentially assist in implementing contingency actions that include localized lethal population reduction of target species or concentrated localized ORV baiting).

4.1.1 Potential for adverse effects on people that become exposed to the vaccine or the baits.

Direct tests of the safety of V-RG in humans have not been conducted, for understandable reasons. Prior EAs by APHIS have analyzed in detail the potential for adverse effects on humans from V-RG exposure as a result of ORV experimental programs (USDA 1991, 1992).

4.1.1.1 Potential to cause rabies in humans.

The nature of the recombinant virus used as the V-RG vaccine is such that it cannot cause rabies. This is because the V-RG vaccine only carries the gene for producing the outer coating of the rabies virus (i.e., rabies virus *glycoprotein*) and not those portions of the virus that could result in replication of the rabies virus which would have to happen for the disease to occur. Implementation of ORV programs would reduce the risk of humans contracting rabies by reducing the chance of encountering rabid animals that have been infected by rabid raccoons, gray foxes, or coyotes.

4.1.1.2 Potential for vaccinia virus to cause disease in humans.

The vaccinia virus portion of the V-RG vaccine has been recognized as having the potential to cause infections in persons exposed to the vaccine, either through direct contact with the liquid or through contact with the mouth of an animal that has recently ingested the oral vaccine (USDA 1991, p. 39). Because the vaccinia virus used in the V-RG vaccine is the same type of virus that was used in smallpox eradication, although more *attenuated* or weakened, persons who have been immunized against smallpox would likely not experience any adverse reaction to the vaccinia virus, but would likely experience at worst a "booster" in immunity against vaccinia virus. However, the routine administration of smallpox vaccinations was discontinued after smallpox was eradicated. Thus, a large percentage of the population (particularly younger individuals) has not been vaccinated against vaccinia. Vaccinia virus rarely poses much risk of serious health effects – even when it was *directly applied* (via "scarification" or by scratching the skin) to many hundreds of millions of people during smallpox eradication campaigns, the number that developed vaccinia virus-related illness was only a few per million. In most of those cases the extent of the illness was a mild fever and some lesions or pustules at the site of the injection, followed by full recovery and subsequent immunity to the vaccinia virus (USDA 1991, p. 39; Elvinger 2001). In most people, localized lesions occurred around the site on the arm where the smallpox vaccine was applied, but this a normal and expected response and, in general, no cause for concern.

More severe complications involving the central nervous system (CNS) can occur with vaccinia virus and the nature of these complications is generally thought to be allergic in nature (USDA 1991, p. 39). CNS complications occurred at an average rate of 3 per million among persons vaccinated with vaccinia virus (e.g., to prevent smallpox) with about 10 to 30% of those cases resulting in death (USDA 1991, p. 39). Thus, the chance of a person dying from direct application of a high dose of vaccinia virus via scarification would be about 1 in a million cases or less. With ORV baits distributed in the wild, people would run far less risk of being exposed to vaccinia virus or the V-RG vaccine in a way similar to deliberate smallpox vaccinations, but would primarily only run the risk of skin contact by handling broken baits or coming into contact with the oral regions of pets that had just consumed a bait. For that type of exposure, the chance of adverse effects from human infection with vaccinia virus would be far less than 1 in a million.

Another highly important characteristic of the V-RG vaccine is that it is weaker (more "attenuated") than the original parent vaccinia strain used in making it, and this has been proven in laboratory tests with mice (USDA 1991, p. 18-19). This characteristic even further reduces the risk of V-RG vaccine causing vaccinia-related illness in humans.

Persons with immune system deficiencies (e.g., AIDS) run a relatively greater risk of experiencing adverse effects if directly exposed to the vaccinia virus than would persons with normal immune systems (USDA 1991, p. 40; USDA 1995a; USDA *undated a;* USDA *undated b*). Experiments in mice suggest that immune-deficient people would be at minimal risk of adverse effects when exposed to V-RG vaccine (Hanlon et al. 1997; USDI 1991, p. 41 and Appendix E therein). To aid in further minimizing the potential for adverse effects on humans because of contact with V-RG vaccine, each ORV bait contains a warning label advising persons who make contact with baits or the vaccine liquid to contact a telephone number for further guidance.

An indirect source of information on this issue is the safety record of laboratories that have worked with the V-RG vaccine (USDA 1991, p. 27). Ordinarily, lab personnel working with infectious materials or animals are protected by immunization and by procedures and equipment that minimize risk. V-RG vaccine has been completely safe for humans in laboratory situations (USDA 1991, p. 27). Potential nonlaboratory exposure of humans in the various European field trials of V-RG vaccine has been considerable, with no program in place that monitors antibody levels of residents before and after the field trials. However, there have not been any reports of increased incidence of sickness in the field trial areas that could be attributable to the V-RG vaccine (USDA 1991, p. 27; G. Moore, TX Dept. of Health, pers. comm. 2001).

Studies of the effects of V-RG vaccine on nonhuman primates can provide an indication of the potential to affect humans (USDA 1991, p. 27). Studies in which squirrel monkeys (*Saimiri sciureus*) and chimpanzees (*Pan troglodytes*) were inoculated with the V-RG vaccine demonstrated that indirect human exposure to the vaccine that might occur via a bite or from contact with body fluids of a recently vaccinated animal is unlikely to produce adverse effects in healthy individuals (Rupprecht et al. 1992b; USDA 1991, p. 27).

McGuill et al. (1998) conducted a retrospective 4-year survey of directors of 6 ORV programs using V-RG vaccine that were conducted from 1992-1996 to evaluate the potential for human health problems. The programs occurred in Florida (2), Massachusetts (6), New Jersey (6), New York (7), and Texas (2). Altogether, they involved a total of 109,276 sq km (42,181 sq miles) of treated area and a total of nearly 6 million baits distributed. Human contacts with the baits totaled 316, of which 53 resulted in contact with the actual vaccine liquid. The directors of all programs reported that human contact was minimal and that there were no reported adverse reactions in people exposed to the baits. Human contact with the baits was more likely in areas where bait had white labels vs. lettering in black ink, and the authors speculated the reason to be because the white labeled baits were more visible and thus more likely to be noticed. The authors concluded that, based on their survey, major concerns about public health risks from V-RG vaccine were

unfounded.

Recently in Ohio there was a documented exposure to vaccinia virus that resulted when a woman was bitten by her dog while trying to take away an ORV bait. The vaccine liquid was exposed to the bite area, resulting in localized inflammation and pox virus lesions at the site of the bite, as well as a whole body rash. She further experienced sloughing of the outer layers of skin from some portions of her body, similar to what occurs in the skin condition eczema (C. Rupprecht, CDC, pers. comm. 2001). The woman, who was in her first trimester of pregnancy, is reported to have recovered from complications and recently gave birth to a 10-lb. baby boy with no apparent adverse health effects (R. Krogwold, OH Dept. of Health, pers. comm. 2001). Most recent reports attribute her response to the vaccinia virus as due likely to the reduced state of immunity typical during pregnancy and an underlying skin disorder (epidermolytic hyperkeratosis) that the woman already had (C. Rupprecht, CDC, pers. comm. 2001). The woman also tested positive for rabies antibodies three weeks after the exposure, indicating she may also have developed rabies immunity (Rupprecht et al. *unpublished* 2001). This type of incident appears to be unusual, but, nevertheless, points to the need for continued public information and education activities and field surveillance for accidental human exposure to the V-RG virus.

Although there is no approved anti-viral compound available yet for treatment of suspected vaccinia virus complications, the CDC can make vaccinia immune globulin available to the state on a case-by-case basis, with a requirement that certain specimens (such as acute and convalescent sera and swabs/scabs of the affected site) be collected for diagnosis (C. Rupprecht, CDC, pers. comm. 2001). This option provides some level of additional assurance that severe adverse effects on humans from vaccinia virus reactions would be successfully treated to avoid significant public health problems.

A recent study indicates vaccinia virus that originated from a strain used in smallpox vaccinations in Brazil may have become established in domestic cows in that country (Damaso et al. 2000). This indicates there is some potential for the use of vaccinia virus to result in a new emerging infectious disease. There is currently no evidence that this type of phenomenon has occurred in the U.S. (C. Rupprecht, CDC, pers. comm. 2001). Also, the vaccinia virus strain used for smallpox vaccination in Brazil was different than the strain that is currently used in the V-RG vaccine, and the vaccinia virus portion of V-RG is more attenuated (i.e., *weaker*) than the strains used in smallpox vaccines (USDA 1991, p. 18-19). Thus, it is less likely that V-RG vaccine would result in the establishment and persistence of vaccinia virus in wild or domestic animals. However, no surveillance or testing of animals for this virus has been done in the U.S. to test this hypothesis (C. Rupprecht, CDC, pers. comm. 2001).

The above information shows there is some potential for unusual circumstances to result in short-term adverse health effects from exposure to the vaccinia virus in the V-RG vaccine. However, the overall risk of such effects appears to be low based on the extremely low rate of reported occurrences in ORV programs.

4.1.1.3 Potential to cause cancer (oncogenicity).

This issue has been addressed in a previous EA and in formal risk analyses (USDA 1991, p. 40; USDA *undated a, undated b*). Vaccinia virus is not known to be a tumor-inducing virus. There have been no documented reports of oncogenicity associated with natural vaccinia virus infections in any animal species. The recombinant DNA methods used for preparation of the V-RG vaccine do not introduce any known oncogenes (i.e., cancer-causing genes) into the vaccinia virus strain that could cause it to become tumor-inducing.

Based on this information, risks to humans from contact with the V-RG vaccine are believed to be minimal. The risk and potential severity of adverse effects from rabies exposures in humans would probably be

greater without ORV programs than would be the risk of serious adverse effects from vaccinia virus infections with ORV programs.

4.1.2 Potential for adverse effects on target wildlife species populations.

4.1.2.1 Effects of the ORV V-RG vaccine on raccoons, gray foxes, and coyotes.

The primary concern here is whether the V-RG virus might cause disease in target animals that consume the ORV baits. Large numbers of raccoons have been inoculated with, or have consumed baits containing, the vaccine without ill effects, and most were successfully immunized against rabies (USDA 1991, p. 25; Rupprecht et al.1986). Tests showed that the V-RG virus did not invade the central nervous system (CNS) or the cerebrospinal fluid of treated raccoons which indicated no adverse effects on the CNS are likely (USDA 1991, p. 25; Hanlon et al. 1989b). Other tests showed that the V-RG vaccine did not cause any lesions or viremia (i.e., presence of the virus in the blood) in tissues sampled from treated raccoons (Rupprecht et al. 1988). These studies, in addition to the absence of reports of adverse effects in free-ranging wildlife in current/historical ORV program areas, have demonstrated the safety and effectiveness of the V-RG vaccine in raccoons. ORV baits containing the V-RG vaccine would thus have no adverse impact on raccoon populations.

Artois et al. (1990) evaluated the safety of V-RG oral vaccine in coyotes and found no evidence of vaccinia virus infections or other complications. Rupprecht et al. (1992a) reported no adverse effects in gray foxes tested. Also, extensive experimental field testing of V-RG vaccine with subsequent collections and necropsies of gray foxes and coyotes for monitoring purposes in Texas have not produced any observed pathological signs of disease or other adverse effects on this species (E. Oertli, TX Dept. of Health, pers. comm. 2001). Extensive laboratory and field testing of V-RG vaccine in many nontarget species, including other closely related members of the Canid (dog) family (see Rupprecht et al. 1992a), indicates virtually no risk of oral baits containing V-RG adversely affecting gray fox or coyote populations.

4.1.2.2 Effects of monitoring/surveillance or localized population reduction (contingency actions) on raccoon populations in eastern states.

The estimated cumulative size (over all involved states) of the proposed raccoon rabies ORV barrier zones to be treated with ORV baits purchased with USDA funds in any one year would be about 102,650 sq km (or about 39,623 square miles) (Kemere et al. 2001). Raccoon densities range from 0.9 to as high as 250 per sq km. (about 2 to 650 per sq mi.) with most reported densities in the range of about 4 to 30 per sq km.(about 10 to 80 per sq mi.) in rural areas (Riley et al. 1998). Assuming this range of densities occurs in the proposed ORV zones, it is reasonable to assume that overall raccoon numbers in those areas total between 400,000 and 3.1 million. Raccoon populations can generally be expected to withstand harvest rates of about 49% or more annually (Sanderson 1987; USDA 1997j). APHIS-WS and cooperating state or local agencies expect to live-trap or lethally remove less than 1% of the lowest estimated number of raccoons in all states combined for monitoring and surveillance purposes or implementation of localized contingency plans involving lethal population reduction. Almost all raccoons captured for monitoring or surveillance purposes would be released at their site of live capture once they have fully recovered from anesthesia. In most instances, only strange behaving individuals would be humanely killed and submitted for rabies testing. An exception may be when the animals were captured and drugged for handling purposes close to or during hunting/trapping seasons, at which times they may be euthanized to avoid concerns about hunters or trappers consuming raccoons that contain drug residues (see section 2.2.1). Contingency actions would be considered that could result in lethal raccoon population suppression in small areas to attempt to contain an outbreak that could occur beyond an existing ORV zone. Given that hunter and trapper harvest and other sources of mortality would occur, there are no anticipated significant cumulative

impacts to raccoon populations even if contingency actions would be infrequently conducted in small areas of the states involved in ORV programs.

4.1.2.3 Effects of monitoring/surveillance or localized population reduction (contingency actions) on gray fox populations in Texas.

The APHIS-WS program in Texas has analyzed the impacts of program activities on gray fox populations including activities that involve assistance with rabies monitoring and surveillance in several previous EAs. Those EAs covered such activities in the area of the state affected by the ORV program as well as the entire state, and include analysis of the effects of all lethal removal of gray foxes by APHIS-WS. The analyses in, and subsequent monitoring reviews of, the EAs showed that APHIS-WS's total gray fox take combined with other known take (e.g., annual trapper and hunfter harvest), has been far below any level that would begin to adversely impact overall populations of gray fox (USDA 1997a, 1997b, 1997c, 1997d, 1997e, 1997f, 1997g, 1997h, and 1997i). Thus, the cumulative impact on gray fox populations in Texas would be insignificant.

4.1.2.4 Effects of monitoring/surveillance or localized population reduction (contingency actions) on coyote populations in Texas.

Impacts on coyote populations from APHIS-WS's depredation management and rabies monitoring activities in south Texas were also analyzed in prior EAs. Those EAs covered such activities in the area of the state affected by the coyote rabies ORV program and include analysis of the effects of all lethal removal of coyotes in those areas by APHIS-WS. Those analyses show that APHIS-WS's take in combination with other known harvest has been less than 15% of the estimated population in any one year which is far below the 70% harvest level that can be sustained by coyotes (USDA 1997g, 1997i). Thus, the cumulative impact on coyote populations in south Texas would be insignificant.

4.1.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species.

4.1.3.1 Effects of the Raboral V-RG® vaccine on nontarget wildlife including threatened or endangered species.

The primary concern here is whether the vaccinia virus-rabies glycoprotein combination (i.e., Raboral V-RG® vaccine) might cause disease in nontarget animals that consume or otherwise come into contact with the vaccine in baits. Rupprecht et al. (1992a) and Pastoret et al. (1995) summarized the results of V-RG safety trials in nontarget species. More than 50 species from Europe and North America have been tested and include relevant taxonomic groups believed to be potentially at risk for contact with the V-RG vaccine such as:

- natural ecological competitors of raccoons and foxes, such as the opossum (*Dedelphis virginianus*), several mustelids (skunk, badger, mink (*Mustela vision*), otter (*Lutra canadensis*), ferret (*Mustela putorius*), other members of the Canid family (coyote, red fox, gray fox, arctic fox (*Alopex lagopus*), raccoon dog (*Nyctereutes procyonoides*), bobcat (*Lynx rufus*), and black bear (*Ursus americanus*).

- Domestic cats (*Felix domesticus*) and dogs (*Canis familiaris*).

- 19 rodent species (Order *Rodentia*) that might be expected to gnaw on or consume baits. Families within this order represented in the studies included: *Muridae, Erethizonidae* (porcupine (*Erithizon dorsatum*)), *Sciuridae, Cricetidae,* and *Zapodidae*.

- 1 bat species (Daubenton's bat (*Myotis daubentoni*)).

- 8 bird species, including three hawk species (red-tailed hawk (*Buteo jamaicensis*), kestrel (*Falco tinnunculus*), common buzzard (*B. Buteo*), and one species each of owl (great horned owl (*Bubo virginianus*)), crow (carrion crow (*Corvus corone*)), gull (ring-billed gull (*Larus delawarensis*)), magpie (*Pica pica*), and jay (*Garrulus glandarius*).

- Domestic livestock (cattle (*Bos taurus*), sheep (*Ovis ovis*)).

- Two wild ungulate species (wild boar (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*)).

- Two primate species (squirrel monkey and chimpanzee).

Rupprecht et al. (1992a) reported there has been no mortality or morbidity (i.e., signs or symptoms of disease) and no lesions typical of pox virus infections caused by V-RG vaccine in over 350 individual animals representing some 20 taxonomic families of animals. They concluded that the extensive laboratory safety experiments showed V-RG to be safe in all species tested to date. In field trials with V-RG ORV baits to treat wild raccoons in which target and nontarget species were captured and tested, no vaccine-related lesions or other adverse effects have been found to occur (Rupprecht et al. 1992a).

With regard to threatened or endangered species, the Raboral V-RG® vaccine distributed in baits as proposed would have no effect on any threatened or endangered species. Few listed species (see Appendix C) would be likely to be attracted to the ORV baits, and the few carnivore species that might consume baits would be expected to experience no effect other than possibly becoming immunized against rabies.

4.1.3.2 Effects of capture/removal methods (used in monitoring and surveillance or to reduce local populations of target species under state contingency plans) on nontarget species, including threatened or endangered species.

The methods proposed for use in raccoon rabies monitoring and surveillance areas or in implementing localized population reduction under state contingency actions would have no significant adverse effects on nontarget species. Nontarget animals captured in cage traps would be released unharmed which would have no effect on nontarget species populations.

Some of the methods proposed for use in collecting gray foxes and coyotes in ORV areas in Texas have the potential for accidentally catching or killing nontarget animals (leghold traps, snares, M-44 devices). Methods such as ground-based and aerial shooting would have no effect on nontarget species because they are virtually 100% selective for target species. APHIS-WS has analyzed the effects on nontarget species by such methods in nine previous EAs which found no significant adverse effects on populations (USDA 1997a, 1997b, 1997c, 1997d, 1997e, 1997f, 1997g, 1997h, and 1997i).

APHIS-WS reviewed lists of federal and state T& E species to determine if any might be affected (Appendices C and D). ORV programs or the methods used in capture/removal of target species in monitoring activities or contingency plan implementation would have no effect on any listed bird, reptile, amphibian, fish, invertebrate, or plant species. The only species on the federal or state T&E or special status lists that might be expected to raise concerns about potential effects from the proposed action are:

Federally listed T&E species:

- **Canada lynx** (*Lynx canadensis*). This species is shown to potentially occur in portions of New York, Pennsylvania, New Hampshire, and Vermont among the states involved in the proposed action). The USFWS has documentation that lynx occur and are reproducing in Maine and therefore believes that lynx could possibly disperse to contiguous suitable habitat in New Hampshire, but consider lynx occurrence as rare in New Hampshire based on recent records (USDI 2000). Furthermore, the USFWS considers it possible that lynx have been extirpated from New Hampshire, Vermont and New York (USDI 2000b). The USFWS has concluded that, in the Northeast, a population of lynx most likely continues to exist in the core region of western Maine, northern New Hampshire, southeastern Quebec, and western New Brunswick; however, the range appears to have retracted northward (USDI 2000). Based on a review of past capture records, APHIS-WS has determined there to be no risk to lynx from ORV programs, from rabies monitoring or surveillance (including the capture and testing of raccoons) or other current APHIS-WS activities in these states (USDA 2000). Also, lynx are not expected to be attracted to or to consume ORV baits and would thus not be affected by them. Therefore, APHIS-WS has determined that the proposed action would have no effect on this species. A potential beneficial indirect impact of ORV programs on lynx conservation would be a reduced risk of contracting and dying of rabies if the spread of raccoon rabies is successfully halted or if the variant strain is eradicated.

- **Eastern puma** (*Puma concolor couguar*). This species is presumed extinct in the wild in the eastern U.S. (USDI 2001). Therefore, ORV programs, including monitoring activities involving the live-capture or lethal removal of raccoons, would have no effect on this species. This species is not expected to be attracted to or to consume ORV baits. Also, animals the size of cougars would not be affected by cage-traps used to collect raccoons for monitoring purposes. A potential beneficial indirect impact of ORV programs on this species would be a reduced risk of contracting and dying of rabies if the spread of raccoon rabies is successfully halted or if the variant strain is eradicated.

- **Florida panther** (*Puma concolor coryi*). This subspecies of cougar occurs in Florida, and it is not expected to be attracted to or to consume ORV baits. Areas currently anticipated for ORV bait use are not in the part of the state where this species currently occurs (B. Constantin, APHIS-WS, pers. comm. 2001). Also, animals the size of cougars would not be affected by cage-traps used to capture raccoons for monitoring purposes. Therefore, ORV programs, including monitoring activities involving the live-capture or lethal removal of raccoons, would have no effect on this species. A potential beneficial indirect impact of ORV programs on this species would be a reduced risk of contracting and dying of rabies if the spread of raccoon rabies is successfully halted or if the variant strain is eradicated.

