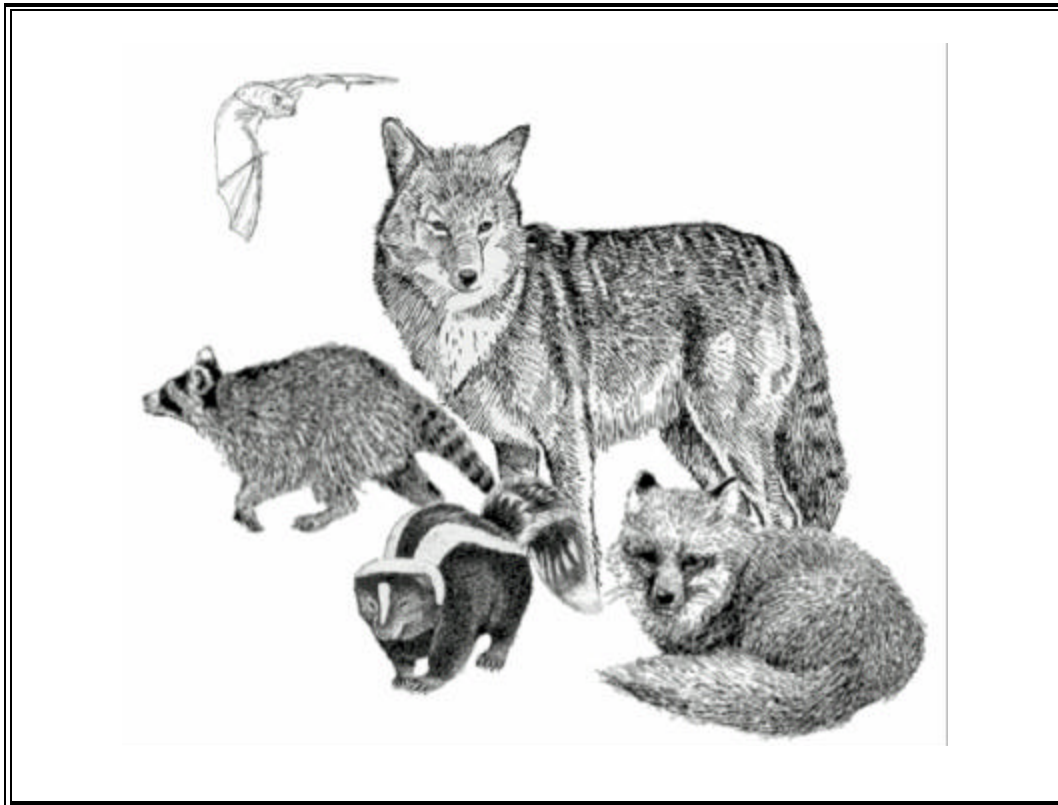


**COOPERATIVE RABIES MANAGEMENT PROGRAM
NATIONAL REPORT 2004**



**United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services**

**COOPERATIVE RABIES MANAGEMENT PROGRAM
NATIONAL REPORT 2004**

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EXECUTIVE SUMMARY

In 2004, United States Department of Agriculture (USDA), Animal Plant and Health Inspection Service, Wildlife Services (WS) participated in coordinated oral rabies vaccination (ORV) projects targeting raccoon rabies in 15 eastern States (Figure 1). Enhanced rabies surveillance was conducted in most of these states, as well as in areas west of the current ORV zone in Michigan, Kentucky, Mississippi and Louisiana. The need for adequate enhanced rabies surveillance was underscored in 2004 by the detection of raccoon rabies 6.6 miles beyond the Ohio ORV zone in July 2004. During 2004, WS and cooperators implemented contingency actions in Ohio to contain raccoon rabies and restore the “barrier.” It is unknown if the focus that emerged west of the barrier in Ohio was the result of a translocation of virus from enzootic areas east of the ORV zone, or if low levels of raccoon rabies persisted in rural areas within or just beyond the ORV zone that could have gone undetected for an extended period in the absence of greatly enhanced surveillance. Contingency actions were also conducted in Massachusetts in response to a breach of the long-standing barrier along the Cape Cod Canal, and in Chattanooga to bolster the existing barrier, and around Montgomery, Alabama. Wildlife Services continued its cooperation in ORV projects targeting rabies in coyotes (*Canis latrans*) and gray foxes (*Urocyon cinereoargenteus*) in Texas (Figure 1).

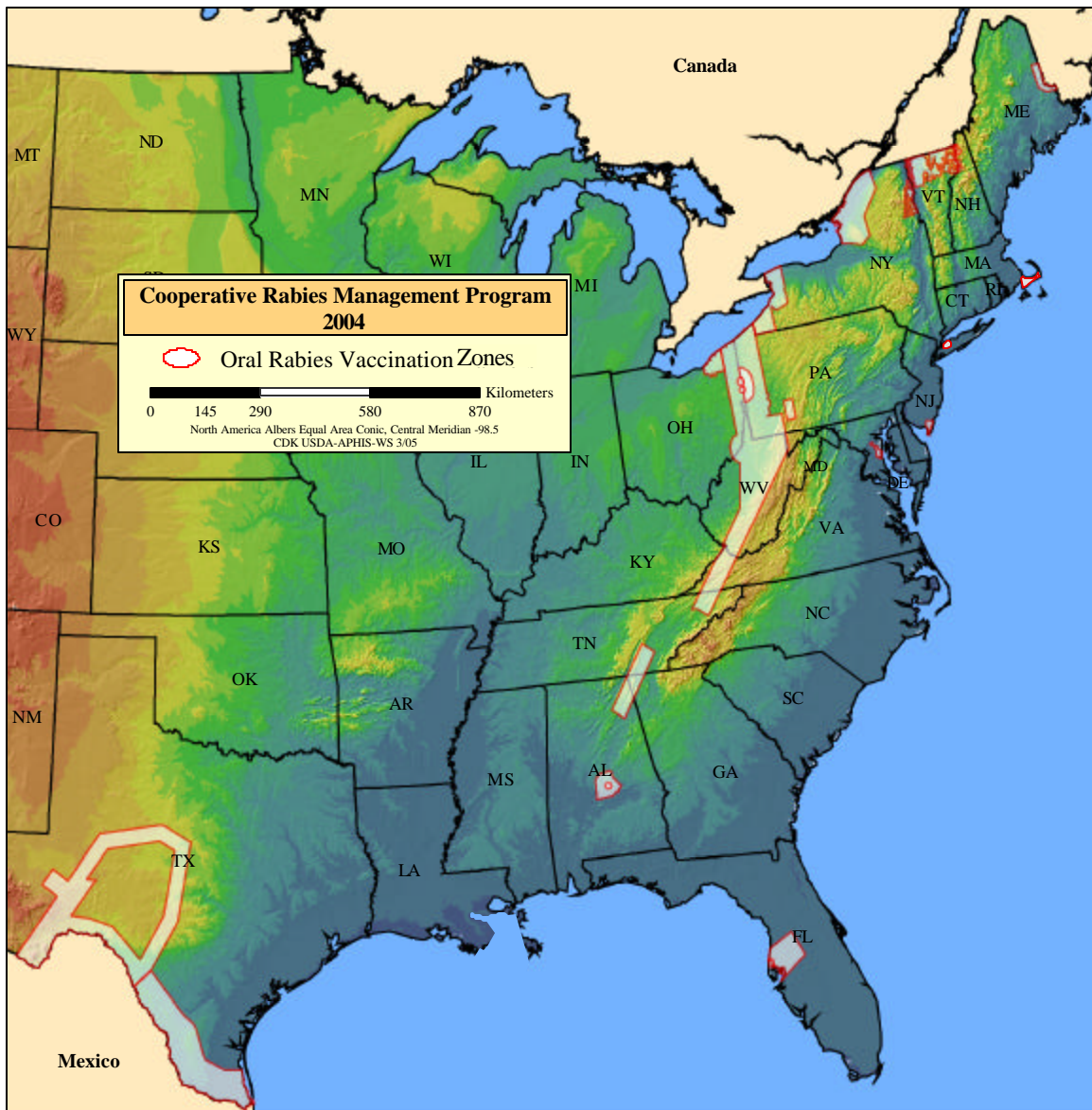


Figure 1. Oral rabies vaccinations zones targeting raccoon rabies in the eastern U.S., gray fox rabies in west-central Texas, and canine strain of rabies in coyotes in south Texas during 2004.

In 2003, WS and cooperators extended the Appalachian Ridge ORV treatment zone, as planned, from southern West Virginia to northeast Tennessee. The ORV zone extends from Lake Erie, in Ohio and Pennsylvania, south through West Virginia and Western Virginia, to northeastern Tennessee, where it articulates with the high mountainous habitats which generally support do not support high density raccoon populations. In 2004, this ORV zone was essentially replicated to bolster the immunity in raccoon populations. In 2004, baits were shifted from eastern portions of the ORV zone in Pennsylvania to treat the emerging focus west of the barrier in Ohio. In 2004, the Appalachian Ridge ORV zone covered approximately 75,619 km² (29,491 mi²) and was treated with approximately 5 million vaccine-laden baits (Table 1).

Table 1. Number of ORV baits and area treated by state in 2004.

State	Baits	Area (km ²)
Alabama	230,975	6,691
Florida	634,320	6,179
Georgia	101,809	1,504
Maine	97,100	1,517
Maryland	98,071	1,327
Massachusetts	101,898	760
New Hampshire	36,612	422
New Jersey	39,310	556
New York	1,415,585	21,407
Ohio	1,092,916	14,609
Pennsylvania	1,781,243	24,559
Tennessee	490,997	6,452
Texas	2,720,420	89,873
Vermont	348,218	7,102
Virginia	365,653	5,360
West Virginia	1,380,808	25,842
Total	10,954,295	214,160

Enhanced rabies surveillance continues to be emphasized in Georgia, Alabama and Tennessee and has been expanded along the western front of the current Appalachian Ridge ORV zone (Figure 2). Enhanced surveillance complements public health surveillance to provide more sensitivity in delineating the leading, western edge of raccoon rabies such that sound ORV decisions can be made to maximize the effective use of resources. Enhanced surveillance includes sampling, in decreasing order of priority, animals exhibiting aberrant behavior suggestive of rabies that were not implicated in human or domestic animal exposures, road kills, and animals removed near locations where rabies has recently been confirmed. Density indexing is also used to characterize raccoon populations where information is lacking and to provide samples from unrepresented rural areas.

RabID, a GIS-based surveillance mapping tool, was developed and implemented at the Centers for Disease Control and Prevention (CDC) (Figure 2). This tool provides nearly real-time access to spatial-temporal rabies distribution data that includes results from enhanced rabies surveillance submissions. Currently, Alabama, Florida, Georgia, Kentucky, Ohio, Tennessee, Virginia, and West Virginia are on RabID. Planning is in place to phase RabID into additional states to provide more comprehensive, real-time rabies surveillance mapping. A future goal includes training of WS personnel at CDC for certification in the application of a Rapid Immunohistochemical Test (RIT) to screen for rabies at remote locations to improve sample turnaround and not overburden rabies laboratories with enhanced rabies samples. All samples involving public health implications such as potential or actual rabies exposures in humans or domestic animals will continue to be processed by public health experts charged with that responsibility at their respective rabies laboratory facilities. Some states may opt to continue to process enhanced rabies surveillance samples.

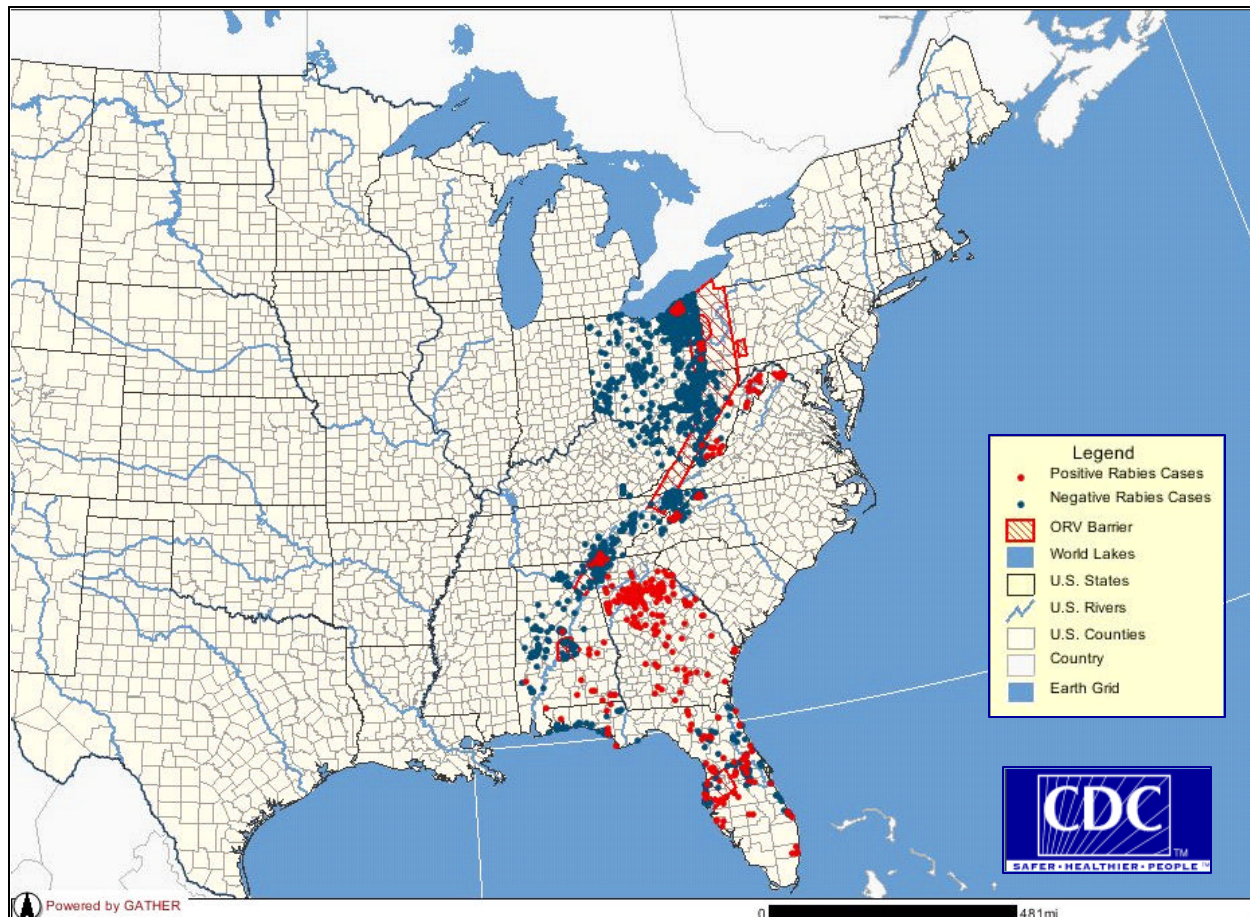


Figure 2. Positive (red) and negative (blue) raccoon rabies cases reported to RabID during 2004. (Map provided compliments of CDC.)

In 2004, WS and cooperators accelerated the shift from fishmeal polymer (FMP) baits to coated sachets (CS), with approximately 2 million CS's distributed. Transition from the predominant use of FMP baits to CS's for raccoon ORV is planned to be phased in over the next 1 to 3 years to accommodate bait production capacity. CS's are less expensive than FMP baits, less likely to cause damage from aerial distribution, and, most importantly, perform as well as or better than FMP baits. The shift to CS's is currently viewed as an interim management step until improved baits can be developed, licensed and produced.

In the Northeast, WS continued to work with Cornell University and cooperating state agencies in ORV along the New Brunswick, Canada border in Maine and the Quebec, Canada border from the Connecticut River Valley, in northern New Hampshire and northern Vermont, through the St. Lawrence River Valley along the Ontario, Canada border in northern New York (Figure 1). Part of this effort includes cooperation with the New York State Health Department led project in the upper Lake Champlain Valley in New York (Figure 1). Wildlife Services also participated in ORV activities led by Cornell University on the Niagara Frontier and in Chautauqua County, New York, which link vaccination zones along the south shore of Lake Erie from New York to Ohio. These projects required close field coordination with our Canadian counterparts in New Brunswick, Ontario and Quebec. Collectively, this ORV area comprised 30,448 km² (approximately 11,756 mi²) and was treated with approximately 1.9 million baits in 2004 (Table 1).

Wildlife Services participated in cooperative ORV projects in Massachusetts, eastern Maryland, and Florida (Figure 1 and Table 1). While not immediately tied to the larger interstate ORV efforts, these continuing projects provide valuable information on ORV and surveillance strategies. The Massachusetts barrier along the Cape Cod Canal was breached in late winter 2004. Contingency actions that included enhanced surveillance and trap-vaccinate-release (TVR), overlaid with ORV began and will continue. TVR was implemented due to the ineffectiveness of the current oral vaccine in striped skunks (*Mephitis mephitis*) and the need to try to quickly create population immunity among raccoons near the initial focus. The goal is to implement and evaluate strategies for

restoring Cape Cod to raccoon rabies-free status and creating a new, appropriate ORV zone on the west side of the Cape Cod Canal to prevent rabies from spreading back onto the Cape. The Maryland project is designed to investigate if ORV can be used to eliminate raccoon rabies from peninsulas on Chesapeake Bay. The Florida ORV project is an extension of the long-standing Pinellas County project, with a near-term goal of determining if rabies-free areas can be created in Florida, where raccoon rabies was first described in 1947. In addition, raccoon rabies was detected on Long Island, New York in August 2004. Prior to this case, ORV had not been conducted on Long Island. Enhanced surveillance, TVR and ORV were implemented around the initial focus. Enhanced surveillance remains in place to determine the need for future actions.

Wildlife Services continues to assume an important cooperative role with the Texas Department of State Health Services (TDSHS), formerly the Texas Department of Health and several other agencies and organizations in ORV efforts that began in Texas in 1995. Since 2000, this program has consisted of maintaining a 40-mile wide barrier in south Texas along the Rio Grande River to prevent the canine strain of rabies from re-emerging from Mexico. A single case of canine strain was confirmed within the southern portion of the vaccination zone near Laredo again in 2004. A case had been previously been confirmed in 2001, underscoring the importance of continuing this preventative ORV management measure and the need for improved long-term surveillance along the border with Mexico. No cases were reported within the barrier during 2002 and 2003. Since its establishment in 2000, the maintenance barrier has been treated with approximately 700,000 vaccine-laden baits annually and has covered the same geographic area (30,080 km² [11,000 mi²]) along the Mexican border (Figure 1).

Wildlife Services is an important funding and operational partner with the Texas Department of Health in ORV efforts to contain a unique gray fox variant of the rabies virus in west-central Texas. In 2004, WS contributed 1.9 million baits and assisted with their distribution over approximately 59,793 km² (23,086 mi²) to contain gray fox rabies in Texas (Figure 1 and Table 1). Wildlife Services also fills a critical cooperative niche by providing expertise, infrastructure, and equipment to help obtain samples to continue to monitor and evaluate the status of the ORV targeting gray fox rabies, as well as ORV targeting coyotes in south Texas.

Research projects on oral rabies vaccine bait acceptance in free-ranging and captive skunks continued, with an emphasis on determining which existing bait configurations could best deliver vaccine to skunks. Raccoons will be included in future studies. A study on the ecology and movement of raccoons continued in Pennsylvania, as well as a study on urban skunks in the Houston, Texas area. A study began to evaluate fidelity of raccoons for specific habitats along the Alabama River system, where the westward movement of rabies has not progressed. A bait uptake study continued in Ohio in cooperation between WS, National Wildlife Research Center (NWRC) and Ohio State University. Results of these studies will be integral to refining ORV strategies. Research was completed on tetracycline biomarker degradation. Results indicate that a combination of initial impurities, baiting manufacturing processes, and polymer binding reduce available tetracycline in end-product FMP baits by about 50%. Work was initiated on persistence of *Vaccinia* infection in mice (*Peromyscus* sp.) and other species as a follow up to previous biosafety studies. Research continued at Thomas Jefferson University on the development of canine adenovirus as a vector for the rabies glycoprotein gene. Genomic characterization of rabies virus from skunks that died of raccoon variant of rabies in Massachusetts was funded at Tufts University; however, work has been delayed but should be completed in 2005. Modeling studies were completed at Queens and Emory Universities to provide context for better characterizing risks associated raccoon rabies with and in the absence of ORV intervention. Economic studies of direct and indirect patient post exposure treatment costs for rabies exposures were completed and a benefit:cost analysis is in progress to evaluate potential ORV scenarios targeting skunk rabies in California. An 18-month study of antibody response to Raboral V-RG® in captive raccoons is to be initiated at NWRC. This study should complement a planned study to evaluate the protective capacity of varying levels of vaccine induced virus neutralizing antibodies among field caught raccoons. This study will be conducted at CDC in the near future.

A separate report will be provided on the results and recommendations from the deliberations of the 10 focus teams (surveillance, National Environmental Protection Act (NEPA) compliance, vaccine development, baiting strategies, rabies economics, air support for baiting, ORV evaluation, communications planning, contingency action planning, and research prioritization) at the WS Rabies Management Team held at CDC, Atlanta, Georgia in March 2004. This report will serve as a benchmark for progress review and future recommendations. Beginning in fiscal year 2005, it will become a chapter in this annual report.

In 2005, WS and cooperators will continue to focus on implementing adequate enhanced rabies surveillance throughout and beyond ORV existing zones. Current ORV zones were created based on the best available surveillance at the time, but as surveillance improves those zones may have to be adapted to new surveillance knowledge. The National Rabies Management Team will continue to provide the interdisciplinary expertise on integral aspects of ORV to optimize strategies to meet national rabies management goals. Formal work will begin on North American Rabies Management Plan/Planning during 2005.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM ALABAMA 2004

BACKGROUND

Raccoon (*Procyon lotor*) rabies is thought to have entered Alabama in the late 1970s from Florida. The raccoon variant of rabies has since been detected in most counties east and south of the Alabama-Coosa River system and is now considered enzootic there. Within the last 9 years, several confirmed raccoon rabies breaches of the Alabama and Coosa Rivers have occurred in Mobile, Clarke, Dallas, Perry, and Autauga Counties, but the cases appeared to be fairly isolated and limited to 1 or 2 animals during each occurrence.

An average of 44 raccoons per year has been confirmed positive for rabies since this variant of the virus spread into southeast Alabama. An average of 8,326 animal bites was investigated each year, for the past 10 years, by county health department personnel, creating a substantial drain on public health resources.

In 2001, the Alabama Department of Public Health (ADPH) asked Wildlife Services (WS) and other cooperators to help determine the leading edge of the raccoon rabies variant in the state in hopes of developing an effective oral rabies vaccination (ORV) program to keep raccoon rabies from spreading into western Alabama. In late 2001, WS began conducting enhanced surveillance of road-killed and trapped raccoons, in counties west of and bordering the Alabama and Coosa Rivers.

Between 2002 and 2003, surveillance conducted by WS and ADPH confirmed 10 raccoon rabies cases in both domestic and wild animals in Autauga and Clarke Counties (where it had previously been detected) and Cherokee and DeKalb Counties (where it had never been detected), indicating that raccoon rabies might be on the move westward. As a result, in November 2003, the ADPH and the Alabama Department of Agriculture and Industries (ADAI) cooperated with Alabama WS and WS offices in Georgia and Tennessee to initiate Alabama's first-ever ORV effort in 5 northeast Alabama counties. The resulting ORV program was coined the Georgia, Alabama, and Tennessee (GAT) program. Furthermore, in 2004, an ORV distribution was initiated for the first time in 8 central Alabama counties and repeated in the 5 northeastern counties during GAT ORV 2004 (Figure 1). The goal of the ORV distributions was to extend the national rabies-immune barrier from Tennessee, into parts of Georgia and Alabama.

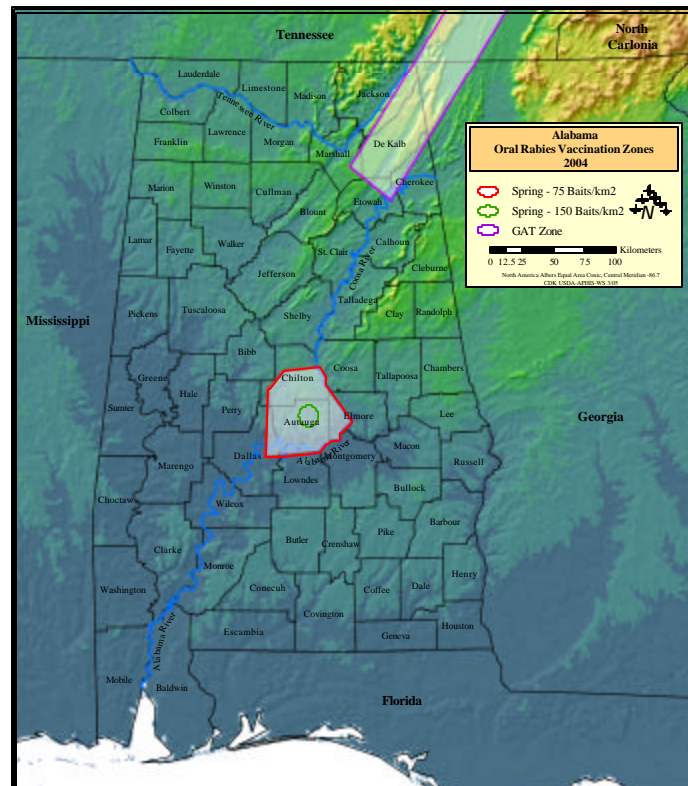


Figure 1. Oral rabies vaccination zones in Alabama, 2004.

In January and October 2004, 2 new raccoon rabies cases were identified by ADPH in Shelby County. In each instance, WS increased the number animals tested within a 1-mile radius of the cases and found no new positives. Wildlife Services also encouraged local health department and animal control personnel to report sick wildlife in these areas.

ORV PROGRAM 2004

Bait Distribution

Central Alabama 2004.--The objective of the first Central Alabama ORV bait drop was to create a rabies-immune barrier west of the Alabama River in central Alabama where 3 new cases of raccoon rabies had been identified in 2002 and 2003. Wildlife Services personnel and volunteers from the Centers for Disease Control and Prevention (CDC) distributed baits in central Alabama from 5-8 April 2004 in an area that was 3,504.36 km² (1,353.07 mi²) (Figure 1). Fishmeal polymer baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA), were distributed from the air and by hand (262,440 and 17,280, respectively) in parts of Autauga, Bibb, Chilton, Coosa, Dallas, Elmore, Lowndes, and Montgomery Counties. The standard baiting density of 75 baits/km² was increased to 150 baits/km² in the center of the ORV bait zone, encompassing a 10-mile radius around the most recent (and farthest west) confirmed raccoon rabies case. The ADPH coordinated information outreach to county and local authorities and assisted WS, Legislative and Public Affairs personnel with media and public inquiries.

GAT 2004.--The objective of the Alabama's 2004 GAT ORV effort was to stop the westward movement of raccoon rabies from northwest Georgia into Cherokee and DeKalb Counties. Wildlife Services personnel and volunteers from the CDC distributed baits in Alabama from 6-9 November 2004, in an area that was 3186.55 km² (1,230 mi²) (Figure 1). Fishmeal polymer baits were distributed from the air and by hand (194,575 and 36,400 respectively) in parts of DeKalb, Marshall, Cherokee, Etowah, and Jackson Counties.

Enhanced Surveillance

In 2004, WS continued to conduct enhanced surveillance targeting abnormally-behaving raccoons, road-killed raccoons, and raccoons within 1 mile of identified positive cases in counties west of the Alabama and Coosa Rivers. The goal of this surveillance was to determine the leading edge of the raccoon-rabies variant in Alabama. Animal control personnel, county health department personnel, and wildlife law enforcement officers contributed surveillance animals to this effort as well. Results from WS enhanced surveillance yielded no confirmed cases of rabies. Two raccoons from Shelby County, tested as part of passive surveillance through the public health department and testing lab, were confirmed to be positive for rabies using direct florescent antibody testing.

Table 1. Raccoons (unless otherwise noted) collected for rabies testing by Wildlife Services personnel, by county, along the Alabama-Coosa River system and westward in Alabama, 2004.