- **Ocelot** (*Leopardus pardalis*) and **Jaguarundi** (*Herpailurus yagouaroundi cacomitli*). These two species potentially occur in south Texas where the coyote rabies ORV programs have been and would continue to be conducted. The FWS provided APHIS-WS an opinion that ORV programs in south Texas are not likely to adversely affect these species (letter dated January 18, 1995, copy contained in USDA 1995b). Methods that would be used to collect coyotes for monitoring purposes that might have the potential to affect these species include leghold traps, snares, and M-44 devices. APHIS-WS has agreed to certain program restrictions on the use of these methods in areas where ocelot and jaguarundis might occur in order to avoid incidental take or jeopardy to these species, and the FWS has issued a Biological Opinion (BO) and incidental take statement concurring that incidental take is unlikely to occur (USDI 1997). The FWS also recognized that a potential beneficial indirect impact of ORV programs on this species would be a reduced risk of contracting and dying of rabies if the spread of coyote rabies is successfully halted or if the variant strain is eradicated.

- **Jaguar** (*Panthera onca*). The jaguar's historical range includes south Texas. The latest record of occurrence in Texas was in 1948 (Nowak 1975). The general consensus appears to be that habitat fragmentation and loss north and south of the Mexican border makes recurrence in TX unlikely (62 FR 39147, July 22, 1997). For these reasons, APHIS-WS determined its activities, including the use of methods proposed for collecting coyotes for monitoring purposes in ORV programs, will have no effect on the jaguar in TX. The FWS issued a BO on the effects of the APHIS-WS program on the jaguar in 1999 in which the Service determined activities by APHIS-WS were not likely to jeopardize the continued existence of this species (USDI 1999). The BO contained an incidental take statement with reasonable and prudent measures and terms and conditions that APHIS-WS follows to minimize the risk of incidental take (USDI 1999).

- **Mexican gray wolf** (*Canis lupus*). The historical range of the Mexican gray wolf includes south Texas where the coyote rabies ORV programs have been and would continue to be conducted. No Mexican wolves are currently known or believed to exist in Texas. Therefore, ORV bait distribution would have no effect on this species. ORV programs would not adversely affect the species, should it once again become established in Texas. The FWS issued a BO (for naturally occurring wolves) and Conference Opinion (on an experimental nonessential population being established in Arizona and New Mexico) on the effects of the APHIS-WS program on the Mexican wolf in 1998. In that BO the Service determined activities by APHIS-WS were not likely to jeopardize the continued existence of this species (USDI 1998). The BO contains an incidental take statement that requires reinitiation of consultation if a wolf is taken (USDI 1998). Should this species be reintroduced in Texas, a potential beneficial indirect impact of ORV programs would be a reduced risk of contracting and dying of rabies if the spread of coyote and gray fox rabies is successfully halted or if the variant strain is eradicated.

- **Louisiana black bear** (*Ursus americanus luteolus*). This species may occur in east Texas which is outside of the areas planned for ORV programs. Therefore, it would not be affected by ORV programs or monitoring activities. Should ORV programs expand into east Texas in the future, they could benefit the species by reducing its risk of dying from rabies.

State listed species:

- **Pine (American) marten** (*Martus americana*). This species is state-listed as threatened in New Hampshire and endangered in Vermont. It is conceivable that this species could consume ORV baits intended for raccoons. Although not specifically tested for safety in this species, safety studies on other closely related Mustelid species (skunk, mink, badger, ferret, otter) (Rupprecht et al. 1992a) indicate martens would not be adversely affected. Also, an indirect beneficial effect would be a reduced risk of the species suffering further declines because of a rabies epizootic. If a pine marten was inadvertently captured in a cage trap set for a raccoon, it would be released unharmed to avoid lethal take and reported to the appropriate state agency to complement their population monitoring data for this state-listed species. Therefore, the proposed action should have no significant impact on this species.

- **Bobcat** and **River Otter** (*Lutra canadensis*). The bobcat is state listed as endangered in Ohio and New Jersey. The river otter is state-listed as endangered in Ohio. ORV baits distributed for raccoons would not adversely affect these species (Rupprecht et al. 1992a). It is considered highly unlikely that bobcats or river otters would be caught in cage traps set for raccoons during monitoring or local population suppression activities. The APHIS-WS program in Ohio has a scientific collecting permit from the Ohio

Department of Natural Resources, Division of Wildlife (ODOW). The ODOW has advised APHIS-WS to release any nontargets captured. If any captures occurred they would be reported to ODOW to complement their population monitoring data for these state-listed species. By following these measures, APHIS-WS should avoid any lethal take of these species. An indirect beneficial effect would be a reduced risk of these species suffering further declines in the state because of a rabies epizootic.

- **Snowshoe hare** (*Lepus americanus*). This species is state-listed as endangered in Ohio and has been recently reintroduced into the state (A. Montoney, APHIS-WS, pers. comm. 2001). ORV baits should have no effect on this species. It is highly unlikely that any would be captured incidentally during rabies monitoring or local raccoon population suppression activities. As stated above, the Ohio APHIS-WS program has a scientific collecting permit from the ODOW and has been advised to release any nontargets captured. If any captures occurred they would be reported to ODOW to complement their population monitoring data for this state-listed species. By following these measures, APHIS-WS should avoid any lethal take of this species. Also, an indirect beneficial effect would be a reduced risk of the species contracting and dying of rabies.

- **New England cottontail** (*Sylvilagus transitionalis*). This species is listed as being of "special concern" in Vermont. That status confers no specific protection for the species. Although unlikely, one could conceivably be captured in a cage trap set for raccoons. Any caught would be released unharmed and reported to the Vermont Department of Fish and Wildlife, which would avoid any significant impacts on the species. Also, an indirect beneficial effect would be a reduced risk of the species contracting and dying of rabies.

The proposed action would have no effect on any of the other listed species in the states involved in the proposed action (see Appendices C and D).

4.1.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits.

Rupprecht et al. (1992a) and Pastoret et al. (1995) summarized the results of V-RG safety trials in nontarget species. The studies included oral vaccination of domestic dogs, cats, cattle, and sheep and found no adverse effects on those species. More than 23 million ORV baits using the Raboral V-RG® vaccine have been distributed in the U.S. thus far with no reported adverse effects on domestic animals. There is no evidence of potential harm to target or nontarget species, including domestic dogs, cats, cattle, and sheep, from overdosage of Raboral V-RG® vaccine by any route; a number of species have been dosed with 2 to 10 times the amount of vaccine in an individual ORV bait without adverse effects (USDA 1991, p. 47; Rupprecht et al. 1992a). Therefore, even if domestic animals received multiple doses of vaccine by consuming multiple baits, no adverse effects would be expected to occur.

As discussed in section 4.1.1.2, a recent study indicates vaccinia virus that originated from a strain used in smallpox vaccinations in Brazil may have become established in domestic cows in that country (Damaso et al. 2000). This indicates there is some potential for use of vaccinia virus in vaccinations to result in a new emerging infectious disease in domestic animals; however, there is currently no evidence that this type of phenomenon has occurred in the U.S. (C. Rupprecht, CDC, pers. comm. 2001). Also, the vaccinia virus strain used for smallpox vaccination in Brazil was different than the strain that is currently used in the V-RG vaccine, and the vaccinia virus portion of V-RG is more attenuated (i.e., *weaker*) than strains used in smallpox vaccines (USDA 1991, p. 18-19). Thus, it is less likely that V-RG would result in the establishment and persistence of vaccinia virus in wild animal populations.

There have been reported instances where a pet dog has consumed several baits and then vomited the plastic sachets (R. Hale, Ohio Dept. of Health, pers. comm. 2001). Reports of these types of instances

have been few, and the dogs have reportedly not experienced any substantive or long term adverse effects.

4.1.5 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals.

The concern here is whether the V-RG recombinant virus is genetically stable so that it would not become virulent (i.e., capable of causing disease) after it replicates (or reproduces) in animals that eat ORV baits containing the Raboral V-RG® vaccine and, perhaps, be transmitted on to other animals. This issue was addressed in previous EAs and in formal risk assessments by USDA, APHIS (USDA 1991, p. 41-42; USDA *undated a*, *undated b*). The Wistar Institute conducted experiments with mice in which the V-RG was "subpassaged[3]" four times into groups of mice (results cited in USDA 1991, p. 41). The V-RG virus could not be found after passage through the second or third groups of mice. The experiments demonstrated that the ability of the V-RG virus to cause disease does not increase by repeated animal passage, thus "reversion to virulence" is unlikely. Further alleviating the concern about this issue is the evidence that V-RG virus does not transmit readily to other animals from animals that have consumed ORV baits (Rupprecht and Kieny 1988).

4.1.6 Potential for the Raboral V-RG® vaccine to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals.

The concern here is whether the Raboral V-RG® vaccine in the ORV baits might encounter other viruses in animals, exchange genetic material with them during replication, and result in new viruses that could cause serious diseases in humans or animals. This potential recombination has been recognized as being more probable with wild pox viruses that are genetically similar to the vaccinia virus used as the vector in the Raboral V-RG® vaccine.

Wild pox viruses present in the U.S. include skunk, rodent, and raccoon pox viruses (C. Rupprecht, CDC, pers. comm. 2001). One type of wild pox virus that would logically be considered for the possibility of recombination with vaccinia virus is raccoon pox (RP) which could occur in raccoons targeted by ORV programs in the eastern U.S. For this type of unanticipated spontaneous recombination to occur, the V-RG and RP would have to simultaneously infect the same cells in the same animal at the same time. RP has not been found to be prevalent in the environment, with only two concurrent isolations (or detections) of it having occurred in the U.S. (Herman 1964, cited in USDA 1991, p. 42). Laboratory experiments on mice infected with RP and inoculated with V-RG showed no adverse effects on the mice (USDA, 1991, p. 42).

The Wistar Institute identified three circumstances that would have to occur simultaneously for there to be a chance of a hazardous recombination between V-RG and RP virus: (1) they would have to occur at the same time in the same animal; (2) "genome contact" (i.e., contact between the actual genetic material in the two viruses as they replicate in an infected cell); *and* (3) the regeneration of the gene that was previously removed from the vaccinia virus (known as the thymidine kinase "TK" gene) (USDA 1991, p. 42). Wistar determined the probability of all three circumstances occurring at the same time was 1 chance in 100 million or less (USDA 1991, p. 42). Also, if this did somehow occur resulting in a recombined virus with the functional "TK" gene reestablished, the properties and virulence of the new virus would probably be similar to the original recipient virus which is vaccinia (USDA *undated b*, p. 28). Vaccinia only causes mild short-term symptoms in most cases (i.e., similar to the localized rash and pustules that occurred on the arms of many persons who received smallpox vaccinations) (USDA 1991, p. 39; Elvinger 2001). Thus, recombination with wild viruses is unlikely, but, if it did occur, it is also unlikely to result in significant adverse effects on animals or people.

Combination of two types of pox viruses in rabbits or hares (leporipoxviruses) has been known to occur (Omlin 1997), but the combination of a leporipoxvirus with another unrelated pox virus has not been

[3]This means the V-RG was inoculated into one group of mice from which material containing the virus was obtained later and injected into a second group of mice, and then material obtained from the second group was injected into a third group, etc., until four such passages had been conducted.

known to occur (USDA 1991, p. 42). Rare examples of recombination between different poxviruses in animal hosts have been documented, although the probability of two viruses infecting the same cell at the same time (which is required for recombination to occur) under natural conditions remains very low (Omlin 1997). Recombination of V-RG with viruses other than orthopoxviruses is not likely (Omlin 1997). In formal risk analyses, APHIS concluded that the probability of recombination with other orthopoxviruses would be limited due to the low prevalence of orthopoxviruses in wildlife species in the U.S. (USDA *undated a, b*).

Hahn (1992) concluded that vaccines developed by the newer genetic engineering (i.e., recombinant) techniques such as the ones used to make V-RG vaccine are no more hazardous than vaccines created by more conventional methods (e.g., "attenuation" and "fractionation"). He further indicated that, with recombinant technology, the potential for ending up with a dangerous virulent strain is probably less than with the older "hit-or-miss" methods, because the specific genetic material responsible for making a virus virulent can be removed or altered which makes the virus safer.

This analysis, which incorporates previous analyses by reference, supports a conclusion that adverse environmental effects from spontaneous recombination of V-RG with other wild viruses are exceedingly unlikely. This is further supported by the fact there have been no observed adverse effects in wildlife and humans both in Europe and North America following a number of years of experimental and field use of the V-RG vaccine.

4.1.7 Potential for aerially dropped baits to strike and injure people or domestic animals.

ORV baits would be distributed from aircraft at an average density of 27 per sq km (70 per sq mile) in the coyote rabies zone and 39 per sq km (100 per sq mi) in the gray fox rabies zone in Texas under the proposed action. Bait density would average 75 per sq km (194 per sq mile) in eastern states where raccoon rabies is targeted. Those densities are sparse enough to predict that the chance of a person being struck and harmed by a falling bait is extremely remote. For example, if 100 persons were standing outdoors in a square mile of area in which ORV baits were being dropped, and each person occupies about 2 square feet of space at the time that baits were dropped, the chance of being struck would be 1 in 139,000 (200 sq ft total space occupied by persons divided by 27.8 million sq ft per sq mi). The low risk of being struck is further supported by the fact that out of more than 33 million ORV baits distributed from aircraft in the U.S. and Canada since 1990, there have been only a few incidents in which a person reported being struck by a falling bait. The incidents (n=4) occurred in Texas, Ohio, and Ontario and did not result in any significant injury or harm to the individuals involved (G. Moore, TX Dept. of Health, pers. comm. 2001; R. Hale, OH Dept. of Health, pers. comm. 2001; C. MacInnes, Ontario Ministry of Natural Resources, pers. comm. 2001). This effect is further mitigated by the fact that bait drop crews avoid dropping baits into cities, towns, and other areas with human dwellings, or if humans are observed below. Hand placement or dropping of baits from slower moving helicopters to allow for more precise control over the areas on which the baits are dropped would primarily be used in urban parks or suburban situations, which would further reduce the risk of being struck.

4.1.8 Cost of the program in comparison to perceived benefits.

4.1.8.1 Raccoon rabies ORV programs.

Meltzer (1996) described a model for estimating the costs and benefits of using oral vaccines to stop or prevent raccoon rabies and identified factors important for consideration. Preventing raccoon rabies from moving into an area is generally much less expensive than the cost of elimination. The cost of eliminating raccoon rabies from New York using ORV was estimated at $72.9 million over a 10-year period. Statewide cost of raccoon rabies was estimated at $0.23 per capita pre-epizootic to $0.89 per capita once the area became infected. Comparing 1990 to 1994, New York found the rabies epizootic increased that state's annual costs over $10 million per year (Huntley et al. *unpublished* 1996).

Benefit:cost ratios of using V-RG vaccine in oral baits to control raccoon rabies in two counties in New Jersey were estimated by Uhaa et al. (1992). In that study, estimated value of benefits were 2.21 times the costs for the most expensive vaccination program. The least expensive program resulted in benefits that exceeded costs by a factor of 6.8. The authors concluded that the program would be cost effective (Uhaa et al. 1992).

Kemere et al. (2001) conducted a detailed analysis of the expected costs compared to the expected value of benefits for establishing a barrier to prevent further westward spread of raccoon rabies that would extend from Lake Erie to the Gulf of Mexico. The barrier would combine natural barriers provided by geographical features such as the Appalachian Mountains with ORV zones. All program costs and benefits (in terms of avoided costs) were discounted to present values to provide valid comparisons. The types of costs avoided by preventing the westward spread of raccoon rabies included post-exposure vaccination treatments for humans, need for increased livestock vaccinations, and costs of increased surveillance and monitoring of rabies in wildlife and domestic animals (including laboratory diagnostic costs, costs of preparing samples for testing, and animal bite investigations). The analysis did not factor in an economic benefit for lives saved. It also did not factor in the potential benefit of decreased costs associated with nuisance and damage by raccoons or of raccoon impacts on ground nesting birds that might occur if the epizootics were not treated and raccoon populations declined as a result. It is probable that such a potential benefit would be short term (1-3 years) until local raccoon populations recovered, or were affected by other disease cycles. However, these types of outcomes are largely unpredictable.

Costs of establishing and maintaining the raccoon rabies barrier are estimated to total between $58 million and $148 million, while the estimates of net benefits ranged between $48 million and $496 million. The analysis indicated that a large scale ORV program should be economically feasible and that net economic benefits would most likely be substantial (Kemere et al. 2001).

4.1.8.2 Gray fox and coyote rabies ORV programs in Texas.

Although no detailed economic analysis of the costs and benefits of the gray fox and coyote rabies programs has been conducted, the assumption about the potential spread of rabies across much of the U.S. without effective ORV programs is most likely also valid for the gray fox and coyote rabies variants. Thus, it is probable that the Texas ORV programs would be found to be cost effective under similar analysis.

4.1.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans.

Some people would view methods employed to capture and/or kill raccoons, gray fox, coyotes, and other wild animals for monitoring and surveillance or local depopulation purposes as inhumane. Humaneness, as it relates to the killing or capturing of wildlife is an important but complex concept that can be interpreted in a variety of ways. Humaneness is a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently.

However, humaneness as it relates to the natural world through natural mortality versus man-induced mortality must be brought into perspective. DeVos and Smith (1995) explain the characteristics of natural mortality in wildlife populations. There seems to be an increasing public perception that, left alone by humans, animal populations will experience few premature deaths and live to an old age without harm, pain or suffering. It should be recognized that wildlife populations reproduce at far greater rates than would be necessary to replace deaths if all lived to old age. To counterbalance this high reproduction, it is natural for most individuals of most species to die young, often before reaching breeding age. Natural mortality in wildlife populations includes predation, malnutrition, disease, inclement weather, and accidents. These "natural" deaths are often greater in frequency than human-caused deaths through

regulated hunting, trapping, and wildlife damage management operations. From the standpoint of the animal, these natural mortality factors also may cause more suffering by wildlife, as perceived by humans, than human-induced mortality. Under given habitat conditions, most wildlife populations fluctuate around a rather specific density, sometimes called the carrying capacity. Populations that overshoot this density via reproduction become very sensitive to various sources of mortality, and death rates increase. Conversely, as populations drop, mortality rates decline (deVos and Smith 1995). Thus, human-induced mortality - which often involves much less suffering of individual animals - invariably lessens mortality from other sources. For example, it would seem that an animal taken in a leg-hold trap or by a snare, would certainly suffer less than if it died from rabies.

Research suggests that with some methods, such as restraint in leghold traps, changes in the blood chemistry of trapped animals indicate "stress." Blood measurements indicated similar changes in foxes that had been chased by dogs for about five minutes as those restrained in traps (USDA 1997j). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness. The challenge in coping with this issue is how to achieve the least amount of animal suffering with the constraints imposed by current technology. To insure the most professional handling of these issues and concerns, APHIS-WS has policies giving direction toward the achievement of the most humane program possible while still accomplishing the program's mission.

APHIS-WS has improved the selectivity of management devices through research and development of pan-tension devices and other device modifications such as breakaway snares. Research is continuing with the goal of bringing new findings and products into practical use. Until such time as new findings and products are found to be practical, some animal suffering will occur during lethal collection of animal specimens if monitoring and program effectiveness objectives are to be met.

4.2 Alternative 2 -- No action (no involvement by APHIS-WS in rabies prevention or control)

4.2.1 Potential for adverse effects on people that become exposed to the vaccine or the baits.

Under this alternative, no APHIS-WS funds would be available for purchasing ORV baits. The states would still likely fund ORV programs to some degree without APHIS-WS's assistance. They may seek other sources of federal funds to complement state or other sources of funding. Thus, people would still have the potential to come into contact with baits or the vaccine; however, the potential would be less. Actual risks of adverse effects from exposure to vaccinia virus would still be exceedingly low and insignificant.

It is conceivable that federal coordination of ORV programs would actually result in fewer numbers of ORV baits used over the years or that ORV bait use in many areas would be for shorter time periods. This is because effective federal coordination may have a better chance of stopping or even eliminating one or more of the several rabies strains from large areas than if the individual states are left to themselves to conduct ORV programs.

4.2.1.1 Potential to cause rabies in humans.

The no action alternative would most likely result in greater risk of human exposure to rabies than the proposed action because state-run ORV programs without APHIS-WS funds would have less chance of being successful in stopping or preventing the spread of the three rabies variants. Therefore, an absence of APHIS-WS cooperative funding could be expected to result in increased risk of human rabies cases because of expanding epizootics. The V-RG vaccine would not cause rabies under any expected scenario involving the distribution of ORV baits.

4.2.1.2 Potential for vaccinia virus to cause disease in humans..

Under the no action alternative, V-RG oral vaccine containing the vaccinia virus vector would still

be available for state-approved use in ORV programs. Such programs would probably be on a lesser scale without APHIS-WS funds. The potential for vaccinia-related disease cases would be lower than under the proposed action. The likelihood that any cases would occur is extremely remote under any expected scenario involving the distribution of ORV baits.

4.2.1.3 Potential to cause cancer (oncogenicity).

Under the no action alternative, V-RG oral vaccine containing the vaccinia virus vector would still be available for state-approved ORV programs but would probably be used on less total land area without APHIS-WS funds. Because vaccinia virus used in the V-RG vaccine is not a cancer-causing agent, expected scenarios involving the use of ORV baits by the states would not result in increased cancer risks.