County	Brainstems tested	County	Brainstems tested	County	Brainstems tested
Autauga	10	Etowah	4	Mobile	1
Bibb	2	Greene	1	Monroe ^f	1
Blount ^a	3	Hale ^d	17	Perry	11
Cherokee	2	Jackson	3	Pickens	1
Chilton ^b	3	Jefferson	3	Shelby	41
Choctaw	2	Limestone	2	St. Clair	1
Clarke	5	Lincoln	1	Tuscaloosa ^e	11
Coosa	1	Lowndes	1	Walker	1
Dallas ^c	3	Madison	99	Washington	1
Dekalb	6	Marengo ^c	6	Total	247
Elmore	3	Marshall	1		

^aincluded 1 gray fox (*Urocyon cinereoargenteus*)

^bincluded 1 gray fox and 1 feral cat (*Felis catus*)

^cincluded 1 gray fox and 1 red fox (*Vulpes vulpes*)

^dincluded 2 bobcats (*Lynx rufus*)

^eincluded 1 red fox

^fincluded 1 striped skunk (*Mephitis mephitis*)

^gincluded 1 gray fox

Population Monitoring

Three studies to index relative densities of raccoon populations were conducted in March, September, and October, 2004 (Table 2). One was conducted within the proposed Central Bait Zone (Autauga County) to index raccoon density and to determine base-line levels of rabies exposure in raccoon populations within the area. Two additional studies were conducted in forested habitats along the Alabama and Coosa Rivers. Studies were conducted using an established protocol of 50 cage traps, over 10 consecutive nights (500 trap nights), on a 3 km² study site comprised of a particular dominant habitat type. Animals were trapped, immobilized, and released after blood, tooth, and hair samples were obtained. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Results of relative density studies on 3 sites in Alabama, 2004.

	Autauga WMA	Cahaba River WMA	Lowndes County WMA
County	Autauga	Shelby	Lowndes
Macro habitat	Forested	Forested	Forested
Elevation (meters)	370-450	140-200	30-50
Unique raccoons captured	30	10	24
Relative density index	10.0	3.3	8.0

Non-target Captures

Non-target animals captured and released included: 2 Eastern cottontail rabbits (*Sylvilagus floridanus*), 18 opossums (*Didelphis virginiana*), 1 box turtle (*Terrapene carolina*), and 4 domestic cats (*Felis catus*). Non-target animals that were captured and euthanized included: 5 gray foxes, 1 striped skunk, 2 bobcats, 2 red foxes, 2 feral cats, 6 nine-banded armadillos (*Dasypus novemcinctus*), and 95 opossums.

Raccoon Movements Study

In January 2004, a 2-year research study was initiated in cooperation with Auburn University to monitor raccoon habitat use and movements relative to the Alabama River. To date, 117 seventeen raccoons have been captured and radio-collared in 4 counties, as part of this study.

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline biomarker, and Age Results

GAT 2003.--Serum and tooth samples from 126 unique raccoons, captured within the ORV zone (DeKalb County), were collected 9-11 weeks following the November 2003 bait drop. Animals were trapped using cage traps, immobilized, processed, and released. A pre-bait ORV drop sample revealed 1 animal with a low level of rabies antibody (2.3%, $n = 44$). Results from virus neutralizing antibody screening of post-bait ORV drop samples revealed that 32.5% of the raccoon population within the ORV zone demonstrated a positive rabies antibody response (Table 3). Tetracycline analysis of tooth samples revealed that bait contact was not as frequently observed in the same population of captured animals (Table 3).

Table 3. Serology and tetracycline biomarker results of raccoon biological samples collected during post -bait ORV program evaluation in Dekalb County, Alabama, 2003.

	Post-bait ORV
Serology	
Unique raccoons captured	126
Testable blood samples	126
Positive rabies antibody response ^a	41 (32.5%)
Tetracycline	
Unique raccoons captured	126
Testable tooth samples	123
Presence of tetracycline biomarker	13 (10.5%)

^aCDC serum titer = 5

SUMMARY

Fall 2004 marked the fourth year of WS cooperative participation in the Alabama ORV program. Work emphasized enhanced surveillance, for evidence of raccoon rabies west and north of the Alabama and Coosa Rivers, as well as pre- and post-bait ORV trapping. In addition, 3 relative density studies were conducted. Oral rabies vaccination efforts were initiated in central Alabama and renewed in northeast Alabama in an attempt to stop the westward movement of the raccoon strain of rabies from northwest Georgia and southeast Alabama. Future ORV baiting strategies in Alabama will continue to be directed towards halting the spread of raccoon rabies into Western Alabama. This barrier is tied to a national planning effort to contain the disease and explore strategies to eliminate the raccoon strain of rabies from North America.

**WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
ARIZONA 2004**

BACKGROUND

Arizona has 2 terrestrial strains of rabies, the South Central Skunk, primarily in striped skunks (*Mephitis mephitis*), and Arizona Gray Fox (*Urocyon cinereoargenteus*) (Centers for Disease Control and Prevention [CDC], 2003). The skunk strain occurs in the southeastern counties of Arizona and the gray fox strain occurs through the eastern counties, across and up into the central part of the state, below the Mogollon Rim. In addition to the 2 terrestrial strains, a bat strain of rabies, found in the big brown bat (*Eptesicus fuscus*), also occurs throughout the state.

In 2004, Arizona had an increase in the total number of confirmed rabies cases. The Arizona Department of Health Services (ADHS) confirmed a total of 120 rabid animals. This was a 60% increase from 2003, when 75 animals were confirmed with rabies. Positive rabies cases occurred in 11 of the 15 counties within Arizona (Table 1).

Table 1. Confirmed rabid animals, by county and species, in Arizona, 2004 (E. Lawaczeck, Arizona Department of Health Services, unpublished data).

County	Bat	Skunk	Fox	Coyote	Other	Total
Cochise	3	5	1			9
Coconino	3	5 ^a	1 ^a			9
Gila	3		3			6
Graham	1					1
La Paz	1					1
Maricopa	10		2		1 (bobcat) ^b	13
Pima	41	10	8	2	1 (bobcat) ^b	62
Pinal	6		2			8
Santa Cruz	2	4				6
Yavapai	3					3
Yuma	2					2
Total	75	24	17	2	2	120

^abig brown bat variant.

^bbobcats (*Lynx rufus*) were infected with the Arizona gray fox variant of rabies.

RABIES PROGRAM 2004

In a continuing effort to reduce the number of confirmed rabies cases, the Wildlife Services (WS) program in Arizona embarked on 3 separate rabies research projects. The first was a skunk oral rabies placebo bait study, conducted in conjunction with the National Wildlife Research Center (NWRC) and research projects in California, Texas, Wyoming, and Louisiana. The second research project was a feral dog (*Canis familiaris*) placebo bait study, conducted with Navajo and Hopi Veterinary Services and CDC. The goal of the oral rabies bait research projects was to determine bait acceptance of placebo rabies vaccine baits among skunks and feral dogs in an effort to develop an oral rabies vaccine (ORV) for use on these species. The third project was a skunk radio telemetry study, to determine home range and denning ecology of striped skunks (*Mephitis mephitis*) in Flagstaff, Arizona. The goal of the radio telemetry project was to help answer questions pertaining to the rabies outbreak, which occurred in Flagstaff in 2001.

Skunk Oral Rabies Placebo Bait Study

Study Area.--Two research sites were selected for this project. The first site was located on the Bureau of Land Management's, San Pedro National Conservation Area and the second site was private lands, located in the Turkey Creek area. Both research sites were located in Cochise County (Figure 1). Habitat types were comprised of plains, desert grassland, and Chihuahuan desert scrub (Brown 1994).

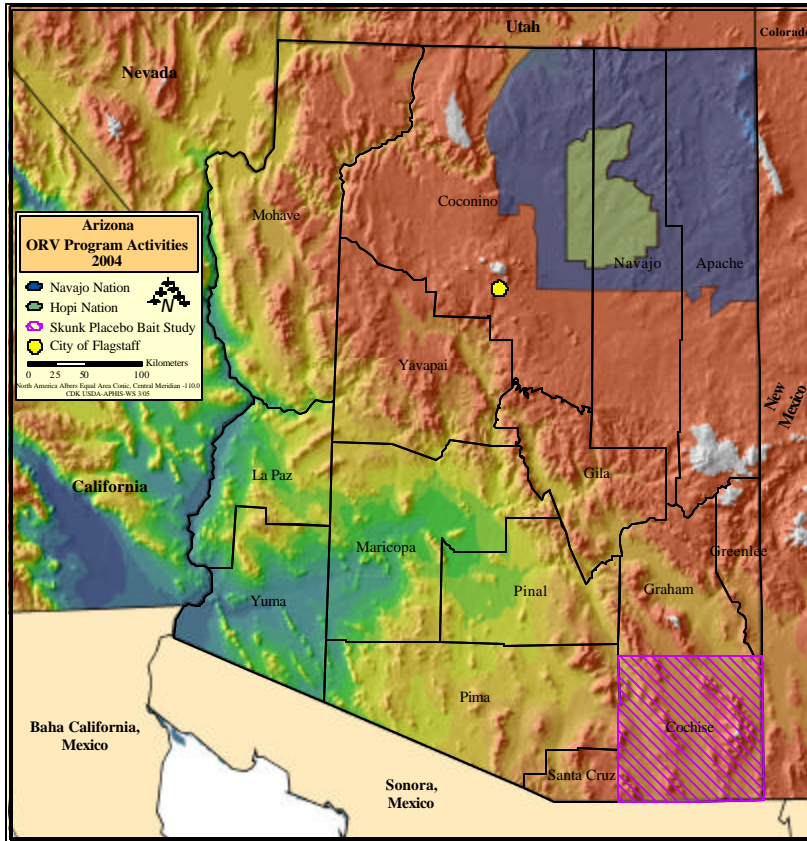


Figure 1. Oral rabies program activities in Arizona, 2004.

Methods.--The project was initiated in October 2004. Four WS employees distributed 3,600 placebo baits by hand (1,800 coated sachets [MERIAL Limited, Athens, Georgia, USA] and 1,800 Artemis blister packs [Artemis Technologies, Inc., Guelph, Ontario, Canada]). After a waiting period of 5 weeks, WS employees initiated post-bait ORV trapping of skunks. One live trap was placed every 0.5 km along a transect line. There were 3 transect lines per research site, each of which were 8 km x 1 km. Traps were located within a 50 m radius from the specified UTM coordinate in the area most suitable for capturing skunks. Trapped animals were anesthetized with a 5:1 mixture of ketamine/xylazine, injected intramuscularly. Blood samples were collected for rabies titer analysis. Animals were euthanized so that the head, jaw, and tissue samples could be collected. All samples, excluding heads, were sent to the NWRC in Ft. Collins, Colorado for analysis. The head samples were sent to ADHS, Bureau of State Laboratory Services for fluorescent rabies antibody testing. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Results.--Fifty one skunks were captured. Skunk species captured included: 26 striped skunks, 12 hooded skunks (*Mephitis macroura*), 11 spotted skunk (*Spilogale putoris*), and 2 hog-nosed skunks (*Conepatus leuconotus*). All skunks tested negative for rabies, results for the tetracycline analysis are pending.

Feral Dog Placebo Bait Study

Study Area.--On 21 April 2004, WS conducted a feral dog placebo bait study. The study was conducted on the Navajo and Hopi Nations, in conjunction with CDC, Navajo Veterinary Services, Hopi Veterinary Services, the Animal Plant Health Inspection Services (APHIS) Tribal Liaison, Veterinary Services, and 2 Mexican Government Dignitaries (Figure 1).

Methods.--The research team was divided into 5 groups. Small groups of 2-4 individuals, including at least 1 representative from either the Navajo or Hopi Nations, hand baited as many feral dogs as possible at each site. Four groups baited dogs on the Navajo Nation, which included sites at Chinle, Many Farms, Pinon, and Lukachuka.

The fifth group traveled to the Hopi Nation where they baited feral dogs at First Mesa, Second Mesa, and Villa. Baits included fishmeal polymer (FMP), dogmeal polymer (DMP), and fishmeal coated sachet (CS) (Merial Limited, Athens, GA, USA).

Data gathered from this baiting project indicated that feral dogs on the Hopi Nation had a high acceptance rate for CS. However, because CS's were not tested with dogs on the Navajo Nation, WS conducted another bait study on 18 May 2004, to test the acceptance of CS for dogs on the Navajo Nation. Wildlife Services also tested the FMP and DMP baits with dogs on the Hopi Nation to compare acceptance rates for both study sites.

Results.--Between the 2 studies, 338 and 163 feral dogs on the Navajo and Hopi Nations, respectively, were given oral rabies placebo baits (Figures 2-7). Of the 3 different baits tested on feral dogs, acceptance of CS baits was greater, when compared to FMP or DMP baits.

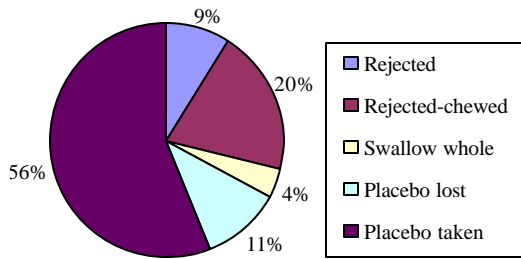


Figure 2. Feral dog preference for DMP baits on the Hopi Nation, Arizona, 2004 ($n = 45$).

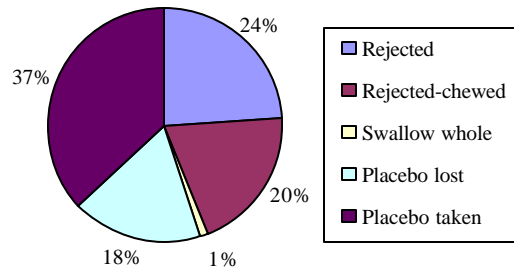


Figure 3. Feral dog preference for DMP baits on the Navajo Nation, Arizona, 2004 ($n = 143$).

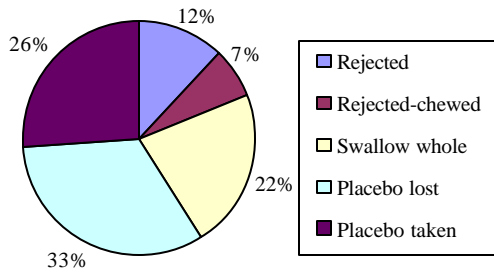


Figure 4. Feral dog preference for FMP baits on the Hopi Nation, Arizona, 2004 ($n = 58$).

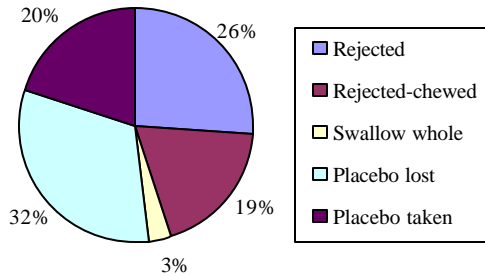


Figure 5. Feral dog preference for FMP baits on the Navajo Nation, Arizona, 2004 ($n = 120$).

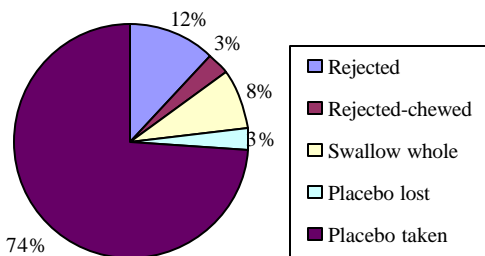


Figure 6. Feral dog preference for CS baits on the Hopi Nation, Arizona, 2004 ($n = 60$).

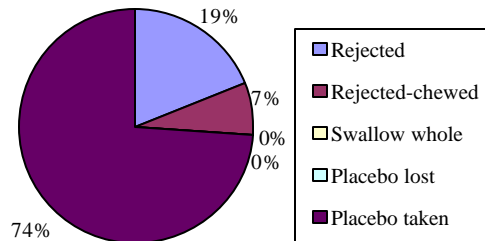


Figure 7. Feral dog preference for CS baits on the Navajo Nation, Arizona, 2004 ($n = 75$).

Navajo Nation Zoo and Botanical Park Baiting Project

Wildlife Services conducted a 1-day oral rabies placebo bait study at the Navajo Nation Zoo and Botanical Park. This study was conducted to determine which animals, native to the Navajo Nation, would accept ORV baits. Wildlife Services employees offered FMP and CS baits to 21 animals, of 12 different species at the zoo. Of the 12 animal species baited, 5 different species accepted and chewed both types of baits; animals included: 3 black bears (*Ursus americanus*), 3 red fox (*Vulpes vulpes*), 1 coyote (*Canis latrans*), 1 Mexican gray wolf (*C. lupus baileyi*), and 1 bobcat.

Skunk Telemetry Study in Flagstaff, Arizona

The 2001 epizootic in Flagstaff was of high concern due to the crossover of big brown bat rabies strain into striped skunks, a terrestrial species, where it began to spread within the population (Engeman et al. 2003). From 8 May-30 June 2001, Arizona WS program conducted a 6-week Trap, Vaccinate, and Release (TVR) project for striped skunks in the Flagstaff area (Figure 1). Coconino County Department of Health Services, ADHS, and funding from the CDC continued the TVR project throughout the summer (B. Worgess, Coconino County Department of Health Services, Personal communication).

From 2001, through August 2004, no skunks had tested positive for bat rabies. However, between 1 September 2004-30 November 2004, 5 striped skunks (in Flagstaff), and 1 gray fox (approximately 30 km south of Flagstaff) tested positive for rabies. As of 30 November 2004, the rabies strain, of the 2 skunks and the gray fox has been typed as the big-brown bat strain (ADHS, unpublished data).

In an effort to better understand striped skunk population dynamics, for management and control of rabies outbreaks in Arizona, WS and NWRC, in cooperation with Northern Arizona University, began a behavioral research project designed to answer the following questions about skunk biology and ecology directly related to the 2001 rabies outbreak:

- 1) What and where are urban skunk den locations and what are the urban skunks denning behaviors?
- 2) What is the interspecific contact at and around den locations?
- 3) Is rabies spread likely due to skunk-to-skunk interactions in dens and can skunks spread rabies to other wildlife or domestic animals at or around den sites?
- 4) What are striped skunk home range sizes in Flagstaff's urban environment and do they overlap?
- 5) Could disease spread have been propagated by translocation?
- 6) What are Flagstaff's urban skunk seasonal and daily movements?
- 7) What is striped skunk density within Flagstaff's east and west urban matrices?

Study Area.--Flagstaff's urban environment is naturally divided into an east and west region by Sweitzer Mesa (a mixed ponderosa and grassland environment). Wildlife Services focused on these urban matrices, which are surrounded by wild lands, creating urban/wildland interfaces. The urban matrix is described by urban disturbance and developments, paved streets, and housing, school, and business districts. The urban/wildland interface is the periphery of the urban matrix, where housing is located adjacent to managed, but undeveloped habitat (i.e., Forest Service managed lands) controlled and managed land within city limits or Flagstaff Parks and Recreation managed lands.

Methods.--Live-trapped striped skunks were equipped with radio collars to determine home range sizes, den locations, and diurnal and nocturnal behavior patterns. Den sites were monitored with automated, infrared 35 mm cameras to document potential inter- and intraspecific contact at den sites.

Results.--This study was initiated in winter 2003-2004. Winter radio tracking data is currently being analyzed. Wildlife Services began radio-collaring animals on the west study site in May 2004. To date, 30 radio collars have been deployed.

Wildlife Services monitored 18 den sites, 6 of which showed evidence of use by multiple skunks. At 4 of these den sites, multiple skunks were captured in the same photograph = 2m from each other. Cameras also recorded dogs, cats (*Felis catus*), foxes, and raccoons using or investigating the den sites. In several cases, both wild and domestic animals were captured in the same photograph with skunks.

Emergency Rabies Response

Due to the rabies outbreak in Flagstaff, Arizona, in 2004, and the reoccurrence of the bat variant of rabies in skunks, WS in cooperation with the CDC, ADHS and Coconino County Health Services began vaccinating skunks, raccoons (*Procyon lotor*), and fox to help manage the rabies outbreak. Twenty striped skunks and 6 raccoons were vaccinated.

Wildlife Services also responded to a bat rabies threat at Bonita Elementary School, located north of Wilcox Arizona. The threat concerned 2 bats flying around the school during the day. Wildlife Services responded with both technical and direct assistance, providing recommendations for exclusion and the removal of 2 bats. The bats were captured, euthanized, and sent to the ADHS, Tucson lab for rabies testing. The bats tested positive for rabies; but there were no human exposures to these bats. The bats were then sent to the CDC to determine which strain of rabies the bats were infected with. Results are pending.

SUMMARY

Based on the results from the feral dog placebo bait study, WS, in conjunction with the CDC, and the Navajo and Hopi Veterinary Services, anticipates implementing a small scale ORV bait distribution on the Navajo and Hopi Nations in April 2005.

In a continuing effort to suppress rabies in Arizona, WS, in conjunction with the ADHS, CDC, and Coconino County Health Services anticipates implementing an ORV bait distribution in Flagstaff, Arizona, in April 2005.

It is the goal of the Arizona WS program to continue to provide support and to respond to any request for rabies surveillance and management. Wildlife Services looks forward to a strong cooperative relationship with state and local agencies, while providing federal leadership in rabies management.

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- Brown, D. 1994. Biotic communities: Southwestern United States and Northwestern Mexico. University of Utah Press, Salt Lake City, Utah, USA.
- Engeman, R., K. Christensen, M. Pipas, and D. Bergman. 2003. Population monitoring in support of a rabies vaccination program for skunks in Arizona. *Journal of Wildlife Disease* 33:746-750.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM CALIFORNIA 2004

BACKGROUND

California has one unique strain of terrestrial rabies in the striped skunk (*Mephitis mephitis*) and bat (order *Chiroptera*) rabies. Since 1945, rabies in skunks has remained enzootic over major areas of the state. Rabies also occurs in other species of wildlife (raccoons [*Procyon lotor*], opossums [*Didelphis virginiana*], and various canids) in California. In these species, rabies likely represents a spillover from enzootic skunk or bat (order *Chiroptera*) rabies. The skunk strain has been limited to areas north of the Tehachapi mountain range in California. From 1993-2002, the California Department of Health Services (CDHS) reported 3,312 cases of rabies throughout the state, approximately 51% of these were skunks. Furthermore, CDHS reported an additional 206 rabies cases in animals in 2003.

ORV PROGRAM 2004

In 2004, Wildlife Services (WS), in conjunction with the WS, National Wildlife Research Center (NWRC) conducted its second round of placebo oral rabies vaccine bait research projects. This is part of a larger project that is being conducted in Arizona, Louisiana, Texas, and Wyoming. The goal is to compare various formulations of placebo baits and determine bait acceptance levels in skunks. The optimal bait formulation derived from these studies may eventually be used to deliver an oral rabies vaccine to skunks. Currently, there is no oral rabies vaccine licensed for use in skunks in the United States. There are several vaccines that are under evaluation and may be ready for testing in a field setting in the near future. California WS has played an important role in carrying out these bait field trials to support finding a good bait for delivering oral rabies vaccine.

Surveillance

Since 1921, rabies has been a legally reportable disease, under the California Code of Regulations, Title 17, Section 2500. The CDHS, Veterinary Public Health Section is responsible for the surveillance, prevention, and control of rabies in California. Currently, only animals that are exhibiting behavior or circumstances consistent with or pertinent to rabies or those animals involved in potential exposure incidents are tested for rabies.

Skunk Oral Rabies Placebo Bait Study

In 2004, the California WS program conducted a placebo bait research project in Sutter County (Figure 1). Two types of placebo baits were distributed on 2 separate sites at a density of 75 baits/km, along 3 transects covering an area of 24 km² (1,800 baits of each type). Placebo baits examined included: (1) Artemis Ontario Slim baits (Artemis Technologies, Inc., Guelph, Ontario, Canada), made with vegetable extract incorporated with tetracycline as a biomarker and (2) Merial Cylindrical baits (MERIAL Limited, Athens, Georgia, USA) made with fishmeal polymer and also containing a tetracycline biomarker. Live traps were placed every 0.5 km along each transect approximately 6 weeks after baits were distributed. Upon capture, each animal had blood drawn for rabies antibody analysis and the lower jaw bones were removed and sent to the NWRC to be tested for the presence of the tetracycline biomarker. Twenty six striped skunks were captured and tested (Table 1). Several non-target animals were captured and tested for presence of the biomarker, they included: 20 raccoons, 3 California ground squirrels (*Spermophilus beecheyi*), 31 opossums, 4 coyotes (*Canis latrans*) and 1 muskrat (*Ondatra zibethica*) (Table 1). Results from blood samples are pending. Heads of all animals captured were submitted to the CDHS to be tested for rabies. Results of from the examination of heads are pending.

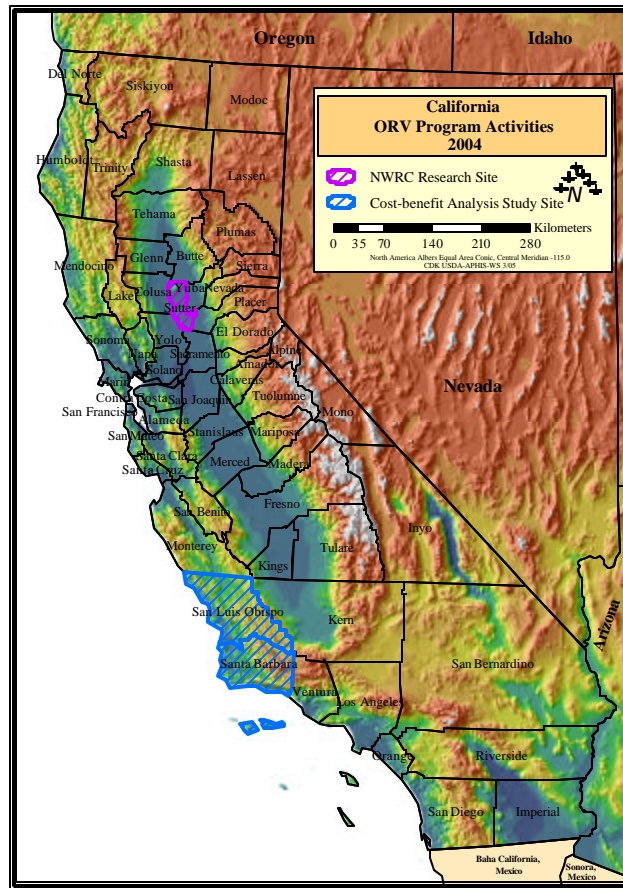


Figure 1. Oral rabies program activities in California, 2004.

Table 1. Results of jawbone analysis, sampled for presence of tetracycline biomarker, after consumption of a placebo ORV bait in California, 2004.

	Merial Cylindrical baits	Artemis Ontario Slim baits
Striped skunk	14 (50.0%)	12 (16.7%)
Opossum	17 (64.7%)	14 (35.7%)
Coyote	2 (0%)	2 (0%)
California ground squirrel	0	3 (100%)
Raccoon	6 (50%)	14 (50%)
Muskrat	0	1 (100%)

Cost-benefit Analysis Study

The CDHS was awarded funds from the WS program to design and conduct a cost-benefit analysis of using ORV to slow the spread or possibly eliminate skunk rabies in high risk regions in California (Figure 1). This study was deemed necessary to support the development and licensing of an effective skunk oral rabies vaccine and implementation of an ORV program on the West Coast. Results from this study are pending.

SUMMARY

In addition to the placebo bait study conducted in Sutter County, the California WS program is continuing to identify areas to conduct future placebo bait studies. Scientists at NWRC are conducting research on baits that could be more easily manipulated and consumed by skunks. This includes looking at different sizes, shapes, and flavors that could potentially be field tested in California during 2005. The California WS program will continue working with NWRC and CDHS on the development of baits for use in skunks in California.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM FLORIDA 2004

BACKGROUND

In 1947, raccoon (*Procyon lotor*) rabies was first documented in Florida and is now considered endemic statewide. During the late 1970s raccoon rabies was translocated by raccoon hunters from Florida to the Mid-Atlantic States, where it began to spread throughout the Eastern United States. An effective raccoon oral rabies vaccination (ORV) program in Florida would constitute an important southern component in the National ORV Program.

In 2004, Wildlife Services (WS) worked cooperatively with the Florida Department of Agriculture and Consumer Services (FDACS), Division of Animal Industry; the Florida Department of Health; the Florida Fish and Wildlife Conservation Commission; the Southwest Florida Water Management District; and the Florida Park Service on the Florida ORV Program. In addition, WS gained the support of many county and city agencies to aid with the planning and the implementation of the 2004 ORV bait drop.