Based on this information, risks to humans from contact with the V-RG vaccine are believed to be minimal with or without APHIS-WS funding or assistance. The risk and potential severity of adverse effects from rabies exposures in humans would probably be greater without ORV programs than would be the risk of serious adverse effects from vaccinia virus infections with ORV programs.

4.2.2 Potential for adverse effects on target wildlife species populations.

It is most likely that fewer raccoons, gray foxes and coyotes in the proposed ORV zones would be vaccinated against rabies without APHIS-WS funds to contribute to ORV bait purchases and distribution. Therefore, more animals would likely die from rabies with potentially greater short-term population impacts. Such impacts would be expected to recur as raccoon, gray fox or coyote populations have strong capabilities to recover (Connolly and Longhurst 1975, Fritzell 1987, and Sanderson 1987), which would establish new populations susceptible to rabies mortality. If the state ORV programs failed for lack of APHIS-WS assistance, rabies epizootics may be expected to occur that would likely result in short-term die-offs of target species over broader geographic areas.

4.2.2.1 Effects of the ORV V-RG vaccine on raccoons, gray foxes, and coyotes.

Under the no action alternative, states would still be able to employ the V-RG oral vaccine to combat raccoon rabies, and Texas would still be able to experimentally use V-RG to combat gray fox and coyote rabies. As concluded in the analysis in section 4.1.2, baits using the V-RG vaccine would have no adverse impact on raccoon, gray fox, or coyote populations.

4.2.2.2 Effects of monitoring/surveillance or localized population reduction (contingency actions) on raccoon populations in eastern states.

Under the no action alternative, states would still likely implement some level of monitoring, control, and, potentially, implementation of contingency actions in response to breaches in vaccination barriers that result in localized population suppression to attempt to maintain the integrity of vaccination barriers. The numbers of raccoons killed under such programs would probably be less than if APHIS-WS funds and personnel were available. Therefore, as supported by the analysis in section 4.1.2.2, effects on raccoon populations would be insignificant.

4.2.2.3 Effects of monitoring/surveillance or localized population reduction (contingency actions) on gray fox populations in Texas.

Under the no action alternative, the State of Texas would likely still conduct monitoring/surveillance and local depopulation activities without APHIS-WS assistance; however, such activities would probably occur at a lesser scale. Therefore, as supported by the analysis in section 4.1.2.3, effects on gray fox populations would be insignificant.

4.2.2.4 Effects of monitoring/surveillance or localized population reduction (contingency actions) on coyote populations in Texas.

Under the no action alternative, the State of Texas could still conduct monitoring/surveillance and local depopulation activities even without APHIS-WS assistance, but such activities would probably be at a lesser scale. Therefore, as supported by the analysis in section 4.1.2.4, effects on coyote populations would be insignificant.

4.2.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species.

4.2.3.1 Effects of the V-RG vaccine on nontarget wildlife including threatened or endangered species.

Under the no action alternative, there would be no potential for APHIS-WS assistance to result in adverse impacts on nontarget wildlife because of ORV programs. However, states would still be free to conduct ORV programs using the V-RG vaccine. Such programs would probably be on a reduced scale without APHIS-WS funds. However, based on the analysis in section 4.1.3, there is almost no potential for adverse effects on nontarget wildlife because of ORV bait consumption under any scenario involving the distribution of baits containing the V-RG vaccine.

4.2.3.2 Effects of capture/removal methods (used in monitoring and surveillance or to reduce local populations of target species under state contingency plans) on nontarget species, including threatened or endangered species.

Under the no action alternative, the potential for APHIS-WS assistance to result in adverse impacts on nontarget wildlife would be zero. However, states could still conduct ORV programs and monitoring that include the capture and/or killing of wild animals for monitoring purposes or localized depopulation under contingency plans. The potential effect on nontarget wildlife and T&E species from methods used in monitoring and surveillance programs would be less than the proposed action, but, similar to the proposed action, would be insignificant.

4.2.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits.

Under the no action alternative, the potential for APHIS-WS assistance to result in adverse impacts on domestic pets or other domestic animals would be zero. However, states could still conduct ORV programs, but such programs would probably be on a reduced scale without APHIS-WS funds. Based on the analysis in section 4.1.4, there is almost no potential for adverse effects on domestic animals because of ORV bait consumption under any scenario involving the distribution of baits containing the V-RG vaccine. On the other hand, failure to stop or prevent the spread of rabies would result in adverse effects on domestic animals by increasing their likelihood of exposure to rabid wild animals.

4.2.5 Potential for aerially dropped baits to strike and injure people or domestic animals.

Under the no action alternative, there would be no potential for APHIS-WS involvement to result in or increase this risk. States could still implement ORV programs, but such programs would probably be on a lesser scale without APHIS-WS funds. As discussed in section 4.1.7, the risk of persons or animals being struck by ORV baits is extremely remote.

4.2.6 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals.

Under the no action alternative, ORV baits with the V-RG vaccine would probably still be used by the

states even without APHIS-WS funds, although such use would likely be on a reduced scale. As shown by the analysis in section 4.1.5, the potential for serious environmental effects with regard to this issue is very low.

4.2.7 Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals.

Under the no action alternative, ORV baits with the V-RG vaccine would probably still be used by the states even without APHIS-WS funds, although such use would likely be on a reduced scale. As shown by the analysis in section 4.1.6, the potential for serious environmental effects with regard to this issue is very low.

4.2.8 Cost of the program in comparison to perceived benefits.

Under the no action alternative, the states or others would be left to conduct ORV programs in the absence of APHIS-WS participation. Without APHIS-WS funds and assistance, such programs would probably be conducted on a reduced scale and may be less successful in stopping the forward advance of the three rabies variants across much of the U.S. Overall program costs would decline, but benefits, in terms of avoided costs (described in section 4.1.8), would also decline with the most likely result being greatly increased state and private costs to monitor and vaccinate for rabies across large areas of the U.S. It is believed that, based on the analysis in section 4.1.8, the increased state and private costs resulting from failure to stop the spread of the rabies variants would exceed by a substantial margin the savings in program costs that would occur by implementing the no action alternative. Thus, the benefit:cost ratio of this alternative would be expected to be much less (i.e., less desirable) than that of the proposed action.

4.2.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans.

Under the no action alternative, APHIS-WS would not assist in collecting wild animal specimens for ORV monitoring programs or for local population suppression efforts under contingency plans to address local rabies outbreaks beyond ORV barriers. States would still most likely conduct such programs on their own, although to a lesser degree without APHIS-WS funds and personnel. The primary method that would be used by APHIS-WS to capture raccoons (cage traps) would also most likely be the primary method used by state programs, although possibly to a lesser degree. It is probable that the methods that would be used by APHIS-WS to capture or kill gray fox and coyotes in Texas for rabies monitoring would also be used to a lesser degree without APHIS-WS funds and personnel. Thus, some persons would view this as being a more humane alternative because of the lower intensity of use of the methods used.

Failure of a successful ORV program would likely result in an increased, but varying, proportion of the raccoon, gray fox, coyote, and other wild mammal species populations succumbing to rabies when exposed to the various specific strains. The symptoms of rabies include insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation, difficulty swallowing, and hydrophobia (fear of water) (CDC 2001a). Some persons might argue that dying from rabies, which can take several days once symptoms appear, results in more animal suffering than being captured or killed by monitoring and surveillance activities. In any event, it is almost certain that much larger numbers of animals would succumb to rabies without effective ORV programs than would experience stress and suffering from being captured or killed by monitoring activities. The numbers dying of rabies could become huge as epizootics of specific strains spread across larger areas of the U.S. With this in mind, it would appear that, on balance, the implementation of successful ORV programs that include animal collections for monitoring results in less animal suffering than taking no action.

4.3 Alternative 3 -- Live-capture-vaccinate-release programs.

4.3.1 Potential for adverse effects on people that become exposed to the vaccine or the baits.

Under this alternative, APHIS-WS would not provide funds to purchase or distribute ORV baits but would provide such funds for live-capture-vaccinate-release programs. For purposes of comparison, it is assumed that, with adequate APHIS-WS funding to conduct these types of programs, states would choose not to implement ORV programs.

4.3.1.1 Potential to cause rabies in humans.

Live-capture-vaccinate-release programs might be as effective as ORV programs in stopping the spread of the three variants of rabies if conducted throughout all areas where ORV programs would have been conducted under the proposed action. The method itself would not present risk of causing rabies in members of the public. The risk of having an increase in human rabies cases because of the failure to stop epizootics of raccoon, gray fox, and coyote rabies would be about the same as with ORV programs under the proposed action.

4.3.1.2 Potential for vaccinia virus to cause disease in humans..

Because it is assumed that ORV using the vaccinia virus vector in V-RG would not be used by states or by APHIS-WS, there should be no risk of vaccinia virus infections in humans caused by contact with the vaccine from ORV baits.

4.3.1.3 Potential to cause cancer (oncogenicity).

No increased risk of cancer would result from this alternative.

4.3.2 Potential for adverse effects on target wildlife species populations.

Under this alternative, APHIS-WS would not provide funds for ORV purchase and distribution but would assist in monitoring and surveillance programs involving the capture or lethal collection and testing of wild raccoons, gray foxes, and coyotes following live-capture-vaccinate and release activities.

4.3.2.1 Effects of the ORV V-RG vaccine on raccoons, gray foxes, and coyotes.

Under a live-capture-vaccinate-release alternative, it is expected that little or no ORV use by the states would occur. Thus, there would be little or no potential for the V-RG oral vaccine to affect these species.

4.3.2.2 Effects of monitoring/surveillance or localized population reduction (contingency actions) on raccoon populations in eastern states.

Under a live-capture-vaccinate-release alternative, it is expected that extent of lethal removal of raccoons for monitoring/surveillance activities or localized population reduction under contingency plans to address rabies outbreaks would be similar to the proposed action. Thus, the impact on populations of raccoons would be similar to the proposed action and would be very low.

4.3.2.3 Effects of monitoring/surveillance or localized population reduction (contingency actions) on gray fox populations in Texas.

Under a live-capture-vaccinate-release alternative, it is expected that extent of lethal removal of gray fox in Texas for monitoring/surveillance activities or localized population reduction under contingency plans to address rabies outbreaks would be similar to the proposed action. Thus, the impact on populations of gray fox in Texas would be similar to the proposed action and would be low.

4.3.2.4 Effects of monitoring/surveillance or localized population reduction (contingency actions) on coyote populations in Texas.

Under a live-capture-vaccinate-release alternative, it is expected that extent of lethal removal of coyotes in south Texas for monitoring/surveillance activities or localized population reduction under contingency plans to address rabies outbreaks would be similar to the proposed action. Thus, the impact on populations of coyotes in south Texas would be similar to the proposed action and would be low.

4.3.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species.

4.3.3.1 Effects of the V-RG vaccine on nontarget wildlife including threatened or endangered species.

Under a live-capture-vaccinate-release alternative, it is expected that little or no ORV use by the states would occur. Thus, there would be no potential for the V-RG oral vaccine to affect nontarget species. Live-capture-vaccinate-release programs would be virtually 100% selective for target species and would therefore have little or no potential to affect nontarget wildlife.

4.3.3.2 Effects of capture/removal methods (used in monitoring and surveillance or to reduce local populations of target species under state contingency plans) on nontarget species, including threatened or endangered species.

Under this alternative, APHIS-WS would continue to assist in monitoring activities and, potentially, in localized contingency plan removals that involve the use of lethal methods such as those discussed under the proposed action. The potential for effects on nontarget species would be similar to the proposed action. The analysis in section 4.1.3.2 shows effects on nontarget and T&E species would not be significant.

4.3.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits.

Live-capture-vaccinate-release programs would pose no risk of inadvertent vaccine exposure to pets or other domestic animals.

4.3.5 Potential for aerially dropped baits to strike and injure people or domestic animals.

Under this alternative it is assumed there would be few or no ORV baits dropped from aircraft. Thus, there would be no potential for such baits to strike people or animals.

4.3.6 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals.

Under this alternative, it is assumed that the states would not use ORV baits with the V-RG vaccine. Thus, there would be no potential for the V-RG virus to revert to a more virulent strain.

4.3.7 Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals.

Under this alternative, it is assumed that the states would not use ORV baits with the V-RG vaccine. Thus, there would be no potential for the V-RG virus to recombine with other viruses in the wild.

4.3.8 Cost of the program in comparison to perceived benefits.

4.3.8.1 Raccoon rabies ORV programs.

A live-capture-vaccinate-release program to control rabies in skunks and raccoons was implemented in Toronto in 1992 and cost an estimated $450 to $1,150/sq km ($1,165 to $2,979/sq mile) in Canadian dollars (Rosatte et al. 1992). A more recent cost estimate of $500 Canadian/sq km for a trap-vaccinate-release program in Ontario was presented by Rosatte et al. (2001). This analysis assumes the latest cost estimate in Rosatte et al. (2001) is the most applicable for comparing this alternative with ORV programs. At the current exchange rate of 0.655 U.S. dollars per Canadian dollar (OANDA 2001), the cost would be about $330/sq km ($855/sq mi) in U.S. dollars. In contrast, Kemere et al. (2001) estimated the cost of establishing an ORV barrier of 102,650 sq km (39,623 sq mi) from Lake Erie to the Gulf coast as totaling about $121/sq km ($313/sq mi) (costs included $1.30/bait, 75 baits/sq km, $8.62/sq km for aerial distribution cost, and $15/sq km for program evaluation). This is comparable to the reported cost of ORV in Ontario of $200 Canadian/sq km ($130 US/sq km) (Rosatte et al. 2001). Therefore, it appears a live-capture-vaccinate-release alternative to manage raccoon rabies could cost about 2.5 times as much as the proposed action. Although a greater known proportion of targeted raccoon populations may be vaccinated by this approach (Rosatte, et al. 2001), it is probably not necessary to achieve such greater vaccination rates because ORV programs have been successful in stopping or eliminating raccoon rabies outbreaks (see section 1.1.5). Based on the analysis in section 4.1.8, it appears benefits may not exceed costs under this alternative.

4.3.8.2 Gray fox and coyote rabies ORV programs in Texas.

Live-capture-vaccinate-release programs have not been attempted for these species. It is believed it would be highly difficult to achieve with these species, particularly with coyotes. Although coyotes can be captured with certain devices such as leghold traps and snares, they are generally too wary to capture in cage traps (Baker and Timm 1998) and it is difficult to live capture and release a high enough proportion of fox or coyote populations with other traps such as leghold traps and snares (Rosatte et al. 1993; C. MacInnes, Ontario Ministry of Natural Resources pers. comm. 2001; personal observation of APHIS-WS personnel). The aerial ORV programs in Texas cost about $64 /sq km ($166/sq mile), including the cost of aircraft, crew, ORV baits, ground crews, surveillance, and laboratory testing (derived from information from E. Oertli, TX Dept. of Health, pers. comm. 2001[4]). Based on the estimated costs of live-capture-vaccinate-release actions shown in section 4.3.8.1, it is expected that this type of program would be much more expensive and time consuming to implement than ORV programs and would result in costs that exceed benefits.

4.3.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans.

Some persons would view live-capture-vaccinate-release programs as less humane than ORV programs, because large numbers of animals would experience the stress of being caught and handled to administer the vaccine. Others would view them as relatively humane compared to other types of rabies control efforts that involve lethal means to suppress target populations over broad geographic areas. Because it is believed this alternative could be as successful in stopping or preventing the spread of rabies as the proposed action, the amount of animal suffering due to contracting and dying from rabies would probably be similar to the proposed action.

4.4 Alternative 4 -- Provide funds to purchase and distribute ORV baits without animal specimen

[4]Reported cost of $152.83 per sq mile for the 2001 TX ORV program bait drop from E. Oertli (pers. comm. 2001), which included cost of baits, aircraft use, pilot and 3 crew members, fuel, surveillance, laboratory titer costs, and laboratory biomarker analysis, but not salary/benefits of other involved personnel. Additional personnel totaled 64 over two 13-day bait drop periods (one each for gray fox and coyote ORV areas), for a total of 1,664 person-days. At an assumed daily cost of $150 per person-day for salaries/benefits, and total treated area of 7,700 sq km (20,000 sq mi), the cost per unit area for additional personnel is estimated to be $4.90/sq km ($12.80/sq mi). Total estimated cost per unit area was therefore about $64/sq mi ($166/sq mi).

collections or lethal removal of animals under contingency plans.

Under this alternative, the states would have to fund collection of target species for monitoring and surveillance without APHIS-WS funds or personnel assistance. This would likely mean that less monitoring would be conducted. If insufficient monitoring and surveillance occurs along the leading edge of the advancing rabies strains, rabies managers would not be able to plan the most efficient and effective use of ORV baiting strategies to control the specific strains spread by wild carnivores. One possibility is that, without adequate surveillance, managers would have to resort to distributing ORV baits across more areas than necessary. The ability to stop or prevent the forward advance of specific rabies strains would likely be reduced, perhaps to the point that cooperative efforts fail.

4.4.1 Potential for adverse effects on people that become exposed to the vaccine or the baits.

4.4.1.1 Potential to cause rabies in humans.

This alternative would present the same risk as the proposed action. Since the V-RG vaccine cannot cause rabies, there would be no potential for the ORV baits to cause rabies in humans under this or any other alternative or scenario involving the distribution of V-RG oral vaccine baits. However, there would be a greater risk of human rabies cases if the lack of federal assistance in monitoring and surveillance results in a reduction in the effectiveness of ORV programs.

4.4.1.2 Potential for vaccinia virus to cause disease in humans..

This alternative would present the same risk as the proposed action. As shown by the analysis in section 4.1.1.2, the risk of V-RG vaccine in ORV baits causing any health problems in humans is exceedingly low.

4.4.1.3 Potential to cause cancer (oncogenicity).

This alternative would result in no probable risk of causing cancer in humans or animals, similar to the proposed action and other alternatives.

4.4.2 Potential for adverse effects on target wildlife species populations.

4.4.2.1 Effects of the ORV V-RG vaccine on raccoons, gray foxes, and coyotes.

This alternative would result in the same risk as the proposed action, which is that adverse effects are highly unlikely. Positive effects on these species from protecting them against rabies would be similar to the proposed action. However, more animals are likely to die of rabies if the lack of federal assistance in monitoring and surveillance results in a reduction in the effectiveness of ORV programs.

4.4.2.2 Effects of monitoring/surveillance or localized population reduction (contingency actions) on raccoon populations in eastern states.

Under this alternative, APHIS-WS would not provide assistance in collecting animal specimens for monitoring purposes. The involved states could still conduct such collections; however, it is likely that fewer animals would be collected without APHIS-WS funds and assistance for that activity. Effects on raccoon populations would be exceedingly minor as supported by the analysis in section 4.1.2.2.

4.4.2.3 Effects of monitoring/surveillance or localized population reduction (contingency actions) on gray fox populations in Texas.

Under this alternative, APHIS-WS would not provide assistance in collecting gray fox specimens for monitoring purposes in Texas. State agencies in Texas could still conduct such collections; however, it is likely that fewer animals would be collected without APHIS-WS funds and assistance for that activity. Effects on gray fox populations would be exceedingly minor as supported by the analysis in section 4.1.2.2.

4.4.2.4 Effects of monitoring/surveillance or localized population reduction (contingency actions) on coyote populations in Texas.

Under this alternative, APHIS-WS would not provide assistance in collecting coyote specimens for monitoring purposes in Texas. State agencies in Texas could still conduct such collections; however, it is likely that fewer animals would be collected without APHIS-WS funds and assistance for that activity. Effects on coyote populations would be exceedingly minor as supported by the analysis in section 4.1.2.2.

4.4.3 Potential for adverse effects on nontarget wildlife species, including threatened or endangered species.

4.4.3.1 Effects of the Raboral V-RG® vaccine on nontarget wildlife including threatened or endangered species.

Effects of the V-RG vaccine on nontarget wildlife would be the same as under the proposed action. The analysis in section 4.1.3.1 showed that adverse effects are unlikely. However, more animals are likely to die of rabies if the lack of federal assistance in monitoring and surveillance results in a reduction in the effectiveness of ORV programs.

4.4.3.2 Effects of capture/removal methods (used in monitoring and surveillance or to reduce local populations of target species under state contingency plans) on nontarget species, including threatened or endangered species.

Under this alternative, APHIS-WS would not continue to assist in monitoring activities or local depopulation activities that involve the use of lethal methods such as those discussed under the proposed action. Therefore, the potential for adverse effects on nontarget species would be even lower than under the proposed action. States would still likely implement monitoring and localized population reduction actions even without APHIS-WS, but such activities would likely be on a lesser scale without APHIS-WS funds. However, the analysis in section 4.1.3.2 indicates effects on nontarget and T&E species would not be significant under the proposed action and would likely also not be significant even without APHIS-WS assistance.

4.4.4 Potential for adverse effects on pet dogs or other domestic animals that might consume the baits.

Under this alternative, the potential for adverse effects on domestic animals from ORV baits would be the same as the proposed action. Based on the analysis in section 4.1.4, there is almost no potential for significant adverse effects on domestic animals because of ORV bait consumption under any scenario involving the distribution of ORV baits containing the V-RG vaccine. Stopping or preventing the spread of rabies would result in beneficial effects on domestic animals by reducing their likelihood of contracting rabies. However, more domestic animals are likely to die of rabies if the lack of federal assistance in monitoring and surveillance results in a reduction in the effectiveness of ORV programs.