ORV PROGRAM 2004

Bait Distribution

The objective of ORV in Florida was to expand the success of the Pinellas County ORV program, initiated in 1995, by establishing a vaccination zone in areas of high human population along the Interstate 4 corridor. The 2004 ORV bait zone in Florida encompasses 6,179 km² (2,386 mi²), and was baited for the second time in February 2004. The zone encompasses portions of Hernando, Hillsborough, Lake, Pasco, Polk, and Sumter Counties (Figure 1). During the February bait drop, 464,040 fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA), were distributed by air (both helicopter and fixed-wing), and 158,400 baits were distributed by hand. Pinellas County also distributed an additional 30,240 FMP baits. In 2004, the FMP baits were distributed by air at a rate of 75 baits/km² east of Interstate 75, and at a rate of 150 baits/km² west of Interstate 75. In 2004, 652,680 FMP baits were distributed within the Florida ORV zone. Aircraft and flight crew for the 2004 ORV program were provided by Ontario Ministry of Natural Resources. Ground and aerial baiting support were provided by WS, FDACS, and county and municipal agencies.

Enhanced Surveillance

In November 2004, WS received a call from a nuisance wildlife trapper who captured 3 raccoons from an area in Pasco County, which lied within the ORV bait zone. The capture location was a transitional area, between aerial and ground baiting zones. All 3 raccoons tested positive for the rabies virus. Focal ground baited is planned to ensure that ORV baits will be distributed within this transition area during the 2005 ORV bait drop.

Population Monitoring

Wildlife Services conducted 4 relative density studies in 2004, all coinciding with post-bait ORV program evaluation trapping. Study sites were located in Polk and Pasco Counties (Table 1). Blood samples were collected from 157 raccoons and sent to the Centers for Disease Control and Prevention (CDC) for rabies antibody testing. No raccoons were euthanized or found deceased in traps during these studies. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Other density studies were planned for 2004. However, 3 hurricanes caused those studies to be postponed. High water levels and downed trees prevented entry into sites that were chosen for study.

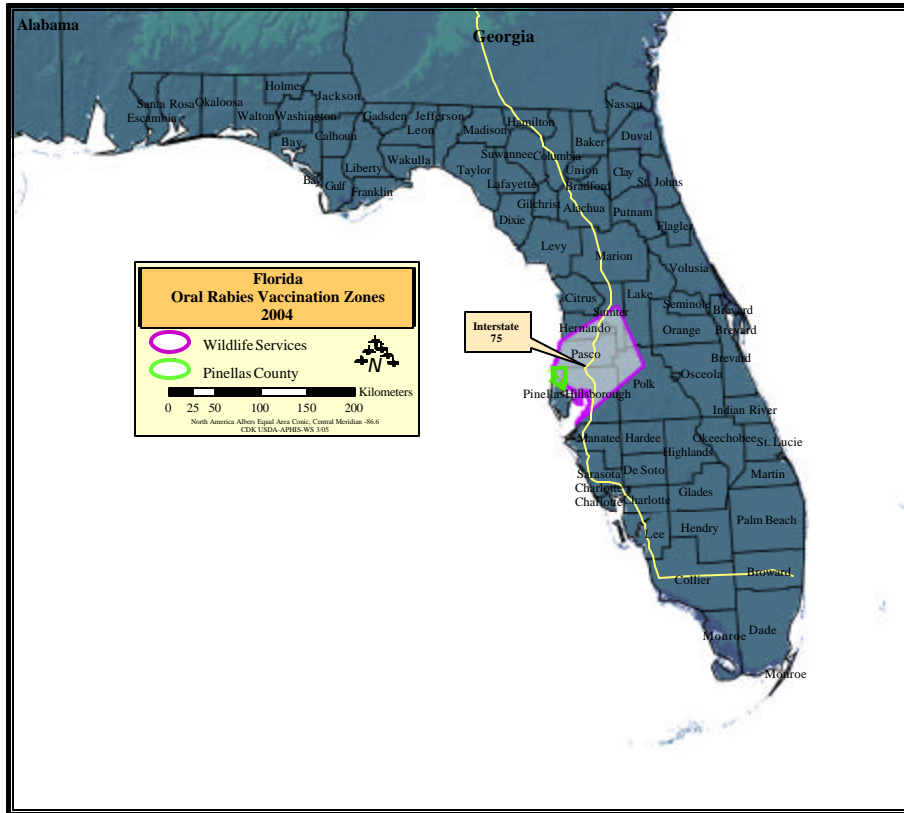


Figure 1. Oral rabies vaccination zones in Florida, 2004.

Table 1. Results of raccoon relative density studies in Polk and Pasco Counties, Florida, 2004.

	Trapping sites			
	Polk #1	Pasco #1	Pasco #2	Polk #2
Macrohabitat	Forest	Forest	Urban	Urban
Trap nights	450	500	500	450
Unique raccoons	18	49	56	34
Recaptured raccoons	14	58	57	34
Total raccoons	32	107	113	68
Trap success ^a	4.0%	9.8%	11.2%	7.6%
Non-target captures	79	66	128	59
Area (km ²)	3.45	4.85	2.08	2.51
Relative density index	5	10	27	14

^aunique raccoons

Post-bait Evaluation

In March 2004, WS commenced post-bait ORV trapping. At the conclusion of the post-bait ORV trapping, 270 tooth and blood serum samples were collected. One raccoon was euthanized after the animal bit 1 of the trappers. The raccoon tested negative for rabies. No raccoons were found deceased in traps during this time.

Non-target Captures

In 2004, non-targets were marked with spray paint at the base of the tail. This enabled WS personnel to identify the number of unique animals captured in an area. The greatest number of non-target animals captured were Virginia opossums (*Didelphis marsupialis*), with 256 unique animals captured. Also captured during 2004 were: 1 American alligator (*Alligator mississippiensis*), 1 turkey vulture (*Cathartes aura*), 3 gray foxes (*Urocyon*

cinereoargenteus), 3 nine-banded armadillos (*Dasyopus novemcinctus*), and 16 feral cats (*Felis cattus*). Seven feral cats were euthanized during the post-bait ORV trapping. These cats were removed from a State rest area, along Interstate 75, at the request of the security officers. One opossum was found deceased in a trap during a density study.

Other Rabies Activities

During the 2004 Polk #1 relative density study, a Southeastern Cooperative Wildlife Disease Study Biologist joined WS personnel for 2 days to sample Virginia opossums for parasites. Twelve opossums were sampled for parasites (ticks, fleas, and mites). Wildlife Services personnel collected blood and tooth samples from the opossums.

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline, and Age Results

Pre- and Post-bait Results.--During the 2002-2003 pre-bait ORV trapping, 201 unique raccoons were trapped. During the 2003 post-bait ORV trapping, 83 unique raccoons were trapped (Table 2). Yearlings dominated (59.5%) the population of raccoons trapped during the post-bait ORV trapping (Figure 2).

Table 2. Serology and tetracycline biomarker results of raccoon biological samples collected during pre- and post-bait ORV program evaluation in Florida, 2003.

	Collection period	
	Winter, pre-bait ORV	Spring, post-bait ORV
Serology		
Unique raccoon captures	201	83
Testable blood samples	201	83
Positive rabies antibody response ^a	16 (8.0%)	4 (4.8%)
Tetracycline		
Unique raccoon captures	201	83
Testable tooth samples	N/A	79
Presence of tetracycline biomarker	N/A	20 (25.3%)

^aCDC serum titer = 5

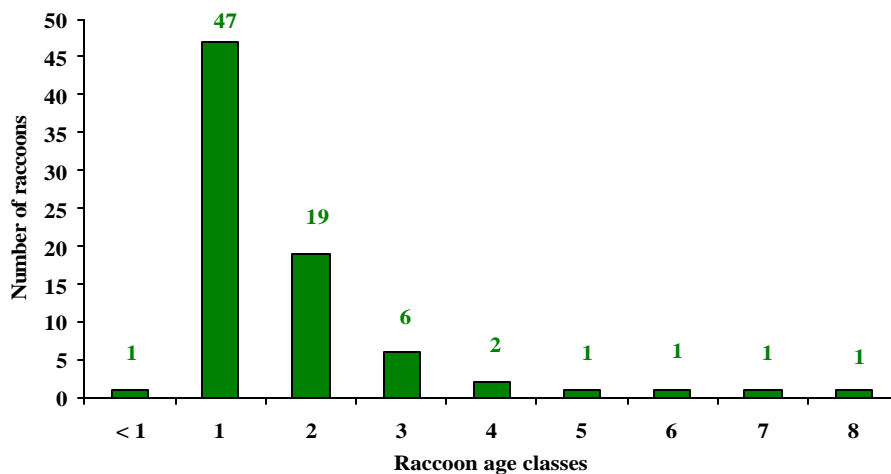


Figure 2. Age class distribution of 79 raccoon tooth samples collected during post-bait ORV program evaluation trapping in Florida, 2003.

Relative Density Study Results.--Five relative density studies were conducted in 2003: Polk (Forest: 26 June-6 July), Sumter (Forest: 24 July-2 August), Hillsborough #1 (Urban: 30 September-9 October), Hillsborough

#2 (Urban: 13 November-23 November), and Hillsborough #3 (Urban: 8 December-18 December). The Sumter study had the greatest percentage of raccoons (33.3%) with positive rabies antibody response and the Hillsborough #1 study had the greatest percentage of raccoons (14.4%) with presence of the tetracycline biomarker (Table 3).

Table 3. Serology and tetracycline biomarker results of raccoon biological samples collected during 5 relative density studies in Florida, 2003.

	Trapping sites				
	Polk	Sumter	Hillsborough #1	Hillsborough #2	Hillsborough #3
Serology					
Unique raccoon captured	56	21	62	95	43
Testable blood samples	56	21	62	95	43
Positive rabies antibody response ^a	13 (23.2%)	7 (33.3%)	10 (16.1%)	31 (32.6%)	9 (20.9%)
Tetracycline					
Unique raccoon captured	56	21	62	95	43
Testable tooth samples	54	18	52	91	40
Presence of tetracycline biomarker	3 (5.6%)	1 (5.6%)	8 (14.4%)	7 (7.7%)	3 (7.5%)

^aCDC serum titer = 5

The Hillsborough #2 study was the only density study to have more < 1-year-old raccoons captured than any other age class (Figure 3). The Hillsborough #1 study was the only density study to have more 2-year-old raccoons captured than any other age class (Figure 3). In the Polk density study, more 1-year-old raccoons were captured than the other age classes.

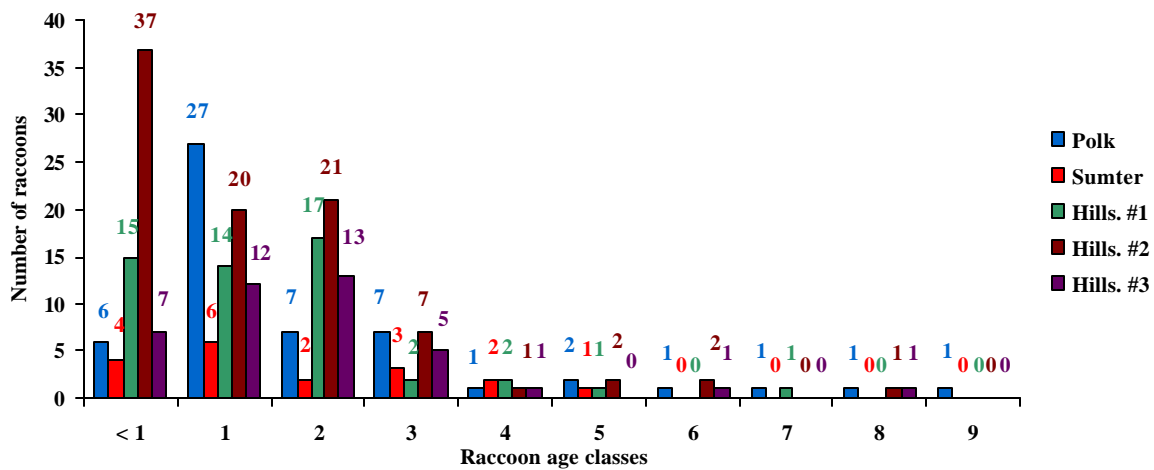


Figure 3. Age class distribution of 255 raccoon tooth samples collected during 5 relative density studies in Florida, 2003.

ORV PROGRAM 2004-EVALUATION

The Florida ORV bait distribution occurred in February 2004. Therefore, data and results presented in this report are for 2004. Data and results reports in all other reports, with the exception of Texas, are from 2003.

Serology, Tetracycline, and Age Results

2004 Trapping Results.--In 2004, 1 post-bait ORV trapping season and 4 relative density studies were completed (Table 4). The Polk #1 density study showed the highest positive rabies antibody response (38.9%), with 31.3% of the raccoons showing the presence of tetracycline biomarker (Table 4). This study was conducted simultaneous to the Pasco #1 study. Post-bait ORV trapping occurred until the end of April, while the Polk #2 study was initiated on 29 April and ended 8 May. The Pasco #2 study was performed during April. All 4 density studies and the post-bait sampling captured more 1-year-old raccoons than any other age class (Figure 4).

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected during post -bait ORV program evaluation and 4 relative density studies in Florida, 2004.