4.4.5 Potential for aerially dropped baits to strike and injure people or domestic animals.

This potential would be the same as under the proposed action. The risk of striking and injuring people or domestic animals with baits is highly remote.

4.4.6 Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals.

This potential would be the same as under the proposed action. The risk of adverse effects from the V-RG virus possibly reverting to a more virulent strain would be highly remote.

4.4.7 Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals.

This potential would be the same as under the proposed action. The risk of adverse effects from the V-RG virus possibly recombining with other viruses in the wild and resulting in significant adverse effects on human or animal health would be highly remote.

4.4.8 Cost of the program in comparison to perceived benefits.

4.4.8.1 Raccoon rabies ORV programs.

Costs of the federal portion of state-run ORV programs would be less since no APHIS-WS funds would be spent on animal collections to be used in monitoring. Benefits would probably be similar to the proposed action. Total costs, including the expenditure of federal and state funds, might be similar if states increased activities for monitoring because of the lack of APHIS-WS funds for this type of activity. Benefits would still probably exceed costs unless reduced monitoring/surveillance results in a reduction in the effectiveness of ORV programs.

4.4.8.2 Gray fox and coyote rabies ORV programs in Texas.

Costs of the federal portion of state-run ORV programs would be less since no APHIS-WS funds would be spent on animal collections to be used in monitoring. Benefits would probably be similar to the proposed action. Total costs, including the expenditure of federal and state funds, might be similar if states increased activities for monitoring because of the lack of APHIS-WS funds for this type of activity. Benefits would still probably exceed costs unless reduced monitoring/surveillance results in a reduction in the effectiveness of ORV programs.

4.4.9 Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans.

Under this alternative, no APHIS-WS funds would be used to collect animal specimens or to conduct localized population reduction of target species using live-capture or lethal methods. States could still conduct these activities, but such efforts would probably be at a lesser scale without APHIS-WS assistance. This alternative would be viewed by some persons as more humane than the proposed action. Animal suffering due to rabies would probably be similar to the proposed action (i.e., greatly reduced). However, more animals are likely to suffer and die of rabies if reduced monitoring/surveillance results in a reduction in the effectiveness of ORV programs (see section 4.2.9 for more detailed discussion).

4.5 CUMULATIVE IMPACTS

No significant cumulative environmental impacts are expected from any alternative, with the possible exception of Alternative 2 - No Action, which might lead to increased human exposures and domestic and wild animal rabies cases across much of the U.S. Although some persons will likely remain opposed to the use of genetically engineered vaccines or the use of the vaccinia pox virus as a component of the ORV, and some will remain opposed to the lethal removal of raccoons, gray fox, or coyotes for monitoring purposes or for implementation of contingency rabies management plans, the analysis in this EA indicates that ORV use and such lethal removals will not result in significant risk of cumulative adverse impacts on the quality of the human environment.

4.6 SUMMARY OF IMPACTS OF ALTERNATIVES FOR EACH ISSUE

Table 4-1 presents a comparison of the alternatives and environmental consequences (impacts) on each of the issues identified for detailed analysis:

Table 4-1. Issues/Impacts/Alternatives/Comparison

Issues/Impacts	Alt. 1 — Proposed Action (provide APHIS-WS funds for ORV and monitoring/ surveillance, potential localized target species population reduction)	Alt. 2 — No Action (no APHIS-WS funds for rabies control provided)	Alt. 3 — Live Capture/Vaccinate and Release	Alt. 4 — Provide funds for ORV without lethal animal collections or removals
Potential for adverse effects on people that become exposed to the vaccine or the baits.				
• Potential to cause rabies in humans.	No probable risk.	No probable risk from ORV use by states. Higher risk of human rabies cases if states are unable to stop the spread of rabies without federal assistance.	No probable risk.	No probable risk from ORV use; higher risk of human rabies cases if reduced monitoring and surveillance reduces effectiveness of ORV programs.
• Potential for vaccinia virus to cause disease in humans	Possible but risk is low; risk of significant adverse effects on individuals that experience vaccinia infections also is low.	Slightly lower risk than Alt. 1; states would likely still conduct ORV programs, but probably on a lesser scale without federal assistance.	No risk.	Possible but risk is low; risk of significant adverse effects on individuals that experience vaccinia infections also is low (same as Alt. 1).
• Potential to cause cancer (oncogenicity).	No probable risk.	No probable risk.	No probable risk.	No probable risk.
Potential for adverse effects on target wildlife species populations.				
• Effects of the ORV V-RG vaccine on raccoons, gray foxes, and coyotes	No probable risk of adverse impacts.	No probable risk; states would likely still conduct ORV programs, but probably on a lesser scale without federal assistance.	No risk from V-RG vaccine.	No probable risk of adverse impact (same as Alt 1).
• Effects of monitoring and surveillance and localized population reduction actions on raccoon populations in eastern states.	Very low impact.	Slightly lower impact than Alt. 1; states would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.	Very low impact (similar to Alt. 1).	Slightly lower impact than Alt. 1; states would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.
• Effects of monitoring and surveillance and localized population reduction actions on gray fox populations in Texas.	Low impact.	Slightly lower impact than Alt. 1; the state would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.	Low impact (similar to Alt. 1).	Lower impact than Alt. 1; the state would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.

Issues/Impacts	Alt. 1 — Proposed Action (provide APHIS-WS funds for ORV and monitoring/ surveillance, potential localized target species population reduction)	Alt. 2 — No Action (no APHIS-WS funds for rabies control provided)	Alt. 3 — Live Capture/Vaccinate and Release	Alt. 4 — Provide funds for ORV without lethal animal collections or removals
• Effects of monitoring and surveillance and localized population reduction actions on coyote populations in Texas.	Low impact.	Slightly lower impact than Alt. 1; the state would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.	Low impact (similar to Alt. 1).	Lower impact than Alt. 1; the state would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.
Potential for adverse effects on nontarget wildlife species, including threatened or endangered species.				
• Effects of the Raboral V-RG® vaccine on nontarget wildlife including threatened or endangered species.	No effect on T&E species; No probable risk of adverse effects on other nontarget species.	No probable risk of adverse effects from ORV vaccine; but greater risk of adverse effects on these species from rabies.	No effect on T&E species; no risk of adverse effect on other species from ORV vaccine.	No effect on T&E species; No probable risk of adverse effects on other nontarget species (Same as Alt. 1); but greater risk of adverse effects on these species from rabies if reduced monitoring and surveillance reduces effectiveness of ORV programs.
• Effects of capture/removal methods (used in monitoring, surveillance, and localized population reduction) on nontarget species, including threatened or endangered species.	No effect on T&E species; Very low risk of adverse effects on other nontarget species.	Probably slightly less impact than Alt. 1.	Less impact than Alt. 1.	Less impact than Alt. 1; states would still conduct monitoring and surveillance and contingency actions, but these are likely to be on a lesser scale without federal assistance.
Potential for adverse effects on pet dogs or other domestic animals that might consume the baits.	Low risk; Possible benefit from improving immunity to rabies.	Low risk; states would likely still conduct ORV programs. Increased risk of rabies for unvaccinated animals without federal assistance.	No risk of adverse effects from consuming ORV baits.	Low risk (similar risk as Alt. 1); increased risk of rabies for unvaccinated animals if reduced monitoring and surveillance reduces effectiveness of ORV programs.
Potential for the recombined V-RG virus to "revert to virulence" and result in a virus that could cause disease in humans or animals.	Very low risk.	Less risk than Alt. 1; states would likely still conduct ORV programs.	No risk.	Low risk (similar risk as Alt. 1).

Issues/Impacts	Alt. 1 — Proposed Action (provide APHIS-WS funds for ORV and monitoring/ surveillance, potential localized target species population reduction)	Alt. 2 — No Action (no APHIS-WS funds for rabies control provided)	Alt. 3 — Live Capture/Vaccinate and Release	Alt. 4 — Provide funds for ORV without lethal animal collections or removals
Potential for the V-RG virus to recombine with other viruses in the wild to form new viruses that could cause disease in humans or animals.	Very low risk.	Less risk than Alt. 1; states would likely still conduct ORV programs.	No risk.	Low risk (similar risk as Alt. 1).
Potential for aerially dropped baits to strike and injure people or domestic animals.	Low risk.	Less risk than Alt. 1; states would likely still conduct ORV programs.	No risk.	Low risk (similar risk as Alt. 1).
Cost of the program in comparison to perceived benefits.	Expected benefits exceed costs of program.	Cost of adverse effects from rabies spread would be much greater than cost savings from not having federal assistance.	Expected benefits unlikely to exceed costs of program.	Expected benefits exceed costs of program (similar to Alt. 1); benefits may not exceed costs if reduced monitoring and surveillance reduces effectiveness of ORV programs.
Humaneness of methods used to collect wild animal specimens critical for timely program evaluation or to reduce local populations of target species under state contingency plans	Capture and handling of raccoons would be viewed by some persons as inhumane. Methods viewed as inhumane by some persons would be used to take gray fox and coyotes in Texas, but many animals saved from suffering and death due to rabies.	Probably less impact on this issue than Alt. 1; states likely to still conduct ORV programs with monitoring and surveillance and contingency plan implementation, but at a smaller scale without federal assistance; more animals likely to die of rabies if lack of federal assistance reduces effectiveness of ORV programs.	Capture and handling of target species would be viewed by some persons as inhumane. Fewer gray fox and coyotes would be taken in Texas using lethal methods, however, so this alternative would be viewed as more humane than Alt. 1.	This Alt. would be viewed as more humane than Alt. 1; states likely to still conduct monitoring and surveillance and contingency plan implementation, but at a smaller scale without federal assistance; more animals likely to die of rabies if reduced monitoring and surveillance reduces effectiveness of ORV programs.

APPENDIX A
LIST OF PREPARERS, REVIEWERS AND PERSONS/AGENCIES CONSULTED

LIST OF PREPARERS/REVIEWERS:

Gary A. Littauer, Wildlife Biologist -- Environmental Coordinator, USDA, APHIS-WS, Albuquerque, NM – *preparer/editor*

Dennis Slate, Wildlife Biologist – State Director - New Hampshire/Vermont and National Rabies Program Coordinator, USDA, APHIS-WS, Concord, NH – *preparer/editor*

Dr. Charles Rupprecht, Chief, Rabies Section, CDC, Atlanta, GA – *reviewer*

Dr. Laura L. Bigler, Zoonotic Disease Section, College of Veterinary Medicine, Cornell University, Ithaca, New York – *reviewer*

Dr. Ernest Oertli, Director, Oral Rabies Vaccination Program, Texas Department of Health, Zoonosis Control Division, Austin, Texas – *reviewer*

Dr. Kathleen A. Smith, State Public Health Veterinarian, Ohio Department of Health, Columbus, Ohio – *reviewer*

Dr. Roger Krogwold, Assistant State Public Health Veterinarian, Ohio Department of Health, Columbus, Ohio – *reviewer*

Dr. Charles D. MacInnes, Coordinator - Rabies Research, Ontario Ministry of Natural Resources, Wildlife and Natural Heritage Science Section, Peterborough, Ontario – *reviewer*

Gary L. Nunley, Wildlife Biologist -- State Director - Texas, USDA, APHIS-WS, San Antonio, Texas – *reviewer*

LIST OF PERSONS/AGENCIES CONSULTED:

In addition to the reviewers listed above, the following Federal and State agencies and persons were consulted on various aspects of the information and analysis in this EA:

Dr. Donna Gatewood, Chief Staff Veterinarian, Mammalian Virology and Antibody Products, USDA, APHIS - Veterinary Services, Center for Veterinary Biologics, Ames, Iowa

Dr. John Mitzel, USDA, APHIS - Veterinary Services, Center for Veterinary Biologics, Ames, Iowa

Dr. Eleanor Eagly, Senior Staff Veterinarian, USDA, APHIS - Veterinary Services, Center for Veterinary Biologics, Ames, Iowa

Dr. Carolin Schumacher, Merial, Inc., Athens, GA

Guy Moore, Wildlife Biologist, Deputy Director, Oral Rabies Vaccination Program, Texas Department of Health, Zoonosis Control Division, Austin, Texas

Robert L. Hale, Rabies Program Coordinator, Ohio Department of Health, Columbus, Ohio

Dr. Malcolm Smith, Senior Vice President, Bait-Tek, The Woodlands, Texas

Michael Liddel, Policy Analyst, USDA, APHIS, PPD, Riverdale, Maryland

Samuel B. Linhart, Research Coordinator (retired), Southeastern Cooperative Wildlife Disease Study, University of Georgia, Athens, Georgia

Dr. Dale L. Nolte, Research Wildlife Biologist, USDA, APHIS-WS National Wildlife Research Center, Olympia Field Station, Olympia, Washington

Andrew Montoney, Wildlife Biologist -- State Director - Ohio, USDA, APHIS-WS, Columbus, Ohio

Richard Chipman, Wildlife Biologist -- State Director - New York, USDA, APHIS-WS, Castleton, New York

Judy Loven, Wildlife Biologist – State Director - Indiana, USDA, APHIS-WS, West Lafayette, Indiana

William Bonwell, Wildlife Biologist – State Director - West Virginia, USDA, APHIS-WS, Elkins, West Virginia

Janet Bucknall, Wildlife Biologist – State Director - New Jersey/Pennsylvania, USDA, APHIS-WS, Pittstown, New Jersey

Frank Boyd, Wildlife Biologist – State Director - Alabama, USDA, APHIS-WS, Auburn, Alabama

Jennifer Cromwell, Wildlife Specialist – USDA, APHIS-WS, Mosely, Virginia

Ronald Healey, Wildlife Biologist – USDA, APHIS-WS, Annapolis, Maryland

Laura Henze, Wildlife Biologist – State Director - Massachusetts/Rhode Island/Connecticut - USDA, APHIS-WS, Amherst, Massachusetts

Kathleen Nelson, Wildlife Specialist – USDA, APHIS-WS, Berlin, Vermont

Gary Nohrenberg, Wildlife Biologist – USDA, APHIS-WS, Youngstown, Ohio

Randy Smith, Staff Specialist – USDA, APHIS-WS, San Antonio, Texas

APPENDIX B
LITERATURE CITED

Andersen, D.E., O.J. Rongstad, and W.R. Mytton. 1989. Response of nesting red-tailed hawks to helicopter overflights. Condor 91:296-299.

Artois, M., F. Cliquet, J. Barrat, and C.L. Schumacher. 1997. Effectiveness of SAG1 oral vaccine for the long-term protection of red foxes (*Vulpes vulpes*) against rabies. Vet. Rec. 140:57-59.

Artois, M., E. Masson, J. Barrat, and M.F.A. Aubert. 1993. Efficacy of three oral rabies vaccine-baits in the red fox:: a comparison. Vet. Microb. 38:167-172.

Artois M., K.M. Charlton, N.D. Tolson , G.A. Casey, M.K. Knowles, and J.B. Campbell. 1990. Vaccinia recombinant virus expressing the rabies virus glycoprotein: safety and efficacy trials in Canadian wildlife. Can J Vet Res. 54(4):504-7.

Baer G.M. 1988. Oral rabies vaccination: an overview. Rev. Infect. Dis. 10:S644-8.

Bailey, R.G. 1995. Description of the ecoregions of the United States. (1st ed. 1980). Misc. Publ. No. 1391 (rev.) Washington, DC: USDA Forest Service. 108 pp.

Baker, R.O., and R.M. Timm. 1998. Management of conflicts between urban coyotes and humans in southern California. Proc. Vertebr. Pest Conf. 18:299-312.

Balser, D.S. 1964. Management of predator populations with antifertility agents. J. Wildl. Manage. 28(2):352-358.

Belanger, L. and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. J. Wildl. Manage. 54:36-41.

Belanger, L. and J. Bedard. 1989. Responses of staging greater snow geese to human disturbance. J. Wildl. Manage. 53:713-719.

Bradley, M.P. 1995. Immunocontraceptive vaccines for control of fertility in the European Red Fox. T.J. Kreeger, tech. coord. Contraception in Wildlife Management. USDA Technical Bulletin No. 1853, U.S. Department of Agriculture, Washington, D.C. pp 195-203.

Brown, C.L. and C.E. Rupprecht. 1990. Vaccination of free-ranging Pennsylvania raccoons (*Procyon lotor*) with inactivated rabies vaccine. J. Wildl. Dis.; 26(2):253-257. 1990.

CDC (Centers for Disease Control and Prevention). 2001a. Rabies prevention and control. Information obtained at web site: 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 web site: http://www.cdc.gov/ncidod/dvrd/rabies/Professional/MMWRtext/mmwr4811.htm

CDC (Centers for Disease Control and Prevention). 2000. Compendium of animal rabies prevention and control, 2000 - National Association of State Public Health Veterinarians, Inc. CDC - Morbidity and Mortality Weekly Report Vol. 49, No. RR-8. p. 21-30. (Information obtained from web site: http://www.cdc.gov/ncidod/dvrd/rabies/)

Clark, K.A. and P.J. Wilson. 1995. Canine and gray fox rabies epizootics in Texas. Great Plains Wildl. Damage

Workshop 12:83-87.

Clark, K.A., S.U. Neill, J.S. Smith, P.J. Wilson, V.W. Whadford, and G.W. McKirahan. 1994. Epizootic canine rabies transmitted by coyotes in south Texas. J. Amer. Vet. Med. Assoc. 204:536-540.

Clark, W.R. and E.K. Fritzell. 1992. A review of population dynamics of furbearers. In: McCullough, D.R., R.H. Barrett, Eds. Wildlife 2001: populations. London, England: Elsevier: 899-910.

Connolly, G. E., and W. M. Longhurst. 1975. The effects of control on coyote populations. Div. of Agric. Sci., Univ. of California Davis. Bull. 1872. 37pp.

Damaso, C.R., J.J. Esposito, R.C. Condit, and N. Moussatche. 2000. An emergent poxvirus from humans and cattle in Rio de Janeiro State: Cantagalo virus may derive from Brazilian smallpox vaccine. Virology 277(2):439-49.

Debbie, J.G. 1991. Rabies control of terrestrial wildlife by population reduction. Pages 477-484 in, ed. G.M. Baer, The natural history of rabies. CRC Press, Boston, MA.

deVos, Jr., J.C. and J.L. Smith. 1995. Natural mortality in wildlife populations. Proactive Strategies Committee Report #1. Proactive Strategies Project of the International Association of Fish and Wildlife Agencies and Arizona Game and Fish Department.

Ellis, D.H. 1981. Responses of raptorial birds to low-level jet aircraft and sonic booms. Results of the 1980-81 joint U.S. Air Force-U.S. Fish and Wildl. Service Study. Institute for Raptor Studies, Oracle, AZ. 59 pp.

Elvinger, F. 2001. Oral rabies vaccine safety. Online fact sheet - Fairfax County, VA Oral Rabies Project, available at http://www.fairfax.va.us/SERVICE/HD/vaccsafe.htm

Farry, S.C., S.E. Henke, A.M. Anderson, and G.M. Fearneyhough. 1998a. Responses of captive and free-ranging coyotes to simulated oral rabies vaccine baits. J. Wildl. Dis.; 34(1): 13-22.

Farry, S.C., S.E. Henke, S.L. Beasom, and G.M. Fearneyhough. 1998b. Efficacy of bait distributional strategies to deliver canine rabies vaccines to coyotes in southern Texas. J. Wildl. Dis.; 34(1): 23-32.

Flamand, A., P. Coulon, F. Laray, and C. Tuffereau. 1993. Avirulent mutants of rabies virus and their use as live vaccine. Trends in Microbiology 1(8):317-320.

Fritzell, E.K. 1987. Gray Fox and Island Gray Fox. pp 408-420 *in* M. Novak, J.A. Baker, M.E. Obbard, B. Mallock. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150pp.

Gaede, T. 1992. Bat rabies in Denmark 1985-1990. In: Bogel, K., Meslin, F.X., Kaplan, M., eds. Wildlife rabies control. Royal Tunbridge Wells, Kent, UK: Wells medical: 76-78.

Glueck, T.F., W.R. Clark, and R.D. Andrews. 1988. Raccoon movement and habitat use during the furharvest season. Wildl. Soc. Bull. 16:6-11.

Guynn, D.C. 1997. Contraception in wildlife management: reality or illusion. T.J. Kreeger, tech. coord. Contraception in Wildlife Management. USDA Technical Bulletin No. 1853, U.S. Department of Agriculture, Washington, D.C. pp 241-246.

Hable, C.P., A N. Hamir, D. E. Snyder, R. Joyner, J. French, V. Nettles, C. Hanlon, and C. E. Rupprecht. 1992. Prerequisites for oral immunization of free-ranging raccoons (*Procyon lotor*) with a recombinant rabies virus vaccine: Study site ecology and bait system development. J. Wildl. Dis.; 28(1): 64-79.

Hadidian, J., S.R. Jenkins, D.H. Johnston, P.J. Savarie, V.F. Nettles, D. Manski, and G.M. Baer. 1989. Acceptance of simulated oral rabies vaccine baits by urban raccoons. J. Wildl. Dis. 25(1):1-9.

Hanlon, C.A., J.E. Childs, V.F. Nettles. 1999. Rabies in wildlife - Article III, Special Series - Recommendations of a national working group on prevention and control of rabies in the United States. J. Amer. Vet. Med. Assoc. 215(11):1612-1620.

Hanlon, C.A., M. Niezgoda, A.N. Hamir, C. Schumacher, H. Koprowski, and C.E. Rupprecht. 1998. First North American field release of a vaccinia-rabies glycoprotein recombinant virus. J Wildl Dis. 34:228-39.

Hanlon, C.A., M. Niezgoda, V. Shankar, H.S. Niu, H. Koprowski, and C.E. Rupprecht. 1997. A recombinant vaccinia-rabies virus in the immunocompromised host: Oral innocuity, progressive parenteral infection, and therapeutics. Vaccine. 1997 Feb;15(2):140-8.

Hanlon, C.A. and C.E. Rupprecht. 1997. Considerations for immunocontraception among free-ranging carnivores: The rabies paradigm. Contraception in Wildlife Management. USDA Technical Bulletin No. 1853, U.S. Department of Agriculture, Washington, D.C. pp 185-194.

Hanlon, C.L., D.E. Hayes, A.N. Hamir, D.E. Snyder, S. Jenkins, C.P. Hable,and C.E. Rupprecht. 1989a. Proposed field evaluation of a rabies recombinant vaccine for raccoons (*Procyon lotor*): Site selection, target species characteristics, and placebo baiting trials. J. Wildl. Dis. 25(4): 555-567.

Hanlon, C.A., E.L. Ziemer, A.N. Hamir, and C.E. Rupprecht. 1989b. Cerebrospinal fluid analysis of rabid and vaccinia-rabies glycoprotein recombinant, orally-immunized raccoons. Am. J. Vet. Res. 50:363-367.

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.

Herman, Y.F. 1964. Isolation and characterization of a naturally occurring poxvirus of raccoons. Bacteriol. Proc. 64th Ann. Mtg. Amer. Soc. Microbiol. p. 117.

Huntley, J., S. Oser, A. Kurst, and L. Karackoloff. (*unpublished*). 1996. The impact of the wildlife rabies epizootic on public health in new york state: A cost benefit analysis of primary vs. secondary intervention strategies. New York State Department of Agriculture and Markets, Division of Animal Industry, 1 Winners Circle, Albany, NY 12235.

Kemere, P., M.K. Liddel, P. Evangelou, D. Slate, and S. Osmek. 2001. Economic analysis of a large scale oral vaccination program to control raccoon rabies. Proc. Human conflicts with wildlife: economic considerations symposium. Fort Collins, CO.

Kennelly, J.J., and K.A. Converse. 1997. An underutilized procedure for evaluating the merits of induced sterility. T.J. Kreeger, tech. coord. Contraception in Wildlife Management. USDA Technical Bulletin No. 1853, U.S. Department of Agriculture, Washington, D.C. pp 21-28.

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.

Krebs, J.W., 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.

Kushlan, J.A. 1979. Effects of helicopter censuses on wading bird colonies. J. Wildl. Manage. 43:756-760.

Lawson, K.F., D.H. Johnston, J.M. Patterson, R. Hertler, J.B. Campbell, and A.J. Rhodes. 1989. Immunization of foxes by the intestinal route using an inactivated rabies vaccine. Can. J. Vet. Res. 53:56-61.

Lawson, K.F. , H. Chiu, S.J. Crosgrey, M. Matson, G.A. Casey, and J.B. Campbell. 1997. Duration of immunity in foxes vaccinated orally with ERA vaccine in a bait. Can. J. Vet. Res. 61:39-42.

Linhart, S.B., J.C. Wodlowski, D.M. Kavenaugh, L. Motes-Kreimeyer, A.J. Montoney, R.B. Chipman, D. Slate, L.L. Bigler, and M.G. Fearneyhough. *unpublished* 2001. A new flavor-coated sachet bait for delivering oral rabies vaccine to raccoons and coyotes. Manuscript submitted to J. Wildl. Dis. 02/28/01. 35 pp.

Linhart, S.B., J. Wlodkowski, V. Nettles, T. Harbin, L. Motes-Kreimeyer, and M. Mackowiak. 1997. A modified bait for delivering V-RG rabies vaccine to wildlife. Rabies Am. Conf.; No. 8: ("Rabies in the Americas Conference, November 2-6, 1997, Kingston, Ontario, Canada"; MacInnes, Charles D. [convener], editor). abstract only; proceedings available on Internet at http: //www.gis.queensu.ca/RReporter/mnr.html.

Linhart, S.B., F.S. Blom, R.M. Engeman, H.L. Hill, T. Hon, D.I. Hall, and J.H. Shaddock. 1994. A field evaluation of baits for delivering oral rabies vaccines to raccoons (*Procyon lotor*). J. Wildl. Dis. 30(2):185-194.

Linhart, S.B., F. S. Blom, G.J. Jasch, J.D. Roberts, R.M. Engeman, J.J. Esposito, J.H Shaddock, and G.M. Baer. 1991. Formulation and evaluation of baits for oral rabies vaccination of raccoons (*Procyon lotor*). J. Wildl. Dis. 27(1).21-33.

Linhart, S.B., H.H. Brusman, and D.S. Balser. 1968. Field evaluation of an antifertility agent, Stilbestrol, for inhibiting coyote reproduction. Transactions of the 33rd North American Wildlife Conference, Vol. 33:316-327.

MacInnes, C. D. 1998. Rabies, *in* M. Novak, J.A. Baker, M.E. Obbard, B. Mallock, eds, Wild Furbearer management and Conservation in North America. Ontario Trappers Association/Ontario Ministry of Natural Resources, Toronto, Ontario, Canada, pp. 910-929.

Mahnel, H. 1987. Experimental results on the stability of poxviruses under laboratory and environmental conditions (*in German*). J. Vet. Med. Ser. B 34 (6); 449-464.

McGuill, M.W., S.M Kreindel, A. DeMaria, Jr., A.H. Robbins., S. Rowell, C.A. Hanlon, C.E. Rupprecht. 1998. Human contact with bait containing vaccine for control of rabies in wildlife. J. Am. Vet. Med. Assoc.; 213(10):1413-1417.

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.

Miller, L.A. 1997. Delivery of immunocontraceptive vaccines for wildlife management. T.J. Kreeger, tech. coord. Contraception in Wildlife Management. USDA Technical Bulletin No. 1853, U.S. Department of Agriculture, Washington, D.C. pp 49-58.

Mills, C.L., E.E. Embree, and F. Elvinger. 1999. Plan for oral rabies vaccination (ORV) initiative for Fairfax County. Prepared for: Director of Health Services Fairfax County, Virginia - August 20, 1999.

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.

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.

Nolte, D.L., J.R. Mason, G. Eple, E. Aronov, and D.L. Campbell. 1994. Why are predator urines aversive to prey? J. Chem. Ecol. 20(7):1505-1516.

Nowak, R.M. 1975. Retreat of the jaguar. National Parks Conservation Magazine 49(12):10-13.

OANDA Corporation. 2001. The currency site: FX CheatSheet: Canadian Dollar(CAD) to US Dollar (USD), Interbank rate for Friday, February 16, 2001. Info. obtained from web site: http://www.oanda.com/converter/travel

Omlin, D. 1997. Tools for safety assessment – vaccinia-derived recombinant rabies vaccine. BATS (Biosicherhelsforschung und Abschatzung von Technikfolgen des Schwerpunktprogrammes Biotechnologie). Swiss National Science Foundation. Paper obtained at web site: http://www.bats.ch/abstr/

Pastoret, P.-P., B. Brochier, J. Blancou, M. Artois, M. Aubert, M.-P. Kieny, J.-P. Lecocq, B. Languet, G. Chappuis, and P. Desmettre. 1992. Development and deliberate release of a vaccinia rabies recombinant virus for the oral vaccination of foxes against rabies. In: Binns, M.M.; Smith, G. L., eds. Recombinant Poxviruses. Boca Raton: CRC Press; p. 163-206.

Pastoret, P.P., B. Brochier, and D. Boulanger. 1995. Target and non-target effects of a recombinant vaccinia-rabies virus developed for fox vaccination against rabies. Dev. Biol. Stand. Basel, Karger, vol. 84, pp 183-193.

Pybus, M.J. 1988. Rabies and rabies control in striped skunks (*Mephitis mephitis*) in three prairie regions of western North America. J. Wildl. Dis. 24:434-449.

Ricketts, T.H., E. Dinerstein, D.M. Olson, C.J. Loucks, W. Eichbaum, D. DellaSala, K. Kavanagh, P. Hedao. P.T. Hurley, K.M. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America: A conservation assessment. World Wildl. Fund - U.S. and Canada. Island Press. Washington, DC. 485 pp.

Robbins A.H., M.D. Borden, B.S. Windmiller, M. Niezgoda, L.C. Marcus, S.M. O'Brien, S.M. Kreindel, M.W. McGuill, A. DeMaria, C.E. Rupprecht, and S. Rowell. 1998. Prevention of the spread of rabies to wildlife by oral vaccination of raccoons in Massachusetts. J. Am. Vet. Med. Assoc. Nov 15;213(10):1407-12

Rosatte, R.C., D. Donovan. M. Allan, L-A. Howes, A. Silver, K. Bennett, C. MacInnes, C. Davies, A. Wandeler, and B. Radford. 2001. Emergency response to raccoon rabies introduction in Ontario. J. Wildl. Dis. 37:265-279.

Rosatte, R.C., C.D. MacInnes, R.T. Williams, and O. Williams. 1997. A proactive prevention strategy for raccoon rabies in Ontario, Canada. Wildl. Soc. Bull.; 25(1):110-116.

Rosatte, R.C., C.D. MacInnes, M.J. Power, D.H. Johnston, P. Bachman, C.P. Nunan, C. Wannop., M. Pedde, L. Calder. 1993. Tactics for the control of wildlife rabies in Ontario (Canada). Rev. Sci. Tech. Off. Int. Epiz.; 12(1):95-98.

Rosatte, R.C., M.J. Power, C.D. MacInnes, and J.B. Campbell. 1992. Trap-vaccinate-release and oral vaccination for rabies control in urban skunks, raccoons and foxes. J. Wildl. Dis.; 28(4):562-571.

Rosatte, R.C.; D.R. Howard; J.B. Campbell and C.D. MacInnes. 1990. Intramuscular vaccination of skunks and raccoons against rabies. J. Wildl. Dis.; 26(2):225-230.

Rupprecht, C.E., L.P. Blass1, I. Krishnarao1, K. Smith, L. Orciari, M. Niezgoda, S. Whitfield, and C.A. Hanlon. *unpublished* 2000. Human exposure to a recombinant rabies vaccine. Abstract presented at the 11th Annual International Conference on Research Advances and Rabies Control in the Americas, Lima, Peru, October, 2000.

Rupprecht, C.E. and J.S. Smith. 1994. Raccoon rabies: the re-emergence of an eipozootic in a densely populated area. Seminars in Virology (5):155-264.

Rupprecht, C.E., C.A. Hanlon, H. Koprowski, and A.N. Hamir. 1992a. Oral wildlife rabies vaccination: development of a recombinant virus vaccine. Trans. 57th N. A. Wildl. & Nat. Res. Conf. 439-452.

Rupprecht, C.E., C.A. Hanlon, L.B. Cummins, and H. Koprowski. 1992b. Primate responses to a vaccinia-rabies glycoprotein recombinant virus vaccine. Vaccine 10:368-374.

Rupprecht, C.E., B. Dietzschold, J. B. Campbell, K. M. Charlton, and H. Koprowski. 1992c. Consideration of inactivated rabies vaccines as oral immunogens of wild carnivores. J. Wild. Dis. 28(4):629-635.

Rupprecht, C.E., B. Dietzschold, J.H. Cox, and L.G. Schneider. 1989. Oral vaccination of raccoons (*Procyon lotor*) with an attenuated (SAD-B_{19}) rabies virus vaccine. J. Wildl. Dis.25(4):548-554.

Rupprecht, C.E., A.N. Hamir, D.H. Johnston, and H. Koprowski. 1988. Efficacy of a vaccinia-rabies glycoprotein recombinant virus vaccine in raccoons (*Procyon lotor*). Rev. Infect. Dis. 10:Supplement 4, p. 803:809.

Rupprecht, C.E. and M.P. Kieny. 1988. Development of a vaccinia-rabies glycoprotein recombinant virus vaccine, p. 335-364 *in* Rabies, J. Campbell and K. Charlton, eds., Kluwere Acad Pub., Boston, MA.

Rupprecht, C.E., T.J. Wiktor, A.N. Hamir, B. Dietzschold, W.H. Wunner, L.T. Glickman, and H. Koprowski. 1986. Oral immunization and protection of raccoons (*Procyon lotor*) with a vaccinia rabies glycoprotein recombinant virus vaccine. Proc. Natl. Acad. Sci. USA 83:7947-7950.

Sanderson, G. C. 1987. Raccoon, *in* M. Novak, J.A. Baker, M.E. Obbard, B. Mallock, eds, Wild Furbearer management and Conservation in North America. Ontario Trappers Association/Ontario Ministry of Natural Resources, Toronto, Ontario, Canada, pp.486-499.

Sanderson, G.C. and G.F. Huber, Jr. 1982. Selected demographic characteristics of Illinois (U.S.A.) raccoons (*Procyon lotor*). pages 487-513 *in* J.A. Chapman and D. Pursely, eds., Worldwide furbearer conference proceedings. MD Wildl. Admin., Annapolis, MD.

Steelman, H.G., S.E. Henke, and G.M. Moore. 2000. Bait delivery for oral rabies vaccine to gray foxes. J. Wildl. Dis.; 36(4): 744-751.

Steelman, H.G., S.E. Henke, and G.M. Moore. 1998. Gray fox response to baits and attractants for oral rabies vaccination. J. Wildl. Dis.; 34(4): 764-770.

TDH (Texas Department of Health), Zoonosis Control Division. The Texas Oral Rabies Vaccine Program. Information from website: www.tdh.state.tx.us/zoonosis

Thompson, J.A. and P.J. Fleming. 1994. Evaluation of the efficacy of 1080 poisoning of red foxes using visitation to non-toxic baits as an index of fox abundance. Wildl. Res. 21:27-39.

Uhaa, I.J., V.M Dato, F.E. Sorhage, J.W. Beckley, D.E. Roscoe, R.D. Gorsky, and D.G. Fishbein. 1992. Benefits and costs of using an orally absorbed vaccine to control rabies in raccoons. J. Amer. Vet. Med. Assoc. 201(12):1873-1882.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). *undated a.* Veterinary Biologics Risk Analysis. Rabies, Vaccine, Live Vaccinia Vector (BA1901-1.298). Biotechnology, Biologics, and Environmental Protection (BBEP), APHIS, USDA. 35 p. plus Appendices 1-20.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). *undated b.* Veterinary Biologics Risk Analysis. Rabies, Vaccine, Live Vaccinia Vector (BA1901-4.298). Biotechnology, Biologics, and Environmental Protection

(BBEP), APHIS, USDA. 40 p. plus Appendices 1-20.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Wildlife Services. 2000. Biological Assessment of Potential Impacts on Lynx by the USDA, APHIS, Wildlife Services Program - Eastern Region. USDA, APHIS, WS, Eastern Regional Office, 920 Main Campus Drive, Suite 200, Raleigh, NC 27606. October 2000. 12 p.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997a. Environmental assessment (EA) – Predator damage management in the Brownwood animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997b. Environmental assessment (EA) -- Predator damage management in the Canyon animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997c. Environmental assessment (EA) -- Predator damage management in the College Station animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997d. Environmental assessment (EA) -- Predator damage management in the Fort Stockton animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997e. Environmental assessment (EA) -- Predator damage management in the Fort Worth animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997f. Environmental assessment (EA) -- Predator damage management in the Kerrville animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997g. Environmental assessment (EA) -- Predator damage management in the Kingsville animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997h. Environmental assessment (EA) -- Predator damage management in the San Angelo animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997i. Environmental assessment (EA) – Predator damage management in the Uvalde animal damage control district - Texas. USDA, APHIS, Wildlife Services-Texas State Office, P.O. Box 100410, San Antonio, TX 78201-1710. 21 pp.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1997j. Final Environmental Impact Statement - revised October 1997. USDA, APHIS,

Wildlife Services Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1995a. EA and Finding of No Significant Impact – Proposed Issuance of a Conditional United States Veterinary Biological Product License to Rhone Merieux, Inc., for Rabies Vaccine, Live Vaccinia Vector. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control Program. 1995b. Environmental Assessment and Finding of No Significant Impact – Proposed Field Application of an Experimental Rabies Vaccine, Live Vaccinia Vector, In South Texas. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1994a. Environmental Assessment and Finding of No Significant Impact – Proposed Field Test of an Experimental Rabies Vaccine, Vaccinia Vector, Cape Cod Canal, Massachusetts. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234. March 1994

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1994b. Environmental Assessment and Finding of No Significant Impact – Proposed Field Test of an Experimental Rabies Vaccine, Vaccinia Vector, Cape Cod Canal, Massachusetts. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234. October 1994

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1994c. Environmental Assessment and Finding of No Significant Impact – Proposed Field Test of an Experimental Rabies Vaccine, Vaccinia Vector, Northern Cape May Peninsula, New Jersey. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234. October 1994

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1993. Environmental Assessment and Finding of No Significant Impact – Proposed Field Test of an Experimental Rabies Vaccine, Vaccinia Vector, Northern Cape May Peninsula, New Jersey. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1992. Environmental Assessment and Finding of No Significant Impact – Proposed Field Trial in New Jersey of a Live Experimental Vaccinia-Vector Recombinant Rabies Vaccine for Raccoons. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234.

USDA (U.S. Department of Agriculture), Animal and Plant Health Inspection Service (APHIS), Biotechnology, Biologics, and Environmental Protection (BBEP). 1991. Environmental Assessment and Finding of No Significant Impact – Proposed Field Trial in Pennsylvania of a Live Experimental Vaccinia-Vector Recombinant Rabies Vaccine for Raccoons. USDA, APHIS, BBEP, 4700 River Road, Riverdale, MD 20737-1234.

USDC (U.S. Department of Commerce), U.S. Census Bureau. 1999. Statistical abstract of the United States. (119th edition) Washington, DC, 1999.

USDI (U.S. Department of Interior), Fish and Wildlife Service (FWS). 2001. Threatened and Endangered Species System (TESS) U.S. Listed Vertebrate Animal Species Report by Taxonomic Group as of 3/26/2001. From FWS website: http://ecos.fws.gov/species_profile/species_profile.html?spcode=A046

USDI (U.S. Department of Interior), Fish and Wildlife Service (FWS). 2000a. Species listed as threatened or endangered and proposed for listing under the Endangered Species Act. U.S. Fish and Wildlife Service web

site: http://endangered.fws.gov/

USDI (U.S. Department of Interior), Fish and Wildlife Service. 2000b. Final Rule. Endangered and Threatened Wildlife and Plants: Determination of Threatened Status of the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Related Rule. 50 CFR Part 17, March 24, 2000.

USDI (U.S. Department of Interior), Fish and Wildlife Service (FWS). 1999. Biological Opinion — Effects of the Nationwide Wildlife Services Program on the Jaguar. USDI-FWS, 2321 W. Royal Palm Road, Suite 103. Phoenix, AZ 85021-495. 19 pp.

USDI (U.S. Department of Interior), Fish and Wildlife Service (FWS). 1998. Biological Opinion and Conference Opinion — Effects of the Nationwide Wildlife Services Program on the Mexican Gray Wolf. USDI-FWS, P.O. Box 1306, Albuquerque, NM 87103. 17 pp. + Appendices A & B.

USDI (U.S. Department of Interior), Fish and Wildlife Service (FWS). 1997. Biological Opinion — Effects of the Nationwide Wildlife Services Program on the Ocelot and Jaguarundi. USDI-FWS, P.O. Box 1306, Albuquerque, NM, AZ 87103. 23 pp.

USDI (U.S. Department of the Interior)/National Park Service (NPS). 1995. Report of effects of aircraft overflights on the National Park System. USDI-NPS D-1062, July, 1995.

Wandeler, A.I. 1991. Oral immunization of wildlife. p. 485-505 *in* The natural history of rabies, 2nd ed., GM Baer, ed, CRC Press, Boca Raton, FL.

White, C.M. and S.K. Sherrod. 1973. Advantages and disadvantages of the use of rotor-winged aircraft in raptor surveys. Raptor Research 7:97-104.

White, C.M. and T.L. Thurow. 1985. Reproduction of ferruginous hawks exposed to controlled disturbance. Condor 87:14-22.

WWHC (Western Wildlife Health Committee). *Undated*. A model protocol for purchase, distribution,and use of pharmaceuticals in wildlife. Western Association of Fish and Wildlife Agencies. Contact: J. deVos, AZ Game and Fish Dept., 2221 W. Greenway Rd., Phoenix, AZ 85023. 9 p.