	Trapping sites				
	Post-bait	Polk #1	Pasco #1	Pasco #2	Polk #2
Serology					
Unique raccoon captures	270	18	49	56	34
Testable blood samples	270	18	49	54	34
Positive rabies antibody response ^a	81 (30.0%)	7 (38.9%)	16 (32.7%)	6 (11.1%)	3 (8.8%)
Tetracycline					
Unique raccoon captures	270	18	49	56	34
Testable tooth samples	233	16	43	48	30
Presence of tetracycline biomarker	32 (13.7%)	5 (31.3%)	5 (11.6%)	8 (16.7%)	1 (3.3%)

^aCDC serum dilution = 5

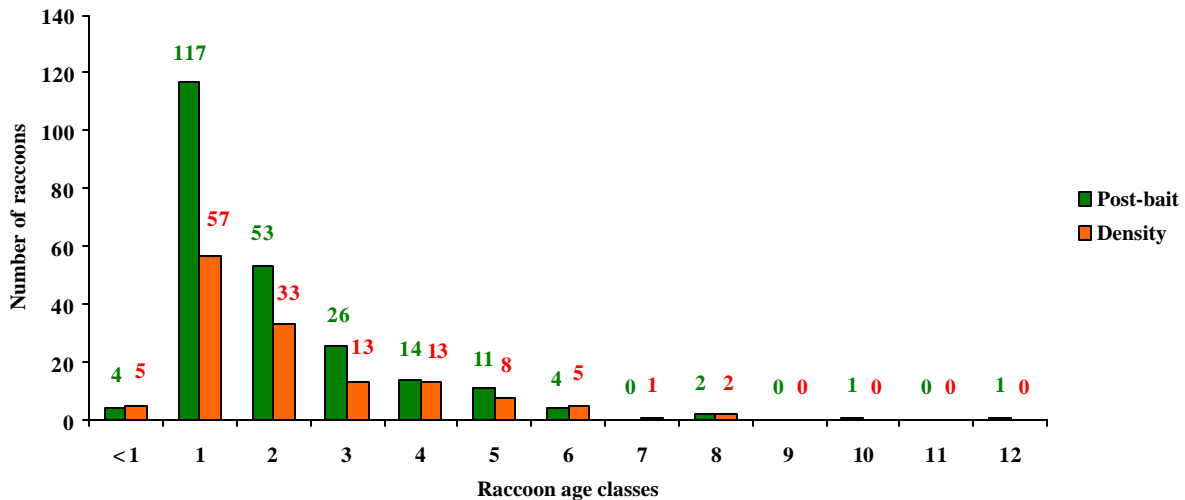


Figure 4. Age class distribution of 233 and 137 raccoon tooth samples collected during post -bait ORV random trapping and 4 relative density studies, respectively, in Florida, 2004.

Other 2004 Rabies Activities.--Twelve opossums were sampled for parasites during the 2004 Polk #1 study. Eleven testable tooth samples were collected, all with the tetracycline biomarker present. The opossums ranged from 2 to 7 years of age. Five (41.7%) of the 12 opossums had a positive rabies antibody response.

SUMMARY

During 2004, WS completed the third year of cooperative participation in the Florida ORV Program. The focus of activities this year was ORV bait distribution and resuming relative density studies within the bait zone area. In 2004, 652,680 baits were distributed by fixed-wing aircraft, helicopter, and by ground baiting activities across 6 counties. The baiting area encompasses 6,179 km²; 1,134,827 ORV baits have been distributed during the 2 years of baiting.

In 2005, Florida's baiting effort will continue to be an extension of the successful Pinellas County ORV Program. The Florida ORV Program is considering expanding the baiting zone from 6,179 km² to 7,191 km² in 2005. Enhanced surveillance and relative density studies will be increased in the coming year and research protocols are being developed to initiate an ORV bait station study.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM GEORGIA 2004

BACKGROUND

In 1947, raccoon (*Procyon lotor*) rabies was first documented in Florida. The disease spread northward, entering South Georgia during the 1960s. Raccoon rabies is now enzootic throughout the state. The Georgia Wildlife Services (WS) oral rabies vaccination (ORV) program began in April 2003. Initially, through the use of enhanced surveillance, Georgia's program was designed to help determine the leading edge of the Southeast (SE) raccoon rabies variant within the state. During the summer of 2003, it was determined that the distribution of ORV baits would occur in Georgia during November of 2003. This became a component of the Georgia-Alabama-Tennessee (GAT) ORV zone.

ORV PROGRAM 2004

In 2004, the Georgia ORV Program continued enhanced surveillance in the northwest portion of the state. The Georgia portion of the GAT ORV bait zone was expanded by 302 km² for the fall of 2004. Clearance was given to distribute baits on federal lands, which included the Chickamauga and Chattahoochee National Military Park and the Chattahoochee National Forest.

Bait Distribution

The Georgia portion of the GAT zone included portions of Catoosa, Chattooga, and Walker Counties, and all of Dade County (Figure 1). The hand distribution of fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), began on 3 November and aerial distribution began on 6 November 2004. Total baits distributed were 101,809 (69,409 by air and 32,400 by hand, respectively) over a 1,503.64 km² area. Since the inception of the program, a total of 200,438 FMP baits have been distributed.

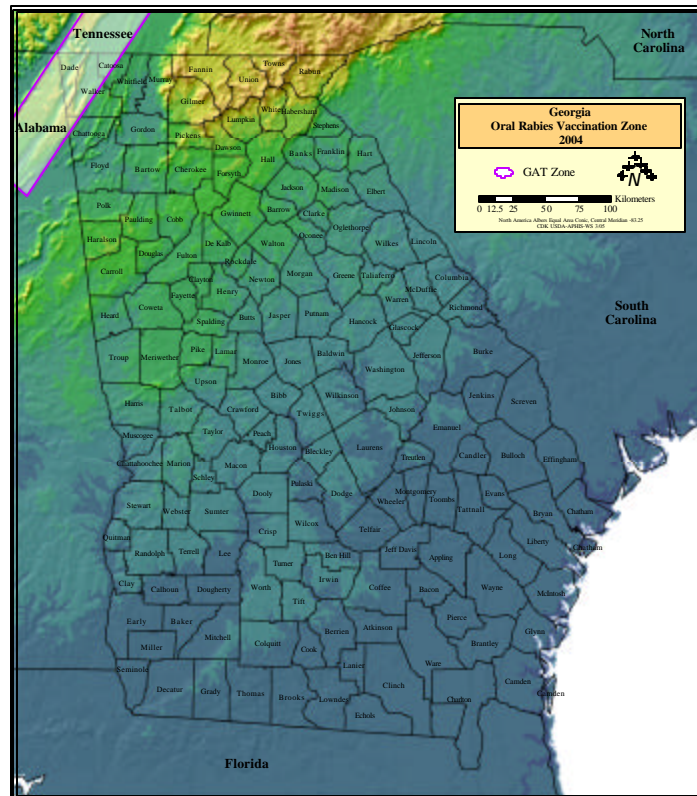


Figure 1. Oral rabies vaccination zone in Georgia, 2004.

Enhanced Surveillance

Georgia's enhanced surveillance included the collection of samples from road-killed animals and abnormally behaving/nuisance wildlife submitted by local animal control agencies. Two hundred twenty four samples, from a 5 county area in northwest Georgia, were submitted to the Centers for Disease Control and Prevention (CDC) for testing (Table 1). Animal species sampled included: bobcat (*Felis rufus*), cat (*F. catus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), raccoon, mink (*Mustela vison*), red fox (*Vulpes vulpes*), and striped skunk (*Mephitis mephitis*). Results determined that 10 (4.5%) of 224 animals submitted were positive for rabies. Nine of 10 animals were positive for the SE raccoon variant of rabies. The 1 exception was a raccoon from Catoosa County that tested positive for the big brown bat (*Eptesicus fuscus*) rabies variant.

Table 1. Enhanced surveillance animals collected for rabies testing, by county, in Georgia, 2004.

County	Bobcat	Cat	Coyote	Gray fox	Mink	Raccoon	Red fox	Skunk	Total
Catoosa			1	2 (1 positive)		73 (3 positive)	1	18 (2 positive)	95
Chattooga						6			6
Dade				3		13 (1 positive)			16
Walker	1	3	2	2	1	84 (3 positive)	3		96
Whitfield						11			11
Total	1	3	3	7 (1 positive)	1	187 (7 positive)	4	18 (2 positive)	224

Post-bait Evaluation

Post-bait ORV program evaluation trapping was conducted in December. The 2004 ORV zone was increased in size, which allowed for an increase in the post-bait ORV trapping area in Walker County and the expansion of the trapping area into Catoosa County. One hundred thirty eight raccoons were captured (Table 2). Samples were collected from 130 animals. One hundred four raccoons were ear-tagged and released, 26 were euthanized, and 4 were found deceased in the trap. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Results of post-bait ORV program evaluation trapping efforts in Georgia, December 2004.

	Post-bait ORV
Trap nights	1,090
Unique raccoons	134
Recaptured raccoons	4
Total raccoons	138
Trap success ^a	12.3%

^aunique raccoons

Non-target Captures

Non-target species captured and released during post-bait ORV trapping included: 293 opossums (*Didelphis virginiana*), 83 cats, 10 striped skunks, 3 dogs (*C. familiaris*), 1 sharp-shinned hawk (*Accipiter striatus*), 1 mouse (*Peromyscus* spp.), 1 gray squirrel (*Sciurus carolinensis*), 1 gray fox, and 1 eastern box turtle (*Terrapene carolina*). One opossum was found dead in the trap.

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Raccoon serum samples from the November 2003 post-bait ORV trapping (January 2004) were submitted to CDC for serologic analysis (Table 3). Tetracycline biomarker analysis and aging results are pending.

Table 3. Serology results of raccoon biological samples collected during post-bait ORV evaluation in Georgia, January 2004.

	Post-bait ORV
Serology	
Unique raccoon captures	122
Testable blood samples	116
Positive rabies antibody response ^a	35 (30.2%)

^aCDC serum titer = 0.05 International Units

SUMMARY

During its second year the Georgia ORV Program has continued to receive positive support from both its cooperators and the general public. Major cooperators were Georgia Department of Human Resources, Public Health Division; Georgia Department of Natural Resources; Georgia Department of Agriculture; and CDC. Additional support on the local level was provided by Catoosa County Animal Control, Walker County Animal Control, and the City of Chickamauga Police Department. These cooperators assisted in various aspects of the ORV program, including providing public information, aerial and hand bait distribution, and enhanced surveillance. Plans for the 2005 Georgia ORV Program are the continuation of enhanced surveillance and the distribution of baits in the GAT barrier zone.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM KANSAS 2004

BACKGROUND

In 2004, Kansas reported 99 positive rabies cases. Striped skunks (*Mephitis mephitis*) accounted for 69 (70%) of the positive results. These numbers were down from near record numbers, 123 (75%) of 164, of skunk rabies cases for the state in 2003. Despite slightly lower numbers of rabies cases in 2004, Kansas rabies cases remain higher than normal levels. For the second year personnel from Kansas Wildlife Services (WS) Program; Kansas State University, College of Veterinary Medicine Rabies Lab (KSUCVM); and the Fort Riley Military Installation (FRMI) have worked cooperatively to collect information on skunk rabies from the striped skunk population found on FRMI, located in northeast Kansas (Figure 1).

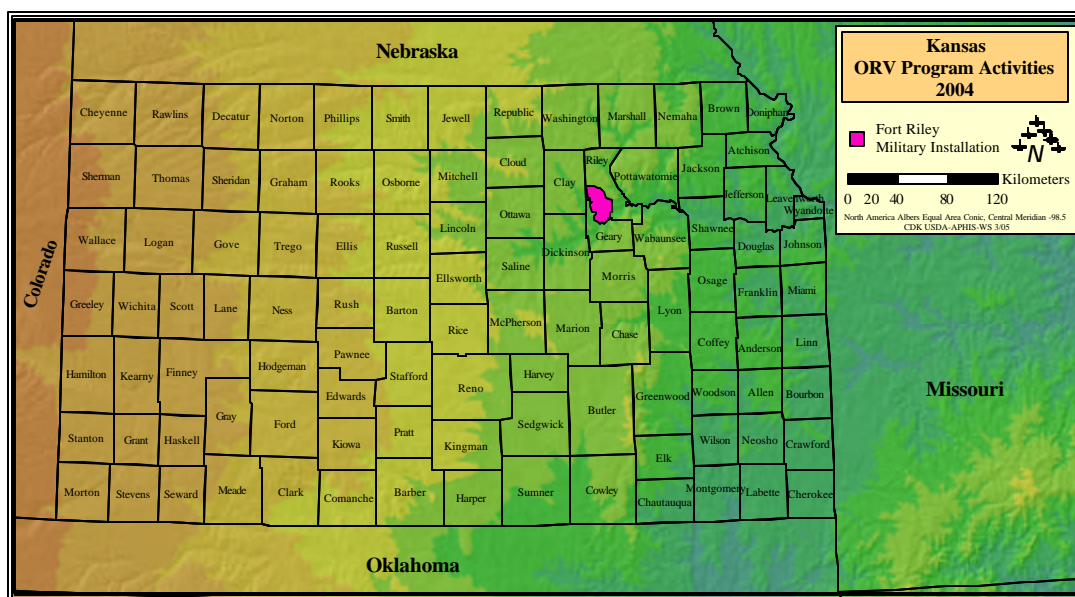


Figure 1. Location of Fort Riley Military Installation, Kansas.

Kansas WS currently has a full-time Wildlife Biologist stationed at FRMI. This Biologist normally collects rabies samples that have resulted in confirmation of a positive rabies case in striped skunks each year over the last several years. Wildlife Services also regularly removes several nuisance skunks each year, while responding to routine nuisance complaints on FRMI. Due to WS existing presence at FRMI and the nature of the land available to sample both urban and rural animal populations, it is an ideal location to monitor rabies and conduct relative density studies on the striped skunk, as well as the raccoon (*Procyon lotor*) populations.

ORV PROGRAM 2004

Currently, there is no oral rabies vaccination (ORV) in Kansas.

Enhanced Surveillance

Due to the unique situation at FRMI and the full-time WS Biologist stationed there, WS has access to all nuisance animals because of the reporting system in place. With a population of 20,000-30,000 soldiers, families, and civilians, FRMI is considered the ninth largest "city" in the state. Citizens of FRMI reported all nuisance animals, including sick or strange acting animals, to either the Military Police or a Public Works service order hotline. These reports are then funneled to the WS Biologist stationed there. This arrangement allows for excellent enhanced rabies surveillance.

Population Monitoring

In 2004, WS conducted 2 relative density studies to index striped skunk populations on FRMI. One study was conducted in the rural training areas on FRMI and the second was conducted in a heavily populated, urban area on FRMI (Table1). Numbers of animals captured in 2004 were similar to 2003, with the exception of raccoons. During spring of 2004, FRMI reported numerous cases of raccoons with canine distemper. This may explain why raccoon numbers appeared to be very low during sampling. All animals captured in 2004 were euthanized and handled according to the American Veterinary Medical Association guidelines.

Table 1. Results of relative density studies conducted during the summer on FRMI Kansas, 2004.

	Rural	Urban
Trap nights	450	500
Unique skunks	7	6
Unique raccoons	2	16
Trap success skunks	1.6%	1.2%
Trap success raccoons	0.4%	3.2%
Non-target captures	10 (opossums)	36 (opossums)
Relative density index - skunks	2.3 ^a	2
Relative density index - raccoons	0.67 ^a	5.3

^aindex formula is based on 500 trap nights

Non-target Captures

Forty six Virginia opossums (*Didelphis virginiana*) were captured and euthanized.