APPENDIX C
Species Listed as Threatened or Endangered and species proposed or candidates for listing under the Endangered Species Act in the states proposed for APHIS-WS continued or expanded funding and assistance in Oral Rabies Vaccination Programs
Information obtained from U.S. Fish and Wildlife Service web site http://endangered.fws.gov/

Alabama -- 107 listings

Animals -- 88

E	Acornshell, southern (Epioblasma othcaloogensis)
T(S/A)	Alligator, American (Alligator mississippiensis)
T	Bankclimber, purple (Elliptoideus sloatianus)
E	Bat, gray (Myotis grisescens)
E	Bat, Indiana (Myotis sodalis)
E	Blossom, turgid (Epioblasma turgidula)
E	Blossom, yellow (Epioblasma florentina florentina)
E	Campeloma, slender (Campeloma decampi)
E	Catspaw (Epioblasma obliquata obliquata)
E	Cavefish, Alabama (Speoplatyrhinus poulsoni)
T	Chub, spotfin Entire (Cyprinella monacha)
E	Clubshell, black (Pleurobema curtum)
E	Clubshell, ovate (Pleurobema perovatum)
E	Clubshell, southern (Pleurobema decisum)
E	Combshell, Cumberlandian (Epioblasma brevidens)
E	Combshell, southern (Epioblasma penita)
E	Combshell, upland (Epioblasma metastriata)
E	Darter, boulder (Etheostoma wapiti)
T	Darter, goldline (Percina aurolineata)
T	Darter, slackwater (Etheostoma boschungi)
T	Darter, snail (Percina tanasi)
E	Darter, watercress (Etheostoma nuchale)
T	Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T	Elimia, lacy (Elimia crenatella)
E	Fanshell (Cyprogenia stegaria)
T	Heelsplitter, Alabama (Potamilus inflatus)
E	Kidneyshell, triangular (Ptychobranchus greeni)
E	Lampmussel, Alabama (Lampsilis virescens)
E	Lilliput, pale (Toxolasma cylindrellus)
E	Lioplax, cylindrical (Lioplax cyclostomaformis)
E	Manatee, West Indian (Trichechus manatus)
T	Moccasinshell, Alabama (Medionidus acutissimus)
E	Moccasinshell, Coosa (Medionidus parvulus)
E	Moccasinshell, Gulf (Medionidus penicillatus)
E	Monkeyface, Cumberland (Quadrula intermedia)
E	Mouse, Alabama beach (Peromyscus polionotus ammobates)
E	Mouse, Perdido Key beach (Peromyscus polionotus trissyllepsis)
T	Mucket, orangenacre (Lampsilis perovalis)
E	Mucket, pink (Lampsilis abrupta)
E	Mussel, oyster (Epioblasma capsaeformis)
E	Pearlymussel, cracking (Hemistena lata)
E	Pearlymussel, dromedary (Dromus dromas)
E	Pearlymussel, littlewing (Pegias fabula)
E	Pearlymussel, white wartyback (Plethobasus cicatricosus)
E	Pebblesnail, flat (Lepyrium showalteri)
E	Pigtoe, dark (Pleurobema furvum)
E	Pigtoe, finerayed (Fusconaia cuneolus)
E	Pigtoe, flat (Pleurobema marshalli)
E	Pigtoe, heavy (Pleurobema taitianum)
E	Pigtoe, oval (Pleurobema pyriforme)
E	Pigtoe, rough (Pleurobema plenum)
E	Pigtoe, shiny (Fusconaia cor)
E	Pigtoe, southern (Pleurobema georgianum)
E	Pimpleback, orangefoot (Plethobasus cooperianus)
T	Plover, piping (except Great Lakes watershed) (Charadrius melodus)
T	Pocketbook, finelined (Lampsilis altilis)
E	Pocketbook, shinyrayed (Lampsilis subangulata)
E	Ring pink (Obovaria retusa)
E	Riversnail, Anthony's (Athearnia anthonyi)
T	Rocksnail, painted (Leptoxis taeniata)
E	Rocksnail, plicate (Leptoxis plicata)
T	Rocksnail, round (Leptoxis ampla)
T	Salamander, flatwoods (Ambystoma cingulatum)
T	Salamander, Red Hills (Phaeognathus hubrichti)
T	Sculpin, pygmy (Cottus pygmaeus)
T	Sea turtle, green (except where endangered) (Chelonia mydas)
E	Sea turtle, hawksbill (Eretmochelys imbricata)
E	Sea turtle, Kemp's ridley (Lepidochelys kempii)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Sea turtle, loggerhead (Caretta caretta)
T	Shiner, blue (Cyprinella caerulea)
E	Shiner, Cahaba (Notropis cahabae)
E	Shiner, palezone (Notropis albizonatus)
E	Shrimp, Alabama cave (Palaemonias alabamae)
T	Slabshell, Chipola (Elliptio chipolaensis)
E	Snail, armored (Pyrgulopsis pachyta)
E	Snail, tulotoma (Tulotoma magnifica)
T	Snake, eastern indigo (Drymarchon corais couperi)
E	Stirrupshell (Quadrula stapes)
E	Stork, wood (AL, FL, GA, SC) (Mycteria americana)
E	Sturgeon, Alabama (Scaphirhynchus suttkusi)
T	Sturgeon, Gulf (Acipenser oxyrinchus desotoi)
T	Tortoise, gopher (W of of Mobile/Tombigbee Rs.) (Gopherus polyphemus)
E	Turtle, Alabama red-belly (Pseudemys alabamensis)
T	Turtle, flattened musk (species range clarified) (Sternotherus depressus)
E	Whale, finback (Balaenoptera physalus)
E	Whale, humpback (Megaptera novaeangliae)
E	Woodpecker, red-cockaded (Picoides borealis)

Plants -- 19

T	Amphianthus, little (Amphianthus pusillus)
T	Potato-bean, Price's (Apios priceana)
T	Fern, American hart's-tongue (Asplenium scolopendrium americanum)
E	Leather flower, Morefield's (Clematis morefieldii)
E	Leather flower, Alabama (Clematis socialis)
E	Prairie-clover, leafy (Dalea foliosa)
T	Sunflower, Eggert's (Helianthus eggertii)
T	Bladderpod, lyrate (Lesquerella lyrata)
E	Pondberry (Lindera melissifolia)
T	Button, Mohr's Barbara (Marshallia mohrii)
E	Harperella (Ptilimnium nodosum)
T	Water-plantain, Kral's (Sagittaria secundifolia)
E	Pitcher-plant, green (Sarracenia oreophila)
E	Pitcher-plant, Alabama canebrake (Sarracenia rubra

alabamensis)
E Chaffseed, American (Schwalbea americana)
E Pinkroot, gentian (Spigelia gentianoides)
T Fern, Alabama streak-sorus (Thelypteris pilosa alabamensis)
E Trillium, relict (Trillium reliquum)
E Grass, Tennessee yellow-eyed (Xyris tennesseensis)

Florida -- 111 listings

Animals -- 56

T(S/A) Alligator, American (Alligator mississippiensis)
T Bankclimber, purple (Elliptoideus sloatianus)
E Bat, gray (Myotis grisescens)
E Butterfly, Schaus swallowtail (Heraclides aristodemus ponceanus)
T Caracara, Audubon's crested (FL pop.) (Polyborus plancus audubonii)
XN Crane, whooping [XN] (Grus americana)
E Crocodile, American (Crocodylus acutus)
E Darter, Okaloosa (Etheostoma okaloosae)
E Deer, Key (Odocoileus virginianus clavium)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T Jay, Florida scrub (Aphelocoma coerulescens)
E Kite, Everglade snail (FL pop.) (Rostrhamus sociabilis plumbeus)
E Manatee, West Indian (Trichechus manatus)
E Moccasinshell, Gulf (Medionidus penicillatus)
E Moccasinshell, Ochlockonee (Medionidus simpsonianus)
E Mouse, Anastasia Island beach (Peromyscus polionotus phasma)
E Mouse, Choctawhatchee beach (Peromyscus polionotus allophrys)
E Mouse, Key Largo cotton (Peromyscus gossypinus allapaticola)
E Mouse, Perdido Key beach (Peromyscus polionotus trissyllepsis)
T Mouse, southeastern beach (Peromyscus polionotus niveiventris)
E Mouse, St. Andrew beach (Peromyscus polionotus peninsularis)
E Panther, Florida (Puma concolor coryi)
E Pigtoe, oval (Pleurobema pyriforme)
T Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E Pocketbook, shinyrayed (Lampsilis subangulata)
T(S/A) Puma (FL) (Puma concolor)
E Rabbit, Lower Keys marsh (Sylvilagus palustris hefneri)
E Rice rat (lower FL Keys) (Oryzomys palustris natator)
T Salamander, flatwoods (Ambystoma cingulatum)
E Sea turtle, green (FL, Mexico nesting pops.) (Chelonia mydas)
T Sea turtle, green (except where endangered) (Chelonia mydas)
E Sea turtle, hawksbill (Eretmochelys imbricata)
E Sea turtle, Kemp's ridley (Lepidochelys kempii)
E Sea turtle, leatherback (Dermochelys coriacea)
T Sea turtle, loggerhead (Caretta caretta)
E Seal, Caribbean monk (Monachus tropicalis)
T Shrimp, Squirrel Chimney Cave (Palaemonetes cummingi)
T Skink, bluetail mole (Eumeces egregius lividus)
T Skink, sand (Neoseps reynoldsi)
T Slabshell, Chipola (Elliptio chipolaensis)
T Snail, Stock Island tree (Orthalicus reses)
T Snake, Atlantic salt marsh (Nerodia clarkii taeniata)
T Snake, eastern indigo (Drymarchon corais couperi)
E Sparrow, Cape Sable seaside (Ammodramus maritimus mirabilis)
E Sparrow, Florida grasshopper (Ammodramus savannarum floridanus)
E Stork, wood (AL, FL, GA, SC) (Mycteria americana)
T Sturgeon, Gulf (Acipenser oxyrinchus desotoi)
E Sturgeon, shortnose (Acipenser brevirostrum)
T Tern, roseate (Western Hemisphere except NE U.S.) (Sterna dougallii dougallii)
E Three-ridge, fat (Amblema neislerii)
E Vole, Florida salt marsh (Microtus pennsylvanicus dukecampbelli)
E Whale, finback (Balaenoptera physalus)
E Whale, humpback (Megaptera novaeangliae)
E Whale, right (Balaena glacialis)
E Woodpecker, red-cockaded (Picoides borealis)
E Woodrat, Key Largo (Neotoma floridana smalli)

Plants -- 55

E Lead-plant, Crenulate (Amorpha crenulata)
E Pawpaw, four-petal (Asimina tetramera)
T Bonamia, Florida (Bonamia grandiflora)
E Bellflower, Brooksville (Campanula robinsiae)
E Prickly-apple, fragrant (Cereus eriophorus fragrans)
E Spurge, deltoid (Chamaesyce deltoidea deltoidea)
T Spurge, Garber's (Chamaesyce garberi)
E Fringe-tree, pygmy (Chionanthus pygmaeus)
E Aster, Florida golden (Chrysopsis floridana)
E Cladonia, Florida perforate (Cladonia perforata)
T Pigeon wings (Clitoria fragrans)
E Rosemary, short-leaved (Conradina brevifolia)
E Rosemary, Etonia (Conradina etonia)
E Rosemary, Apalachicola (Conradina glabra)
E Harebells, Avon Park (Crotalaria avonensis)
E Gourd, Okeechobee (Cucurbita okeechobeensis okeechobeensis)
E Pawpaw, beautiful (Deeringothamnus pulchellus)
E Pawpaw, Rugel's (Deeringothamnus rugelii)
E Mint, Garrett's (Dicerandra christmanii)
E Mint, longspurred (Dicerandra comutissima)
E Mint, scrub (Dicerandra frutescens)
E Mint, Lakela's (Dicerandra immaculata)
T Buckwheat, scrub (Eriogonum longifolium gnaphalifolium)
E Snakeroot (Eryngium cuneifolium)
T Spurge, telephus (Euphorbia telephioides)
E Milkpea, Small's (Galactia smallii)
T Seagrass, Johnson's (Halophila johnsonii)
E Beauty, Harper's (Harperocallis flava)
E Hypericum, highlands scrub (Hypericum cumulicola)
E Jacquemontia, beach (Jacquemontia reclinata)
E Water-willow, Cooley's (Justicia cooleyi)
E Blazingstar, scrub (Liatris ohlingerae)
E Pondberry (Lindera melissifolia)
E Lupine, scrub (Lupinus aridorum)
T Birds-in-a-nest, white (Macbridea alba)
E Beargrass, Britton's (Nolina brittoniana)
T Whitlow-wort, papery (Paronychia chartacea)
E Cactus, Key tree (Pilosocereus robinii)
T Butterwort, Godfrey's (Pinguicula ionantha)
E Polygala, Lewton's (Polygala lewtonii)
E Polygala, tiny (Polygala smallii)
E Wireweed (Polygonella basiramia)

E	Sandlace (Polygonella myriophylla)
E	Plum, scrub (Prunus geniculata)
E	Rhododendron, Chapman (Rhododendron chapmanii)
T	Gooseberry, Miccosukee (Ribes echinellum)
E	Chaffseed, American (Schwalbea americana)
T	Skullcap, Florida (Scutellaria floridana)
E	Campion, fringed (Silene polypetala)
E	Pinkroot, gentian (Spigelia gentianoides)
E	Meadowrue, Cooley's (Thalictrum cooleyi)
E	Torreya, Florida (Torreya taxifolia)
E	Warea, wide-leaf (Warea amplexifolia)
E	Mustard, Carter's (Warea carteri)
E	Ziziphus, Florida (Ziziphus celata)

Maryland -- 26 listings

Animals -- 19

E	Bat, Indiana (Myotis sodalis)
E	Darter, Maryland (Etheostoma sellare)
T	Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T	Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E	Puma, eastern (Puma concolor couguar)
T	Sea turtle, green (except where endangered) (Chelonia mydas)
E	Sea turtle, hawksbill (Eretmochelys imbricata)
E	Sea turtle, Kemp's ridley (Lepidochelys kempii)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Sea turtle, loggerhead (Caretta caretta)
E	Squirrel, Delmarva Peninsula fox (except Sussex Co., DE) (Sciurus niger cinereus)
E	Sturgeon, shortnose (Acipenser brevirostrum)
T	Tiger beetle, northeastern beach (Cicindela dorsalis dorsalis)
T	Tiger beetle, Puritan (Cicindela puritana)
T	Turtle, bog (northern) (Clemmys muhlenbergii)
E	Wedgemussel, dwarf (Alasmidonta heterodon)
E	Whale, finback (Balaenoptera physalus)
E	Whale, humpback (Megaptera novaeangliae)
E	Whale, right (Balaena glacialis)

Plants -- 7

T	Joint-vetch, sensitive (Aeschynomene virginica)
E	Gerardia, sandplain (Agalinis acuta)
T	Amaranth, seabeach (Amaranthus pumilus)
T	Pink, swamp (Helonias bullata)
E	Dropwort, Canby's (Oxypolis canbyi)
E	Harperella (Ptilimnium nodosum)
E	Bulrush, Northeastern (Scirpus ancistrochaetus)

Massachusetts -- 23 listings

Animals -- 20

E	Beetle, American burying (Nicrophorus americanus)
T	Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T	Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E	Puma, eastern (Puma concolor couguar)
E	Sea turtle, hawksbill (Eretmochelys imbricata)
E	Sea turtle, Kemp's ridley (Lepidochelys kempii)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Sea turtle, loggerhead (Caretta caretta)
E	Sturgeon, shortnose (Acipenser brevirostrum)
E	Tern, roseate (northeast U.S. nesting pop.) (Sterna dougallii dougallii)
T	Tiger beetle, northeastern beach (Cicindela dorsalis dorsalis)
T	Tiger beetle, Puritan (Cicindela puritana)
T	Turtle, bog (northern) (Clemmys muhlenbergii)
E	Turtle, Plymouth redbelly (Pseudemys rubriventris bangsi)
E	Wedgemussel, dwarf (Alasmidonta heterodon)
E	Whale, blue (Balaenoptera musculus)
E	Whale, finback (Balaenoptera physalus)
E	Whale, humpback (Megaptera novaeangliae)
E	Whale, right (Balaena glacialis)
E	Whale, Sei (Balaenoptera borealis)

Plants -- 3

E	Gerardia, sandplain (Agalinis acuta)
T	Pogonia, small whorled (Isotria medeoloides)
E	Bulrush, Northeastern (Scirpus ancistrochaetus)

New Jersey -- 21 listings

Animals -- 16

E	Bat, Indiana (Myotis sodalis)
T	Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T	Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E	Puma, eastern (Puma concolor couguar)
E	Sea turtle, hawksbill (Eretmochelys imbricata)
E	Sea turtle, Kemp's ridley (Lepidochelys kempii)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Sea turtle, loggerhead (Caretta caretta)
E	Sturgeon, shortnose (Acipenser brevirostrum)
E	Tern, roseate (northeast U.S. nesting pop.) (Sterna dougallii dougallii)
T	Tiger beetle, northeastern beach (Cicindela dorsalis dorsalis)
T	Turtle, bog (northern) (Clemmys muhlenbergii)
E	Wedgemussel, dwarf (Alasmidonta heterodon)
E	Whale, finback (Balaenoptera physalus)
E	Whale, humpback (Megaptera novaeangliae)
E	Whale, right (Balaena glacialis)

Plants -- 5

T	Joint-vetch, sensitive (Aeschynomene virginica)
T	Pink, swamp (Helonias bullata)
T	Pogonia, small whorled (Isotria medeoloides)
T	Beaked-rush, Knieskern's (Rhynchospora knieskernii)
E	Chaffseed, American (Schwalbea americana)

New Hampshire -- 12 listings

Animals -- 8

E Butterfly, Karner blue (Lycaeides melissa samuelis)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T Lynx, Canada (lower 48 States) (Lynx canadensis)
T Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E Puma, eastern (Puma concolor couguar)
E Sea turtle, leatherback (Dermochelys coriacea)
T Tiger beetle, Puritan (Cicindela puritana)
E Wedgemussel, dwarf (Alasmidonta heterodon)

Plants -- 4

E Milk-vetch, Jesup's (Astragalus robbinsii jesupi)
T Pogonia, small whorled (Isotria medeoloides)
E Cinquefoil, Robbins' (Potentilla robbinsiana)
E Bulrush, Northeastern (Scirpus ancistrochaetus)

New York -- 25 listings

Animals -- 19

E Bat, Indiana (Myotis sodalis)
E Butterfly, Karner blue (Lycaeides melissa samuelis)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T Lynx, Canada (lower 48 States) (Lynx canadensis)
E Plover, piping (Great Lakes watershed) (Charadrius melodus)
T Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E Puma, eastern (Puma concolor couguar)
T Sea turtle, green (except where endangered) (Chelonia mydas)
E Sea turtle, hawksbill (Eretmochelys imbricata)
E Sea turtle, Kemp's ridley (Lepidochelys kempii)
E Sea turtle, leatherback (Dermochelys coriacea)
T Sea turtle, loggerhead (Caretta caretta)
T Snail, Chittenango ovate amber (Succinea chittenangoensis)
E Sturgeon, shortnose (Acipenser brevirostrum)
E Tern, roseate (northeast U.S. nesting pop.) (Sterna dougallii dougallii)
T Turtle, bog (northern) (Clemmys muhlenbergii)
E Wedgemussel, dwarf (Alasmidonta heterodon)
E Whale, humpback (Megaptera novaeangliae)
E Whale, right (Balaena glacialis)

Plants -- 6

T Monkshood, northern wild (Aconitum noveboracense)
E Gerardia, sandplain (Agalinis acuta)
T Amaranth, seabeach (Amaranthus pumilus)
T Fern, American hart's-tongue (Asplenium scolopendrium americanum)
T Roseroot, Leedy's (Sedum integrifolium leedyi)
T Goldenrod, Houghton's (Solidago houghtonii)

Ohio -- 24 listings

Animals -- 18

E Bat, Indiana (Myotis sodalis)
E Beetle, American burying (Nicrophorus americanus)
E Butterfly, Karner blue (Lycaeides melissa samuelis)
E Butterfly, Mitchell's satyr (Neonympha mitchellii mitchellii)
E Catspaw (Epioblasma obliquata obliquata)
E Catspaw, white (Epioblasma obliquata perobliqua)
E Clubshell (Pleurobema clava)
E Dragonfly, Hine's emerald (Somatochlora hineana)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
E Fanshell (Cyprogenia stegaria)
E Madtom, Scioto (Noturus trautmani)
E Mucket, pink (Lampsilis abrupta)
E Plover, piping (Great Lakes watershed) (Charadrius melodus)
T Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E Puma, eastern (Puma concolor couguar)
E Riffleshell, northern (Epioblasma torulosa rangiana)
T Snake, copperbelly water (MI, OH, IN N of 40° N. Lat.) (Nerodia erythrogaster neglecta)
T Snake, Lake Erie water (subspecies range clarified) (Nerodia sipedon insularum)

Plants -- 6

T Monkshood, northern wild (Aconitum noveboracense)
T Daisy, lakeside (Hymenoxys herbacea)
T Pogonia, small whorled (Isotria medeoloides)
T Orchid, eastern prairie fringed (Platanthera leucophaea)
T Spiraea, Virginia (Spiraea virginiana)
E Clover, running buffalo (Trifolium stoloniferum)