Other Rabies Activities

In 2004, Kansas WS Program initiated a rabies enhanced surveillance program for bats. Wildlife Services Biologists have access to hundreds of buildings on FRMI, with resident big brown bats (*Eptesicus fuscus*) inhabiting many of those buildings. In the past, nuisance bats were excluded and/or relocated. The only bats euthanized and collected for rabies testing were those that had contact with humans. Due to the high number of buildings that humans and bats co-occupy on FRMI, the Department of Defense Biologist wanted to investigate the prevalence of rabies in this local population. Currently, we are removing selected bats from different buildings, euthanizing them, and testing them for rabies. Results are pending.

SUMMARY

This was the second year that the Kansas WS Program has been involved with the National Rabies Management Program and there was again strong cooperator support from FRMI and the KSUCVM, for the work that was accomplish this year. Cooperators at FRMI continue to express interest in rabies monitoring for striped skunks, but are perhaps more interested in expanding monitoring efforts for bats as well. We believe that this could be an excellent opportunity for the rabies program to explore some basic rabies dynamics in a local bat population.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM KENTUCKY 2004

BACKGROUND

In 2002, enhanced rabies surveillance was conducted in Kentucky as an integral part of the Wildlife Services (WS) National Rabies Management Program to stop the westward spread of the raccoon (*Procyon lotor*) strain of rabies. In an effort to obtain baseline information on raccoon populations in Kentucky and actively search for raccoon rabies west of the Appalachian Ridge ORV zone, WS began conducting relative density studies and enhanced surveillance, through collecting and testing road-killed animals in the eastern counties bordering Ohio, Virginia, and West Virginia.

Activities conducted by WS are in cooperation with the Kentucky Department of Fish and Wildlife Resources (KDFWR), the Kentucky Department of Health, and the Centers for Disease Control and Prevention. The Kentucky Department of Forestry and the KDFWR provided access to state owned properties for ORV program trapping and monitoring.

ORV PROGRAM 2004

Enhanced surveillance

In 2004, WS contracted with the KDFWR to conduct enhanced surveillance for the raccoon strain of rabies in 21 counties in Kentucky (Figure 1). Sixteen raccoons, 7 striped skunks (*Mephitis mephitis*), 10 coyotes (*Canis latrans*), and 3 gray foxes (*Urocyon cinereoargenteus*) were collected from 10 counties on road kill survey routes. All samples tested negative for rabies.

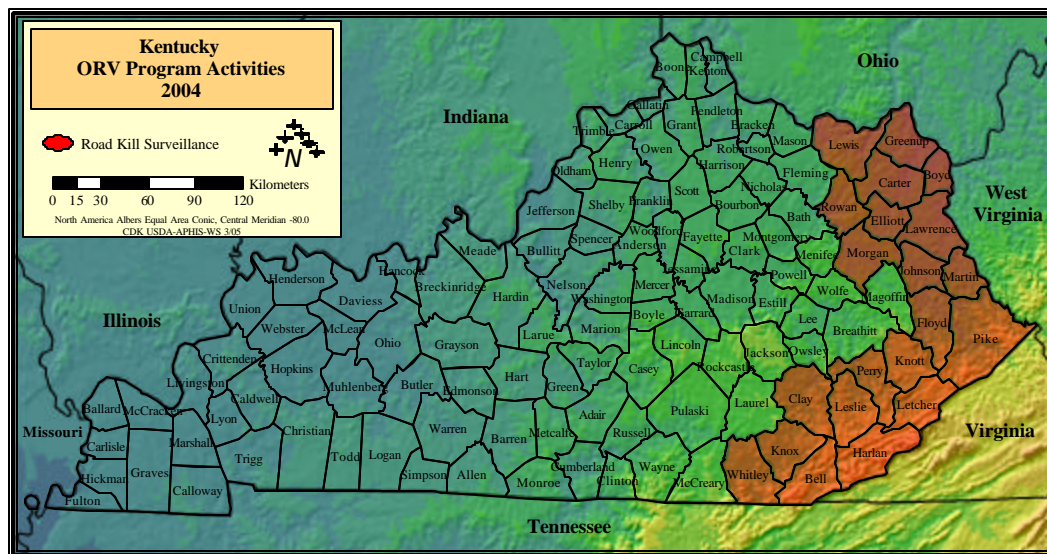


Figure1. Location of road kill surveillance in Kentucky, 2004.

Population Monitoring

In 2004, no relative density studies were conducted in Kentucky.

SUMMARY

In 2004, enhanced surveillance efforts resulted in the collection and testing of 36 animals ; all tested negative for raccoon strain rabies.

During 2005, WS will continue to conduct and coordinate enhanced surveillance for the raccoon strain of rabies in eastern Kentucky. Surveillance efforts will concentrate on 18 counties bordering Ohio, West Virginia and

Virginia. Additional relative density studies may be conducted to compare raccoon population characteristics between northeastern and southeastern Kentucky.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM LOUISIANA 2004

BACKGROUND

To date, there have been no reported cases of raccoon (*Procyon lotor*) strain rabies in Louisiana, although other strains (including bat [Order *Chiroptera*] and striped skunk [*Mephitis mephitis*]) do occur. During 2004, Wildlife Services (WS) continued participation in the placebo skunk bait studies being conducted by the National Wildlife Research Center (NWRC), Fort Collins, Colorado.

ORV PROGRAM 2004

Louisiana WS continued to assist NWRC personnel in conducting trials of placebo baits that may be used to deliver oral rabies vaccination (ORV) to skunks. Study sites were located in southwest Louisiana, in Cameron and Vermilion Parishes (Figure 1). Louisiana personnel assisted in setting up the studies, capturing mesocarnivores on the study areas, and processing biological specimens for shipment to analytical labs. Final results of this study are pending. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

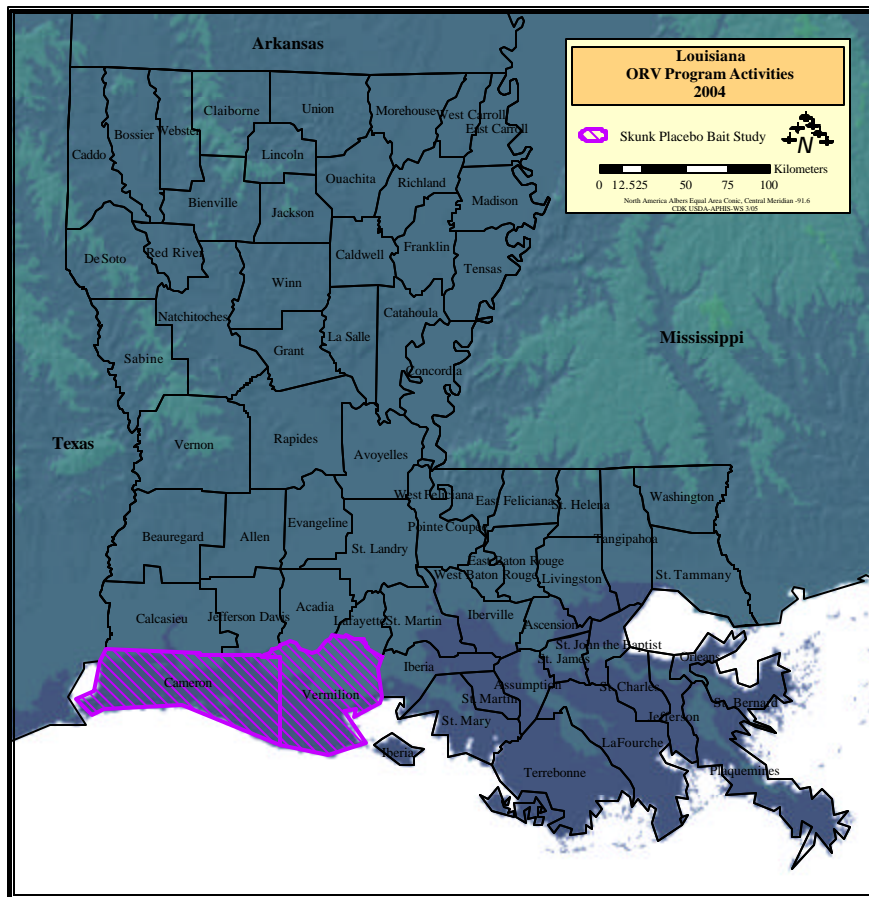


Figure 1. Oral rabies vaccination program activities in Louisiana, 2004

SUMMARY

This was the second year for rabies work in Louisiana. No enhanced surveillance was conducted in 2004 due in large part to poor sampling results obtained in 2003 and hiring challenges. Participation in the NWRC ORV placebo skunk bait study was continued.

**WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
MAINE 2004**

BACKGROUND

On 8 August 1994 the first case of raccoon variant of the rabies virus was confirmed in Maine by the Maine State Health and Environmental Testing Laboratory (MHETL). Since this date, 1,326 cases of rabies have been confirmed by the MHETL and raccoons (*Procyon lotor*) account for 702 (53%) of these cases (Table 1). During 2004, 69 positive rabies cases were confirmed by the MHETL, 37 (54%) were raccoons (J. Crosby, MHETL, personal communication). Wildlife Services (WS) is continuing an effort to vaccinate raccoons across the eastern United States, from Lake Erie to the Gulf of Mexico, in an attempt to prevent the western and northeastern spread of the mid-Atlantic raccoon rabies to areas naïve to this variant. To date, to combat the mid-Atlantic strain of rabies, WS has distributed over 50 million baits covering 69,500 mi² (180,000 km²) throughout the eastern United States. Since the first oral rabies vaccination (ORV) distribution in Maine (August 2003), 373,600 ORV baits have been distributed, via aerial and hand delivery, over a 1,600 mi² (4,200 km²) area.

Table 1. Confirmed positive rabies cases in Maine, 1994-2004 (MHETL, personal communication).

Year	Positive rabies cases	Positive raccoons
1994	10	0
1995	43	41
1996	131	53
1997	244	130
1998	248	143
1999	208	116
2000	139	73
2001	85	34
2002	67	37
2003	82	38
2004	69	37
Total	1,326	702 (53%)

The objective of the ORV program is to achieve rabies immunity in the susceptible raccoon populations of northern Maine and help prevent the northern and eastern spread of rabies into uninfected areas of Maine and Canada. Maine has a unique geographic distribution of human population densities, presumably influencing raccoon densities throughout the state. The primary land class in Maine is forest, which comprises approximately 18,000,000 acres (90%), of Maine's 20,000,000 acres. The northern section of Maine contains primarily forested habitat and human density is very low, as compared to the southern section of the state (USDA 1999). For example, Aroostook County, which is primarily forested land, has the largest county (6,672 mi²) in Maine and has the lowest human density of 75,000 people (11.1 people/mi²) (United States Census Bureau 2000).

In comparison, a southern Maine county, such as Cumberland County (836 mi²) has a population of approximately 270,000 people (317.9 people/mi²), with the primary land class categorized as developed land. Raccoons, being opportunistic animals, are able to thrive in and around urban habitats due to the availability of food and shelter. The majority of Maine's confirmed rabies cases are concentrated in southern Maine, along with the higher density of human populations. This correlation may reflect an increased likelihood of human wildlife interactions, therefore generating a higher number of reported rabies cases. Northern Maine supports five towns (Millinocket, Houlton, Presque Isle, Caribou, and Limestone) with concentrated human populations of 5,000 to 10,000. These are the areas of concern in which rabies could pose a problem of disease transmission, if able to reach these communities. Enhanced surveillance efforts and ORV bait placement are targeted towards creating a barrier to stop the progress of rabies in Maine.

Wildlife Services provides federal leadership by continuing to play an active role in project planning and coordination, organizing ground support for the bait drop, working in and navigating aircraft to distribute baits, and coordinating the hand distribution of baits in areas too populated to bait by air. The program is a cooperative effort among Cornell University, federal and state agencies, in international coordination, and community support.

ORV PROGRAM 2004

Bait distribution

The 2004 ORV project was based out of the Houlton International Airport in Houlton, Maine on 3 September 2004 (Figure 1). Fishmeal polymer (FMP) baits (97,100) were distributed by fixed-wing aircraft in northeastern Maine at a density of 70 baits/km². Five hundred of the FMP baits were distributed by hand, within Houlton, ME city limits. The baits, which contained Raboral V-RG® (MERIAL Limited, Athens, Georgia, USA), are a combination of fishmeal, fish oil, and wax and contain a tetracycline tooth biomarker. The 2004 ORV barrier, which averaged 15 miles wide and 50 miles long, encompassed 586 mi² (1,517 km²) of northeastern Maine, along the United States-Canadian border.

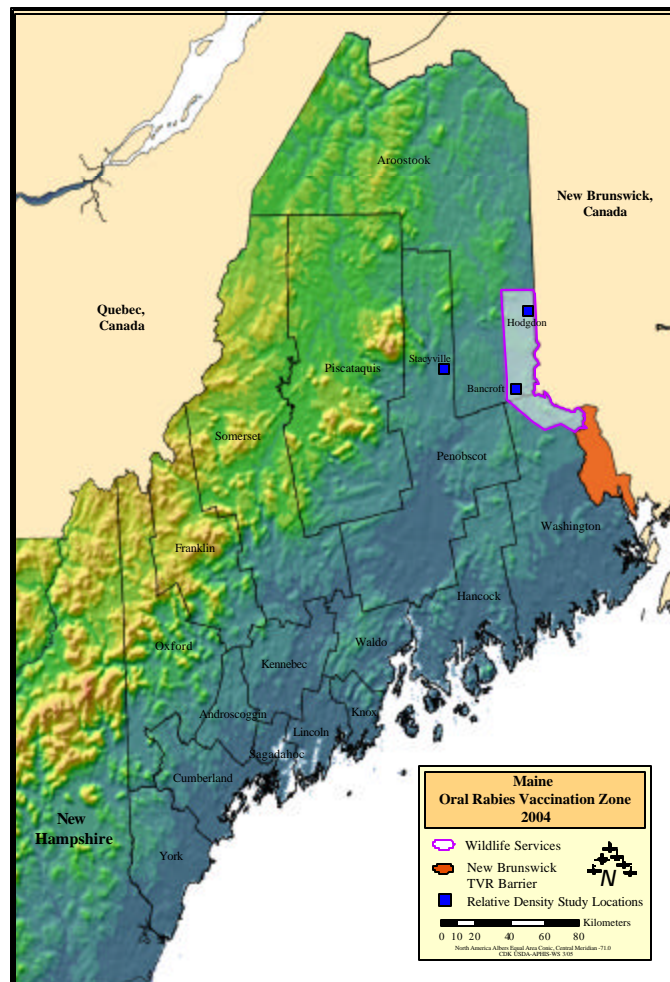


Figure 1. Oral rabies vaccination zone in Maine, 2004.