Pennsylvania – 17 listings

Animals -- 14

E Bat, Indiana (Myotis sodalis)
E Clubshell (Pleurobema clava)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T Lynx, Canada (lower 48 States) (Lynx canadensis)
E Mucket, pink (Lampsilis abrupta)
E Pearlymussel, cracking (Hemistena lata)
E Pigtoe, rough (Pleurobema plenum)
E Pimpleback, orangefoot (Plethobasus cooperianus)
E Plover, piping (Great Lakes watershed) (Charadrius melodus)
E Puma, eastern (Puma concolor couguar)
E Riffleshell, northern (Epioblasma torulosa rangiana)
E Ring pink (Obovaria retusa)
T Turtle, bog (northern) (Clemmys muhlenbergii)
E Wedgemussel, dwarf (Alasmidonta heterodon)

Plants -- 3

T Pogonia, small whorled (Isotria medeoloides)
E Bulrush, Northeastern (Scirpus ancistrochaetus)
T Spiraea, Virginia (Spiraea virginiana)

Texas -- 91 listings

Animals -- 63

T(S/A) Alligator, American (Alligator mississippiensis)
E Amphipod, Peck's cave (Stygobromus pecki)
E Bat, Mexican long-nosed (Leptonycteris nivalis)
T(S/A) Bear, American black (County range of LA b.bear) (Ursus americanus)
T Bear, Louisiana black (Ursus americanus luteolus)
E Beetle, Coffin Cave mold (Batrisodes texanus)
E Beetle, Comal Springs dryopid (Stygoparnus comalensis)
E Beetle, Comal Springs riffle (Heterelmis comalensis)
E Beetle, Kretschmarr Cave mold (Texamaurops reddelli)
E Beetle, Tooth Cave ground (Rhadine persephone)
E Crane, whooping (except where XN) (Grus americana)
E Curlew, Eskimo (Numenius borealis)
E Darter, fountain (Etheostoma fonticola)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
E Falcon, northern aplomado (Falco femoralis septentrionalis)
E Flycatcher, southwestern willow (Empidonax traillii extimus)
E Gambusia, Big Bend (Gambusia gaigei)
E Gambusia, Clear Creek (Gambusia heterochir)
E Gambusia, Pecos (Gambusia nobilis)
E Gambusia, San Marcos (Gambusia georgei)
E Ground beetle, [unnamed] (Rhadine exilis)
E Ground beetle, [unnamed] (Rhadine infernalis)
E Harvestman, Bee Creek Cave (Texella reddelli)
E Harvestman, Bone Cave (Texella reyesi)
E Harvestman, Robber Baron Cave (Texella cokendolpheri)
E Jaguar (Panthera onca)
E Jaguarundi, Gulf Coast (Herpailurus yagouaroundi cacomitli)
E Manatee, West Indian (Trichechus manatus)
T Minnow, Devils River (Dionda diaboli)
E Minnow, Rio Grande silvery (Hybognathus amarus)
E Mold beetle, Helotes (Batrisodes venyivi)
E Ocelot (Leopardus pardalis)
T Owl, Mexican spotted (Strix occidentalis lucida)
E Pelican, brown (except U.S. Atlantic coast, FL, AL) (Pelecanus occidentalis)
T Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E Prairie-chicken, Attwater's greater (Tympanuchus cupido attwateri)
E Pseudoscorpion, Tooth Cave (Tartarocreagris texana)
E Pupfish, Comanche Springs (Cyprinodon elegans)
E Pupfish, Leon Springs (Cyprinodon bovinus)
E Salamander, Barton Springs (Eurycea sosorum)
T Salamander, San Marcos (Eurycea nana)
E Salamander, Texas blind (Typhlomolge rathbuni)
T Sea turtle, green (except where endangered) (Chelonia mydas)
E Sea turtle, hawksbill (Eretmochelys imbricata)
E Sea turtle, Kemp's ridley (Lepidochelys kempii)
E Sea turtle, leatherback (Dermochelys coriacea)
T Sea turtle, loggerhead (Caretta caretta)
T Shiner, Arkansas River (Arkansas R. Basin) (Notropis girardi)
T Snake, Concho water (Nerodia paucimaculata)
E Spider, Government Canyon cave (Neoleptoneta microps)
E Spider, Madla's cave (Cicurina madla)
E Spider, Robber Baron cave (Cicurina baronia)
E Spider, Tooth Cave (Neoleptoneta myopica)
E Spider, Vesper cave (Cicurina vespera)
E Spider, [unnamed] (Cicurina venii)
E Tern, least (interior pop.) (Sterna antillarum)
E Toad, Houston (Bufo houstonensis)
E Vireo, black-capped (Vireo atricapillus)
E Warbler, golden-cheeked (Dendroica chrysoparia)
E Whale, finback (Balaenoptera physalus)
E Whale, humpback (Megaptera novaeangliae)
XN Wolf, gray Mexican gray wolf, EXPN population (Canis lupus)
E Woodpecker, red-cockaded (Picoides borealis)

Plants -- 28

E Sand-verbena, large-fruited (Abronia macrocarpa)
E Ambrosia, south Texas (Ambrosia cheiranthifolia)
E Cactus, Tobusch fishhook (Ancistrocactus tobuschii)
E Cactus, star (Astrophytum asterias)
E Ayenia, Texas (Ayenia limitaris)
E Poppy-mallow, Texas (Callirhoe scabriuscula)
E Cactus, Nellie cory (Coryphantha minima)
T Cory cactus, bunched (Coryphantha ramillosa)
E Cactus, Sneed pincushion (Coryphantha sneedii sneedii)
E Cat's-eye, Terlingua Creek (Cryptantha crassipes)
T Cactus, Chisos Mtn. hedgehog (Echinocereus chisoensis chisoensis)
E Cactus, black lace (Echinocereus reichenbachii albertii)
E Pitaya, Davis' green (Echinocereus viridiflorus davisii)
T Cactus, Lloyd's Mariposa (Echinomastus mariposensis)
E Frankenia, Johnston's (Frankenia johnstonii)
T Sunflower, Pecos (Helianthus paradoxus)
E Rush-pea, slender (Hoffmannseggia tenella)
E Dawn-flower, Texas prairie (Hymenoxys texana)
E Bladderpod, white (Lesquerella pallida)
E Bladderpod, Zapata (Lesquerella thamnophila)
E Manioc, Walker's (Manihot walkerae)
E Phlox, Texas trailing (Phlox nivalis texensis)
E Pondweed, Little Aguja Creek (Potamogeton clystocarpus)
T Oak, Hinckley (Quercus hinckleyi)
E Ladies'-tresses, Navasota (Spiranthes parksii)
E Snowbells, Texas (Styrax texanus)
E Dogweed, ashy (Thymophylla tephroleuca)
E Wild-rice, Texas (Zizania texana)

Vermont -- 8 listings

Animals -- 6

E Bat, Indiana (Myotis sodalis)
T Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
T Lynx, Canada (lower 48 States) (Lynx canadensis)
E Puma, eastern (Puma concolor couguar)
T Tiger beetle, Puritan (Cicindela puritana)
E Wedgemussel, dwarf (Alasmidonta heterodon)

Plants -- 2

E Milk-vetch, Jesup's (Astragalus robbinsii jesupi)
E Bulrush, Northeastern (Scirpus ancistrochaetus)

Virginia -- 63 listings

Animals -- 50

E Bat, gray (Myotis grisescens)
E Bat, Indiana (Myotis sodalis)
E Bat, Virginia big-eared (Corynorhinus townsendii virginianus)

E	Bean, purple (Villosa perpurpurea)
E	Blossom, green (Epioblasma torulosa gubernaculum)
T	Chub, slender (Erimystax cahni)
T	Chub, spotfin Entire (Cyprinella monacha)
E	Combshell, Cumberlandian (Epioblasma brevidens)
E	Darter, duskytail Entire (Etheostoma percnurum)
T	Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
E	Fanshell (Cyprogenia stegaria)
E	Isopod, Lee County cave (Lirceus usdagalun)
T	Isopod, Madison Cave (Antrolana lira)
E	Logperch, Roanoke (Percina rex)
XN	Madtom, yellowfin [XN] (Noturus flavipinnis)
T	Madtom, yellowfin (except where XN) (Noturus flavipinnis)
E	Monkeyface, Appalachian (Quadrula sparsa)
E	Monkeyface, Cumberland (Quadrula intermedia)
E	Mucket, pink (Lampsilis abrupta)
E	Mussel, oyster (Epioblasma capsaeformis)
E	Pearlymussel, birdwing (Conradilla caelata)
E	Pearlymussel, cracking (Hemistena lata)
E	Pearlymussel, dromedary (Dromus dromas)
E	Pearlymussel, littlewing (Pegias fabula)
E	Pigtoe, finerayed (Fusconaia cuneolus)
E	Pigtoe, rough (Pleurobema plenum)
E	Pigtoe, shiny (Fusconaia cor)
T	Plover, piping (except Great Lakes watershed) (Charadrius melodus)
E	Puma, eastern (Puma concolor couguar)
E	Rabbitsfoot, rough (Quadrula cylindrica strigillata)
E	Riffleshell, tan (Epioblasma florentina walkeri)
E	Salamander, Shenandoah (Plethodon shenandoah)
T	Sea turtle, green (except where endangered) (Chelonia mydas)
E	Sea turtle, hawksbill (Eretmochelys imbricata)
E	Sea turtle, Kemp's ridley (Lepidochelys kempii)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Sea turtle, loggerhead (Caretta caretta)
E	Snail, Virginia fringed mountain (Polygyriscus virginianus)
E	Spinymussel, James (Pleurobema collina)
E	Squirrel, Delmarva Peninsula fox (except Sussex Co., DE) (Sciurus niger cinereus)
E	Squirrel, Virginia northern flying (Glaucomys sabrinus fuscus)
E	Sturgeon, shortnose (Acipenser brevirostrum)
E	Tern, roseate (northeast U.S. nesting pop.) (Sterna dougallii dougallii)
T	Tiger beetle, northeastern beach (Cicindela dorsalis dorsalis)
T(S/A)	Turtle, bog (southern) (Clemmys muhlenbergii)
E	Wedgemussel, dwarf (Alasmidonta heterodon)
E	Whale, finback (Balaenoptera physalus)
E	Whale, humpback (Megaptera novaeangliae)
E	Whale, right (Balaena glacialis)
E	Woodpecker, red-cockaded (Picoides borealis)

Plants -- 13

T	Joint-vetch, sensitive (Aeschynomene virginica)
E	Rock-cress, shale barren (Arabis serotina)
T	Birch, Virginia round-leaf (Betula uber)
E	Bittercress, small-anthered (Cardamine micranthera)
E	Coneflower, smooth (Echinacea laevigata)
T	Sneezeweed, Virginia (Helenium virginicum)
T	Pink, swamp (Helonias bullata)
E	Mallow, Peter's Mountain (Iliamna corei)
T	Pogonia, small whorled (Isotria medeoloides)
T	Orchid, eastern prairie fringed (Platanthera leucophaea)
E	Sumac, Michaux's (Rhus michauxii)
E	Bulrush, Northeastern (Scirpus ancistrochaetus)
T	Spiraea, Virginia (Spiraea virginiana)

West Virginia -- 20 listings

Animals -- 14

E	Bat, gray (Myotis grisescens)
E	Bat, Indiana (Myotis sodalis)
E	Bat, Virginia big-eared (Corynorhinus townsendii virginianus)
E	Blossom, tubercled (Epioblasma torulosa torulosa)
E	Clubshell (Pleurobema clava)
T	Eagle, bald (lower 48 States) (Haliaeetus leucocephalus)
E	Fanshell (Cyprogenia stegaria)
E	Mucket, pink (Lampsilis abrupta)
E	Puma, eastern (Puma concolor couguar)
E	Riffleshell, northern (Epioblasma torulosa rangiana)
T	Salamander, Cheat Mountain (Plethodon nettingi)
T	Snail, flat-spired three-toothed (Triodopsis platysayoides)
E	Spinymussel, James (Pleurobema collina)
E	Squirrel, Virginia northern flying (Glaucomys sabrinus fuscus)

Plants -- 6

E	Rock-cress, shale barren (Arabis serotina)
T	Pogonia, small whorled (Isotria medeoloides)
E	Harperella (Ptilimnium nodosum)
E	Bulrush, Northeastern (Scirpus ancistrochaetus)
T	Spiraea, Virginia (Spiraea virginiana)
E	Clover, running buffalo (Trifolium stoloniferum)

Species Proposed or Candidates for Listing under the Endangered Species Act:

Mammals

Status	Species Name
PE	Addax (Addax nasomaculatus)
PT	Bat, Mariana fruit (Pteropus mariannus mariannus)
C	Bat, sheath-tailed (Emballonura semicaudata)
PE	Dugong (Dugong dugon)
C	Fox, swift (Vulpes velox)
PE	Gazelle, dama (Gazella dama)
PE	Oryx, scimitar-horned (Oryx dammah)
C	Otter, northern sea (Enhydra lutris kenyoni)
C	Prairie dog, black-tailed (Cynomys ludovicianus)
PE	Shrew, Buena Vista Lake ornate (Sorex ornatus relictus)
C	Squirrel, Coachella Valley round-tailed ground (Spermophilus tereticaudus chlorus)
C	Squirrel, Washington ground (Spermophilus washingtoni)

Birds

Status	Species Name

C	Crake, spotless (Porzana tabuensis)
C	Creeper, Kauai (Oreomystis bairdi)
C	Dove, friendly ground (Gallicolumba stairi)
C	Dove, many-colored fruit (Ptilinopus perousii perousii)
C	Grouse, Gunnison sage (Centrocercus minimus)
PT	Plover, mountain (Charadrius montanus)
C	Prairie-chicken, lesser (Tympanuchus pallidicinctus)
C	Storm-petrel, band-rumped (Oceanodroma castro)
C	Warbler, elfin woods (Dendroica angelae)
C	White-eye, Rota bridled (Zosterops conspicillata rotensis)

Reptiles

Status	Species Name
C	Massasauga, eastern (Sistrurus catenatus catenatus)
C	Snake, black pine (Pituophis melanoleucus lodingi)
C	Snake, Louisiana pine (Pituophis ruthveni)
C	Turtle, Cagle's map (Graptemys caglei)
C	Turtle, Sonoyta mud (Kinosternon sonoriense longifemorale)

Amphibians

Status	Species Name
PT	Frog, Chiricahua leopard (Rana chiricahuensis)
C	Frog, Columbia spotted (Rana luteiventris)
PE	Frog, Mississippi gopher (Rana capito sevosa)
PE	Frog, mountain yellow-legged (Rana muscosa)
C	Frog, Oregon spotted (Rana pretiosa)
C	Salamander, California tiger (Ambystoma californiense)
C	Toad, boreal (Bufo boreas boreas)
C	Waterdog, black warrior (Necturus alabamensis)

Fishes

Status	Species Name
PE	Chub, Cowhead Lake tui (Gila bicolor vaccaceps)
C	Chub, Gila (Gila intermedia)
C	Chub, sicklefin (Macrhybopsis meeki)
C	Chub, sturgeon (Macrhybopsis gelida)
C	Darter, Arkansas (Etheostoma cragini)
C	Darter, Cumberland johnny (Etheostoma nigrum susanae)
C	Darter, Pearl (Percina aurora)
PE	Darter, vermilion (Etheostoma chermocki)
C	Grayling, Arctic (Thymallus arcticus)
PT	Salmon, coho (Oncorhynchus kisutch)
PT	Trout, coastal cutthroat (Oncorhynchus clarki clarki)

Clams

Status	Species Name
PEXPN	Bean, Cumberland (Villosa trabalis)
PEXPN	Blossom, tubercled (Epioblasma torulosa torulosa)
PEXPN	Blossom, turgid (Epioblasma turgidula)
PEXPN	Blossom, yellow (Epioblasma florentina florentina)
PEXPN	Catspaw (Epioblasma obliquata obliquata)
PEXPN	Clubshell (Pleurobema clava)
C	Clubshell, Alabama (Pleurobema troshelianum)
C	Clubshell, painted (Pleurobema chattanoogaense)
PEXPN	Combshell, Cumberlandian (Epioblasma brevidens)
C	Kidneyshell, fluted (Ptychobranchus subtentum)
PEXPN	Lampmussel, Alabama (Lampsilis virescens)
PEXPN	Mapleleaf, winged (Quadrula fragosa)
PEXPN	Monkeyface, Cumberland (Quadrula intermedia)
PEXPN	Mussel, oyster (Epioblasma capsaeformis)
PE	Mussel, scaleshell (Leptodea leptodon)
C	Pearlshell, Alabama (Margaritifera marrianae)
PEXPN	Pearlymussel, birdwing (Conradilla caelata)
PEXPN	Pearlymussel, cracking (Hemistena lata)
PEXPN	Pearlymussel, dromedary (Dromus dromas)
C	Pearlymussel, slabside (Lexingtonia dolabelloides)
PEXPN	Pigtoe, finerayed (Fusconaia cuneolus)
C	Pigtoe, Georgia (Pleurobema hanleyanum)
PEXPN	Pigtoe, shiny (Fusconaia cor)

Snails

Status	Species Name
C	Cavesnail, Tumbling Creek (Antrobia culveri)
C	Mountainsnail, Ogden Deseret (Oreohelix peripherica wasatchensis)
C	Pondsnail, Bonneville (Stagnicola bonnevillensis)
PEXPN	Riversnail, Anthony's (Athearnia anthonyi)
C	Rocksnail, Georgia (Leptoxis downei)
C	Sisi (Ostodes strigatus)
C	Snail, Diamond Y Spring (Tryonia adamantina)
C	Snail, fragile tree (Samoana fragilis)
C	Snail, Guam tree (Partula radiolata)
C	Snail, Humped tree (Partula gibba)
C	Snail, Koster's tryonia (Tryonia kosteri)
C	Snail, Lanai tree (Partulina semicarinata)
C	Snail, Lanai tree (Partulina variabilis)
C	Snail, Langford's tree (Partula langfordi)
C	Snail, Pecos assiminea (Assiminea pecos)
C	Snail, Tutuila tree (Eua zebrina)
C	Springsnail, Chupadera (Pyrgulopsis chupaderae)
C	Springsnail, Gila (Pyrgulopsis gilae)
C	Springsnail, Gonzales (Tryonia stocktonensis)
C	Springsnail, Huachuca (Pyrgulopsis thompsoni)
C	Springsnail, New Mexico (Pyrgulopsis thermalis)
C	Springsnail, Page (Pyrgulopsis morrisoni)
C	Springsnail, Roswell (Pyrgulopsis roswellensis)
C	Springsnail, Three Forks (Pyrgulopsis trivialis)
C	Talussnail, Wet Canyon (Sonorella macrophallus)
C	Tree snail, Newcomb's (Newcombia cumingi)

Insects

Status	Species Name
C	Beetle, Holsinger's cave (Pseudanophthalmus holsingeri)
C	Beetle, warm springs zaitzevian riffle (Zaitzevia thermae)
C	Bug, Wekiu (Nysius wekiuicola)
C	Butterfly, Mariana eight-spot (Hypolimnas octucula mariannensis)
C	Butterfly, Mariana wandering (Vagrans egestina)
C	Caddisfly, Sequatchie (Glyphopsyche sequatchie)
C	Damselfly, blackline Hawaiian (Megalagrion nigrohamatum nigrolineatum)
C	Damselfly, crimson Hawaiian (Megalagrion leptodemus)
C	Damselfly, flying earwig Hawaiian (Megalagrion nesiotes)
C	Damselfly, oceanic Hawaiian (Megalagrion oceanicum)
C	Damselfly, orangeblack Hawaiian (Megalagrion xanthomelas)
C	Damselfly, Pacific Hawaiian (Megalagrion pacificum)
C	Gall fly, Po'olanui (Phaeogramma sp.)
C	Moth, fabulous green sphinx (Tinostoma smaragditis)
C	Pomace fly, [unnamed] (Drosophila aglaia)
C	Pomace fly, [unnamed] (Drosophila attigua)
C	Pomace fly, [unnamed] (Drosophila differens)
C	Pomace fly, [unnamed] (Drosophila digressa)
C	Pomace fly, [unnamed] (Drosophila hemipeza)
C	Pomace fly, [unnamed] (Drosophila heteroneura)
C	Pomace fly, [unnamed] (Drosophila montgomeryi)
C	Pomace fly, [unnamed] (Drosophila mulli)
C	Pomace fly, [unnamed] (Drosophila musaphila)
C	Pomace fly, [unnamed] (Drosophila neoclavisetae)
C	Pomace fly, [unnamed] (Drosophila obatai)
C	Pomace fly, [unnamed] (Drosophila ochrobasis)
C	Pomace fly, [unnamed] (Drosophila substenoptera)
C	Pomace fly, [unnamed] (Drosophila tarphytrichia)
C	Skipper, Carson wandering (Pseudocopaeodes eunus obscurus)

C	Skipper, Mardon (Polites mardon)
C	Tiger beetle, Coral Pink Sand Dunes (Cicindela limbata albissima)
C	Tiger beetle, highlands (Cicindela highlandensis)
PE	Tiger beetle, Ohlone (Cicindela ohlone)
C	Tiger beetle, Salt Creek (Cicindela nevadica lincolniana)

Arachnids

Status	Species Name
C	Spider, Warton's cave (Cicurina wartoni)

Crustaceans

Status	Species Name
C	Crayfish, Camp Shelby burrowing (Fallicambarus gordoni)
C	Shrimp, anchialine pool (Antecaridina lauensis)
C	Shrimp, anchialine pool (Calliasmata pholidota)
C	Shrimp, anchialine pool (Metabetaeus lohena)
C	Shrimp, anchialine pool (Palaemonella burnsi)
C	Shrimp, anchialine pool (Procaris hawaiana)
C	Shrimp, anchialine pool (Vetericaris chaceorum)
C	Shrimp, troglobitic groundwater (Typhlatya monae)

Flowering Plants

Status	Species Name
C	Sand-verbena, Ramshaw Meadows (Abronia alpina)
PE	Ambrosia, San Diego (Ambrosia pumila)
C	Rockcress, Georgia (Arabis georgiana)
C	Silverbrush, Blodgett's (Argythamnia blodgettii)
C	Wormwood, Northern (Artemisia campestris wormskioldii)
C	Pa`iniu (Astelia waialealae)
C	Aster, Georgia (Aster georgianus)
PE	Milk-vetch, Shivwitz (Astragalus ampullarioides)
C	Milk-vetch, horseshoe (Astragalus equisolensis)
PE	Milk-vetch, Holmgren (Astragalus holmgreniorum)
PE	Milk-vetch, Ventura Marsh (Astragalus pycnostachyus lanosissimus)
C	Milk-vetch, Sleeping Ute (Astragalus tortipes)
C	Ko`oko`olau (Bidens amplectens)
C	Ko`oko`olau (Bidens campylotheca pentamera)
C	Ko`oko`olau (Bidens campylotheca waihoiensis)
C	Ko`oko`olau (Bidens conjuncta)
C	Ko`oko`olau (Bidens micrantha ctenophylla)
C	Brickell-bush, Florida (Brickellia mosieri)
C	Reedgrass, [unnamed] (Calamagrostis expansa)
C	Reedgrass, [unnamed] (Calamagrostis hillebrandii)
C	Calliandra locoensis (No common name)
C	Calyptranthes estremerae (No common name)
C	`Awikiwiki (Canavalia napaliensis)
C	`Awikiwiki (Canavalia pubescens)
PE	Sedge, golden (Carex lutea)
C	Paintbrush, Aquarius (Castilleja aquariensis)
C	Paintbrush, Christ's (Castilleja christii)
C	Pea, Big Pine partridge (Chamaecrista lineata keyensis)
C	Sandmat, pineland (Chamaesyce deltoidea pinetorum)
C	Spurge, wedge (Chamaesyce deltoidea serpyllum)
C	`Akoko (Chamaesyce eleanoriae)
C	`Akoko (Chamaesyce remyi kauaiensis)
C	`Akoko (Chamaesyce remyi remyi)
C	Papala (Charpentiera densiflora)
C	Spineflower, San Fernando Valley (Chorizanthe parryi fernandina)
C	Thoroughwort, Cape Sable (Chromolaena frustata)
C	Cordia rupicola (No common name)
C	Haha (Cyanea asplenifolia)
C	Haha (Cyanea eleeleensis)
C	Haha (Cyanea kuhihewa)
C	Haha (Cyanea kunthiana)
C	Haha (Cyanea lanceolata calycina)
C	Haha (Cyanea lanceolata lanceolata)
C	Haha (Cyanea obtusa)
C	Haha (Cyanea pseudofauriei)
C	Haha (Cyanea tritomantha)
C	Ha`iwale (Cyrtandra filipes)
C	Ha`iwale (Cyrtandra kaulantha)
C	Ha`iwale (Cyrtandra oenobarba)
C	Ha`iwale (Cyrtandra oxybapha)
C	Ha`iwale (Cyrtandra sessilis)
C	Prairie-clover, Florida (Dalea carthagenensis floridana)
C	Crabgrass, Florida pineland (Digitaria pauciflora)
C	Na`ena`e (Dubautia imbricata imbricata)
C	Na`ena`e (Dubautia plantaginea magnifolia)
C	Na`ena`e (Dubautia waialealae)
C	Cactus, Acuna (Echinomastus erectocentrus acunensis)
C	Daisy, basalt (Erigeron basalticus)
C	Fleabane, Lemmon (Erigeron lemmonii)
C	Desert-buckwheat, Umtanum (Eriogonum codium)
C	Buckwheat, Red Mountain (Eriogonum kelloggii)
C	Festuca hawaiiensis (No common name)
C	Fescue, Guadalupe (Festuca ligulata)
C	Nanu (Gardenia remyi)
C	Nohoanu (Geranium hanaense)
C	Nohoanu (Geranium humile)
C	Nohoanu (Geranium kauaiense)
C	Alice-flower, wonderland (Gilia caespitosa)
C	`Ena`ena (Gnaphalium sandwicensium molokaiense)
C	Gonocalyx concolor (No common name)
PE	Stickseed, showy (Hackelia venusta)
C	Kampua`a (Hedyotis fluviatilis)
C	Sunflower, whorled (Helianthus verticillatus)
C	Rose-mallow, Neches River (Hibiscus dasycalyx)
C	Indigo, Florida (Indigofera mucronata keyensis)
C	Ohe (Joinvillea ascendens ascendens)
C	Hulumoa (Korthalsella degeneri)
C	Kamakahala (Labordia helleri)
C	Kamakahala (Labordia pumila)
C	Lagenifera erici (No common name)
C	Lagenifera helenae (No common name)
C	Gladecress, [unnamed] (Leavenworthia crassa)
C	Gladecress, Texas golden (Leavenworthia texana)
C	Peppergrass, Slick spot (Lepidium papilliferum)
C	Bladderpod, Short's (Lesquerella globosa)
C	Bladderpod, White Bluffs (Lesquerella tuplashensis)
PE	Meadowfoam, large-flowered wooly (Limnanthes floccosa grandiflora)
C	Flax, sand (Linum arenicola)
C	Flax, Carter's small-flowered (Linum carteri carteri)
PE	Lomatium, Cook's (Lomatium cookii)
C	Makanoe lehua (Lysimachia daphnoides)
C	Lysimachia venosa (No common name)
C	Alani (Melicope christophersenii)
C	Alani (Melicope degeneri)
C	Alani (Melicope hiiakae)
C	Alani (Melicope macropus)
C	Alani (Melicope makahae)
C	Alani (Melicope paniculata)
C	Alani (Melicope puberula)
C	Kolea (Myrsine fosbergii)
C	Kolea (Myrsine mezii)
C	Kolea (Myrsine vaccinioides)
C	Asphodel, bog (Narthecium americanum)
PE	Nesogenes rotensis (No common name)
C	`Aiea (Nothocestrum latifolium)
C	Holei (Ochrosia haleakalae)
C	Cactus, Florida semaphore (Opuntia corallicola)

C	Cholla, Blue Diamond (Opuntia whipplei multigeniculata)
PE	Osmoxylon mariannense (No common name)
C	Panic grass, Hirsts' (Panicum hirstii)
C	Whitlow-wort, bushy (Paronychia congesta)
C	Cactus, Fickeisen plains (Pediocactus peeblesianus fickeiseniae)
C	Beardtongue, Parachute (Penstemon debilis)
C	Beardtongue, Graham (Penstemon grahamii)
C	Beardtongue, White River (Penstemon scariosus albifluvis)
C	`Ala `ala wai nui (Peperomia subpetiolata)
C	Phacelia, DeBeque (Phacelia submutica)
C	Phyllostegia bracteata (No common name)
C	Phyllostegia floribunda (No common name)
C	Phyllostegia helleri (No common name)
C	Phyllostegia hispida (No common name)
C	Phyllostegia imminuta (No common name)
C	Ho`awa (Pittosporum napaliense)
C	Orchid, white fringeless (Platanthera integrilabia)
C	Platydesma cornuta cornuta (No common name)
C	Platydesma cornuta decurrens (No common name)
C	Platydesma remyi (No common name)
C	Pilo kea lau li`i (Platydesma rostrata)
C	Hala pepe (Pleomele fernaldii)
C	Hala pepe (Pleomele forbesii)
PE	Polygonum, Scotts Valley (Polygonum hickmanii)
C	Lo`ulu, (=Na`ena`e) (Pritchardia hardyi)
C	Kopiko (Psychotria grandiflora)
C	Kopiko (Psychotria hexandra oahuensis)
C	Kopiko (Psychotria hobdyi)
C	Kaulu (Pteralyxia macrocarpa)
C	Makou (Ranunculus hawaiensis)
C	Makou (Ranunculus mauiensis)
C	Cress, Tahoe yellow (Rorippa subumbellata)
C	Schiedea attenuata (No common name)
C	Ma`oli`oli (Schiedea pubescens pubescens)
C	Schiedea salicaria (No common name)
C	Stonecrop, Red Mountain (Sedum eastwoodiae)
C	`Anunu (Sicyos macrophyllus)
C	Checkerbloom, Parish's (Sidalcea hickmanii parishii)
PT	Catchfly, Spalding's (Silene spaldingii)
C	Popolo (Solanum nelsonii)
C	Stenogyne cranwelliae (No common name)
C	Stenogyne kealiae (No common name)
PE	Tabernaemontana rotensis (No common name)
C	Pu`uka`a (Torulinium odoratum auriculatum)
PT	Yellowhead, desert (Yermo xanthocephalus)
C	A`e (Zanthoxylum oahuense)

Ferns and Allies

Status	Species Name
C	Doryopteris takeuchii (No common name)
C	Dryopteris tenebrosa (No common name)
C	Microlepia mauiensis (No common name)
C	Wawae`iole (Phlegmariurus stemmermanniae)
C	Thelypteris boydiae (No common name)

Proposed and Candidate Species count is 296.

(Information last updated by FWS on Tuesday, December 26, 2000 11:27:55 AM)

APPENDIX D
Summary of species listed as threatened, endangered, or special status under state laws in states proposed for APHIS-WS continued or expanded involvement in oral rabies vaccination programs
(Species for which concerns about ORV programs might be raised are shown identified and shown in Bold)

State	Number of State Listed Species by Category						
	Mammals	**Birds**	**Reptiles**	**Amphibians**	**Fish**	**Invertebrates**	**Plants**
Alabama	9NG	19NG	14NG	8NG	20NG		
Florida	20E,4T **Florida black bear, Everglades mink**	8E, 11T	6E, 10T		3E, 2T	3	
Maryland	11E, 1T, 6I **eastern cougar**	12E, 4T, 7 I	7E, 3T, 1I	5E, 1T, 2I	4E, 1T, 2I	34E, 5T, 7I	
Massachusetts	7E, 5SC	21E, 6T, 16SC	8E, 5T, 3SC	2T, 4SC	4E, 2T, 3SC	24E, 17T, 56SC	120E, 77T, 52SC
New Hampshire	2E, 1T **lynx**, **eastern cougar, american marten**	12E, 7T	1E, 1T	1	2	6E, 3T	
New Jersey	9E **bobcat**	18E, 12T	7E, 3T	5E, 2T	1	4T	
New York	10E, 1T, 3SC	10E 10T, 19SC	7E, 5T, 6SC	2E, 0T, 7SC	8E, 11T, 5SC	16E, 8T, 18SC	None
Ohio	6E, 8SI **bobcat, snowshoe hare**	29E, 3T, 20SI	5E, 1T, 10SI	5E, 2SI	24E, 13T, 9SI	61E, 12T, 47SI	
Pennsylvania	3E, 5T **lynx, eastern cougar**	10E, 7T	3E, 2T, 2C	2E, 1T	29E, 12T, 12C	2	682 (species on one or more lists of concern)
Texas	12E, 20T **ocelot, jaguarundi, jaguar, Mexican gray wolf, Louisiana black bear**	14E, 21T	3E, 21T	3E, 10T	8E, 21T	1	23E, 4T
Vermont	4E, 1T, 3SC **lynx**, **eastern cougar, american marten**	8E, 3T, 20SC	2E, 2T, 5SC	1E, 5SC	3E, 2T, 12SC	2E, 6T, 12SC	61E, 92T
Virginia	4	2E, 5T	3E, 2T	1E, 2T	5E, 10T	17E, 12T	
West Virginia	20 SC	22SC	17SC	12SC	34SC	None	None

C=candidate species for listing as threatened or endangered; NG= Nongame; SC=Species of concern; SI= "Special Interest" species; E=State endangered; T=State threatened

State	T&E Protections under State Law
Alabama	no state threatened or endangered status; certain listed "nongame" species given special protection against "take"; "take" not specifically defined.
Florida	unlawful to "capture" endangered or to "take" threatened species without permit.
Maryland	state law defines "take" similar to ESA; endangered and threatened categories have protections against "take".
Massachusetts	"take" defined similar to ESA; threatened, endangered, and "special concern" categories have equal protections against "take".
New Hampshire	unlawful to "take" any endangered or threatened species; "take" not specifically defined; no exemptions or permits to allow for incidental take; permits for take allowed for scientific and conservation purposes.
New Jersey	unlawful to "take" any endangered species of fish or wildlife; "take" defined similar to ESA; no exemptions or permits to allow for incidental take.
New York	endangered and threatened categories have protections against "take"; "special concern" category has no special additional protection.
Ohio	unlawful to "take" any endangered species of fish or wildlife; "take" not specifically defined; no exemptions or permits to allow for incidental take; no special protections for "threatened" or "special interest" species; APHIS-WS advised to just release any state listed species if captured or to report accidental mortality.
Pennsylvania	endangered and threatened categories have protections against "take"
Texas	unlawful to "take" any endangered or threatened species without the issuance of a permit; "take" not specifically defined; state law includes all federally listed species as state listed.
Vermont	unlawful to "take" any endangered or threatened species without the issuance of a permit; "take" not specifically defined; state law includes all federally listed species as state listed.
Virginia	unlawful to "take" any endangered or threatened species of fish or wildlife; "take" defined same as federal ESA; no exemptions or permits to allow for incidental take.
West Virginia	West Virginia only lists federal T&E species as having protections; "Species of Concern" are listed, but have no legal status other than those that are already federally listed.

APPENDIX E
ECOREGION DESIGNATIONS
WITHIN STATES AFFECTED BY
APHIS-WS CONTINUED OR EXPANDED INVOLVEMENT IN
RABIES ORAL VACCINATION PROGRAMS

Ecoregions are ecosystems of regional extent as defined by Bailey (1995). An "X" means the state contains the ecosystem/ecoregion described in the key below. The reader is referred to Bailey (1995) for more detailed descriptions of each ecoregion and the climate, soils, vegetation, and animal life that occur there.

State	Ecoregion Designation Number (Bailey 1995) (See Key Below)									
	212	M21	221	222	M22	231	232	315	321	411
New Hampshire		X	X							
Vermont	X	X								
Massachusetts		X	X							
New York	X	X	X	X						
Pennsylvania	X		X		X					
Ohio			X	X	X					
New Jersey			X							
Maryland			X			X	X			
West Virginia			X		X					
Virginia					X	X	X			
Alabama						X	X			
Florida							X			X
Texas								X	X	

Key to Ecoregion Designations (adapted from descriptions by Bailey 1995):

Numbers in the 200 series are within the "Humid Temperate Domain":

212 Laurentian Mixed Forest Province – lower elevation areas (sea level to 2,400 ft.), flat to rolling hills in relief, moderately long and severe winters; native vegetation types are transitional between spruce-fir coniferous boreal forest and broadleaf deciduous forest zones and are characterized by mixed stands of coniferous (mainly pine) species and a few deciduous species (mainly yellow birch, sugar maple, and American beech); in some areas, other tree species include hemlock, red cedar.

M212 Adirondack-New England Mixed Forest-Coniferous Forest-Alpine Meadow Province – mountainous region with elevations between 500 and 4000 ft.; warm summers and sometimes cold winters; native vegetation types transitional between boreal spruce-fir coniferous forest to the north and deciduous forest to the south; valleys contain hardwood forest (sugar maple, yellow birch, beech, hemlock), lower mountain slopes with mixed forest of spruce, fir, maple, beech, and birch, and higher elevations with fir and spruce.

221 Eastern Broadleaf Forest (Oceanic) Province – diverse topography; elevations from 1000 to 3000 ft.; cold winters and warm summers; native vegetation characterized by temperate deciduous forest dominated by tall broadleaf trees that provide a dense, continuous canopy in summer and shed their leaves in winter; dominant deciduous species include American beech, yellow-poplar, basswoods, sugar maple, buckeye, red oak, white oak, hemlock; includes areas of pine-oak forest ("Pine Barrens").

222 Eastern Broadleaf Forest (Continental) Province – flat to rolling to moderate in relief; elevations from 80 to 1,650 ft.; hot summers; native vegetation dominated by broadleaf deciduous forest with oak and hickory tree species more abundant than in other provinces; gradually turns more to prairie towards the Midwest, forming a mosaic pattern with prairie.

M221 Central Appalachian Broadleaf Forest - Coniferous Forest - Meadow Province – low mountains at elevations ranging from 300 to 6,700 ft.; distinct summers and winters; native vegetation characterized by mixed oak-pine forest, dominated by the white

and black oak groups at lower levels; northeastern hardwood forest at mid elevation levels, and spruce-fir forest and meadows on the highest peaks.

231 Southeastern Mixed Forest Province – comprised of the Piedmont and irregular Gulf Coastal Plains with elevations from 100 to 1000 feet and flat to gentle sloping relief; mild winters, hot humid summers; native vegetation comprised of broadleaf deciduous (oak, hickory, sweetgum, blackmun, red maple, winged elm) and needleleaf evergreen trees (mostly loblolly pine, shortleaf pine, other southern yellow pine species).

232 Outer Coastal Plain Mixed Forest Province – flat and irregular Atlantic and Gulf Coastal Plains areas; flat to gentle sloping to gentle rolling in relief; temperatures relatively steady across seasons; native vegetation comprised of temperate rainforest characterized by evergreen oaks and members of the laurel and magnolia families, with coastal marshes and interior swamps dominated by gum and cypress tree species; most upland areas covered by subclimax pine forest.

Numbers in the 300 series are within the "Dry Domain":

315 Southwest Plateau and Plains Dry Steppe and Shrub Province – generally flat to rolling plains and plateaus with elevations ranging from sea level to 6,500 ft.; semiarid climate; long hot summers and short mild winters; native vegetation characterized by arid grasslands in which shrubs and low trees grow singly or in bunches; dominant grass species include blue grama, buffalo grass, with mesquite, oak, and juniper typically the dominant shrub and tree species.

321 Chihuahuan Desert Province – mostly desert with undulating plains with elevations near 4,000 ft.; long hot summers and short winters; native vegetation mostly dominated by thorny shrubs, in many places associated with short grass such as grama; shrubs and trees include mesquite, creosote bush, yucca, and occasional scattered juniper and pinyon.

Numbers in the 400 series are within the "Humid Tropical Domain":

411 Everglades Province – extensive low elevation (sea level to about 25 ft.) areas consisting primarily of large areas of swamps and marshes; hot summers and warm winters; native vegetation consists of tropical moist hardwood forest dominated by cypress trees and mangroves along the eastern and southern coasts; much open marsh characterized by grasses, reeds, sedges, and other aquatic herbaceous plants; some areas with dense stands of sawgrass and three-awn grasses.

APPENDIX F
AMERICAN INDIAN TRIBES LOCATED IN STATES THAT MAY BE AFFECTED BY APHIS-WS CONTINUED OR EXPANDED INVOLVEMENT IN ORV PROGRAMS

FEDERALLY RECOGNIZED TRIBES

Alabama-Coushatta Tribe of Texas

Aroostook Band of Micmac Indians of Maine

Catawba Indian Nation (aka Catawba Tribe of South Carolina)

Cayuga Nation of New York

Eastern Band of Cherokee Indians of North Carolina

Houlton Band of Maliseet Indians of Maine

Kickapoo Traditional Tribe of Texas

Mashantucket Pequot Tribe of Connecticut

Miccosukee Tribe of Indians of Florida

Mohegan Indian Tribe of Connecticut

Narragansett Indian Tribe of Rhode Island

Oneida Nation of New York

Onondaga Nation of New York

Passamaquoddy Tribe of Maine

Penobscot Tribe of Maine

Poarch Band of Creek Indians of Alabama

Seminole Tribe of Florida, Dania, Big Cypress & Brighton Reservations

Seneca Nation of New York

St. Regis Band of Mohawk Indians of New York

Tonawanda Band of Seneca Indians of New York

Tuscarora Nation of New York

Wampanoag Tribe of Gay Head (Aquinnah) of Massachusetts

Ysleta del Sur Pueblo (Texas)

STATE RECOGNIZED TRIBES

Cherokees of SE Alabama

Cherokee Tribe of Northeast

Chickahominy Tribe

Coharie Intra-Tribal Council

Eastern Chickahominy

Echota Cherokee of Alabama

Haliwa-Saponi Tribe, Inc.

Hassanamisco Nipmuc Tribe

Langley Band of Chickamogee Cherokee Indians

Lumbee Regional Development

Machis Lower Creek Indian

Mattiponi Indian Nation

Meherrin Indian Tribe

Monacan Indian Tribe

Nansemond Indian Tribal Association

Nanticoke Lenni-Lenape

Oklevuaha Band of Yamassee Seminole

Pamunkey Nation

Paucatuck Eastern Pequot

Powhatan Renape Nation

Ramapough Mountain Indians

Schaghticoke Indian Tribe

Shinnecock Tribe

Star Clan of Muskogee Creeks of Pike County

United Rappahannock Tribe

United Remnant Band Shawnee Nation

Unkechaug Indian Nation of Poospatuck Indians

Upper Mataponi Tribe

Waccamaw-Siouan Development