Enhanced Surveillance

WS conducted enhanced surveillance to help monitor the movement of rabies in northern Maine. Methods applied for surveillance were road kill surveys and the collection of sick or suspicious acting animals. An important tool in surveillance has been creating a network of agencies and individuals aware of the WS ORV program and WS intent to collect and test animals in Maine, in and around the ORV zone and from areas where rabies has not yet been documented. During 2004 WS provided logistics and funding for the testing of 28 animals in the ORV zone. All samples tested negative for rabies. Efforts to carry out enhanced rabies surveillance and public awareness will continue in 2005.

Population Monitoring

Since 2002 WS has conducted 7 raccoon relative density studies in northeast Maine (Table 2). Protocol for relative density studies involve setting 50 live traps, throughout a 3 km² area, in specified habitats for 10 consecutive nights. Biological data collected from each animal included: blood serum, for pre-bait ORV baseline rabies antibody levels and/or post-bait ORV antibody levels; tooth sample (upper premolar 1); sex; reproductive status; weight; age; and general health status.

Table 2. Raccoon relative density studies conducted in Maine, 2002-2004.

Year	Location	Relative density index km ²	Habitat type	Elevation
2002	Hodgdon	6	Forested	166 m
2002	Codyville	1	Forested	66 m
2003	Shin Pond	4	Forested	300 m
2003	Hodgdon	4	Forested	166 m
2004	Staceyville	4	Agriculture/forested	200 m
2004	Hodgdon	4	Forested	166 m
2004	Bancroft	5	Agriculture/forested	150 m

In 2004, WS conducted 3 raccoon relative density studies in Maine during July, August, and September. The first 2004 raccoon relative density study was conducted from 19-30 July and was located within Penobscot County, near Staceyville, Maine (Figure 1). Land use consisted of 50% agriculture (hay), 40% forested, and 10% wetlands. The study site was approximately 200 m above sea level. Twelve unique raccoons (4 adult males, 8 adult females) were captured, sampled, and released (Table 3). Non-target species captured and released included: 17 snowshoe hares (*Lepus americanus*), and 2 woodchucks (*Marmota monax*). All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 3. Results of relative density studies conducted in Maine, 2004.

	Staceyville pre-bait ORV	Hodgdon post-bait ORV	Bancroft post-bait ORV
Trap nights	500	500	500
Unique raccoons	12	11	16
Recaptured raccoons	8	4	16
Total raccoons	20	15	32
Trap success ^a	2.4%	2.2%	3.2%
Relative density index	4	4	5

^aunique raccoons

A second density study was located within Aroostook County, 5 miles west of New Brunswick, Canada, in the town of Hodgdon, Maine (Figure 1). This study was conducted from 23 July-3 September 2004. The entire study area was encompassed by the Lt. Gordon Manuel Wildlife Management Area. Habitat types included: forested, agriculture, and wetland. The study site was approximately 166 m above sea level. Twelve unique raccoons (5 adult males, 4 adult females, and 2 juvenile males) were captured and sampled (Table 3). Non-target species captured and released included: 9 pine martens (*Martes americana*), 7 snowshoe hares, and 2 striped skunks (*Mephitis mephitis*). One additional skunk was euthanized and submitted for rabies testing. The skunk tested negative for rabies.

The third density study took place in Bancroft, Maine, on 23 September-3 October 2004, 3 weeks following the 2004 ORV bait distribution (Figure 1). This study was located within the 2004 ORV bait zone and also provided post-bait ORV evaluation samples. Land use was comprised of agriculture, forested, wetland, seasonal cottages, and an adjacent river. The study site was approximately 150 m above sea level. Sixteen unique raccoons (6 juvenile males, 5 adult females, and 5 juvenile females) were captured and sampled (Table 3). Two nuisance raccoons were trapped, sampled, euthanized within this study area and tested for rabies. Both raccoons tested negative for rabies. Non-target species captured and released included: 11 snowshoe hares, 1 skunk, 1 red squirrel (*Tamiasciurus hudsonicus*), and 1 ruffed grouse (*Bonasa umbellus*).

Post-bait Evaluation

In 2003 and 2004, the location of the ORV zone in Maine has been on areas ahead of (north) the current rabies infected areas. This strategy was applied to help protect the current raccoon populations from the assumed advance of rabies. The placement of Maine's ORV zone is a northern continuation of neighboring New Brunswick, Canada's trap-vaccinate-release zone (Figure 1). Together, the international effort to help stop the northward and eastward spread of rabies covers approximately 161 km of the Maine and New Brunswick, Canada border. Since March 2002, New Brunswick, Canada, has maintained a "rabies-free" status. This followed the implementing a large scale trap-vaccinate-release (TVR) program.

Wildlife Services has played an essential role conducting post-bait ORV trapping throughout the ORV zone, which included parts of Aroostook and Washington Counties (Figure 1). During September and October 2004, 105 raccoons were captured, handled, and released within the ORV zone (Table 4). Biological data collected from each animal included: blood, tooth sample (upper premolar 1), sex, reproductive status, weight, age, and assessed general health. Blood serum and tooth biomarker samples will be tested to determine the number of raccoons vaccinated during the second ORV distribution in Maine. Blood serum samples of raccoons exposed to the FMP baits are expected to have elevated levels of rabies antibodies. Teeth of raccoons exposed to the baits should show presence of the tetracycline biomarker. Non-target species captured and released included 9 skunks. Two additional nuisance skunks were trapped and euthanized for rabies testing. Both skunks tested negative for rabies.

Table 4. Results of post-bait ORV program evaluation efforts in Maine, 2004.

	Post-bait ORV
Trap nights	1,180
Unique raccoons	105
Recaptured raccoons	10
Total raccoons	115
Trap success ^a	8.8%

^aunique raccoons

ORV PROGRAM 2003- EVALUATION

During 2003, WS conducted the first cooperative ORV bait distribution in Maine. To evaluate program effectiveness WS conducted post-bait ORV trapping to analyze rabies antibody levels and age classes within the ORV zone (Table 5, Figure 3). In addition, WS conducted 2 raccoon relative density studies during 2003 to help determine raccoon densities in northern Maine to help strategize future ORV projects.

Table 5. Serology and tetracycline biomarker results of raccoon biological samples collected during pre- and post-bait ORV program evaluation in Maine, 2003.

	Summer, pre-bait ORV	Fall, post-bait ORV coated sachet (no biomarker)	Fall, post-bait ORV FMP (biomarker)
Serology			
Unique raccoon captures	11	64	54
Testable blood samples	11	63	54
Positive rabies antibody response ^a	0	11 (17.4%)	17 (31.5%)
Tetracycline			
Unique raccoon captures	NA	NA	54
Testable tooth samples	NA	NA	53
Presence of tetracycline biomarker	NA	NA	19 (35.8%)

^aNew York State Department of Health serum titer = 0.125 International Units.

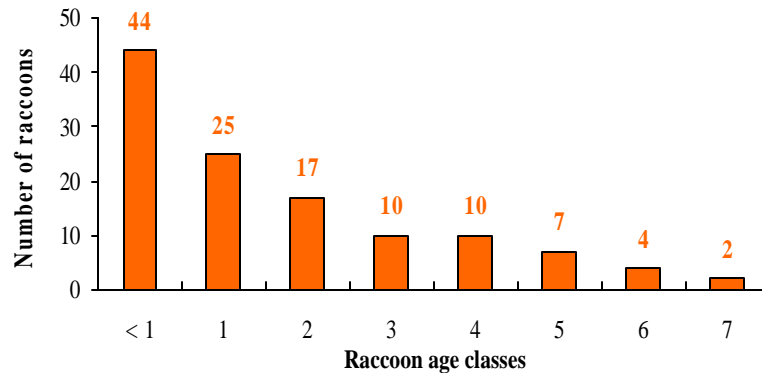


Figure 3. Age class distribution of 119 raccoon biological samples collected during pre- and post-bait ORV program evaluation in Maine, 2003.

SUMMARY

The United States and Canada have implemented rabies prevention efforts to stop the spread of raccoon strain rabies further north and east. Enhanced surveillance efforts, along with raccoon population density research, in northern Maine, have helped define where rabies is present, the direction the virus is spreading, and the raccoon populations it may affect. Continuing efforts of enhanced surveillance, raccoon relative density research, and continuing participation in the National Rabies Management Program are goals of the 2005 Maine WS Rabies Program. In addition, WS continues to work with state agriculture, health and wildlife agencies, animal control officers, and rehabilitators to stop the spread and ultimately eliminate terrestrial rabies in Maine.

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WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MARYLAND 2004

BACKGROUND

In 1981, raccoon (*Procyon lotor*) rabies first entered Maryland in Allegany County. It quickly spread and is now present throughout the state. In 1982, raccoon rabies was first documented in Anne Arundel County. In 2000, Anne Arundel County reported 43 cases of rabies, a downward trend from the 97 and 73 cases reported in 1997 and 1998, respectively. From 1996-1998 an average of 18 cases of rabies was reported from the Annapolis Peninsula alone.

In October 1998, the Anne Arundel County Department of Health initiated an oral rabies vaccination (ORV) program on the Annapolis Peninsula. Fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), have been distributed each year on the Annapolis Peninsula (94 km²) since October 1998, on Gibson Island (4 km²) since 2000, and on the Broadneck Peninsula (88 km²) since 2001. With the assistance of Wildlife Services (WS) in 2003, ORV efforts expanded to include the entire area (1,080 km²) of Anne Arundel County, Maryland. This is a cooperative effort between WS and the Anne Arundel County Department of Health. Wildlife Services provides the major source of funds for project implementation.

In 2003, the Appalachian Ridge ORV project expanded the eastern boundary into Garrett County, Maryland. To date, WS has distributed 59,420 FMP baits in Garrett County.

ORV PROGRAM 2004

Bait Distribution

Anne Arundel County.--The 2004 ORV efforts included all (1,080 km²) of Anne Arundel County, with 87,082 FMP baits, distributed (Figure 1). On 9 August, 35,280 FMP baits were distributed by fixed-wing aircraft. From 12-20 August, 39,822 FMP baits were distributed by helicopter. From 10-24 August, ground teams distributed 11,980 FMP baits by hand. The fixed-wing aircraft and flight crew were provided by Dynamic Aviation and the helicopter and flight crew were provided by the Anne Arundel County Police Department. Baiting efforts and support were provided by WS and the Anne Arundel County Department of Health.

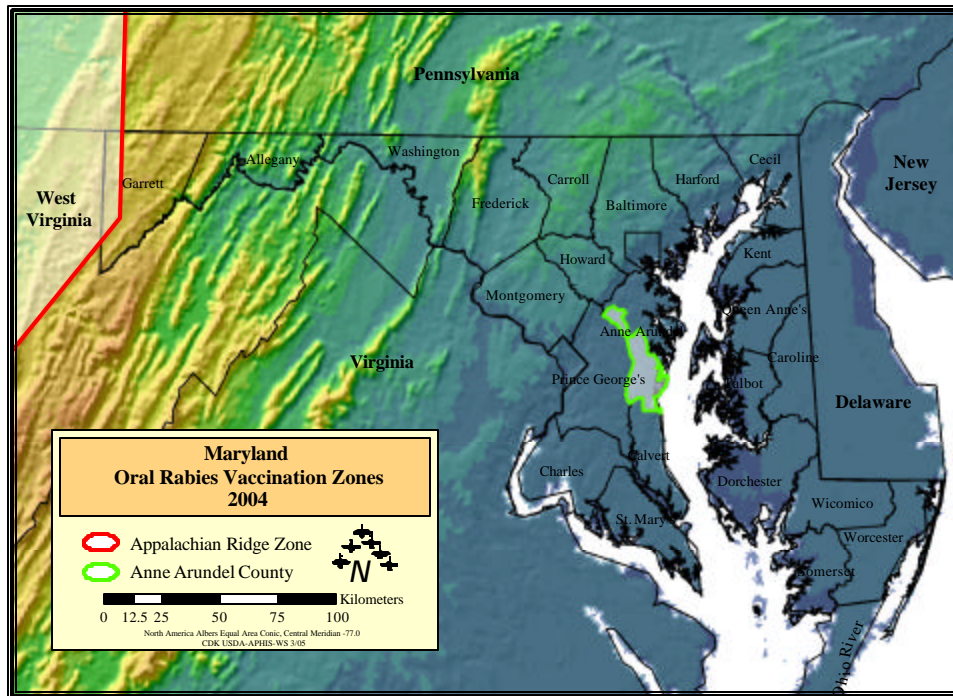


Figure 1. Oral rabies vaccination zones in Anne Arundel and Garrett Counties, Maryland, 2004.

Garrett County.--The fall of 2004 marked the second year of the eastward expansion of the Appalachian Ridge ORV program into Maryland. From 15-19 August, WS distributed 10,629 FMP baits by fixed-wing aircraft in Garrett County (Figure 1). Ground teams distributed an additional 360 FMP baits by hand. Aerial baiting efforts and support were provided by WS, and ground baiting was provided by the Garrett County Department of Health.

Enhanced Surveillance

WS submitted 58 blood and tooth samples collected from raccoons trapped by a Nuisance Wildlife Control Cooperator in Anne Arundel County.

Post-bait Evaluation

On 7 September 2004, WS initiated post-bait ORV trapping to collect blood and tooth samples to evaluate and monitor program success in Anne Arundel County (Table 1).

Table 1. Results of post-bait ORV program evaluation trapping in Anne Arundel County, Maryland, 2004.

	Post-bait ORV
Trap nights	663
Unique raccoons	139
Recaptured raccoons	11
Total raccoons	150
Trap success ^a	20.9%

^aunique raccoons

Levels of rabies virus neutralizing antibodies in relative density and post-bait ORV live-trapped raccoons will be used to help determine the effectiveness of current ORV baiting in Anne Arundel County. The location of recaptures will also aid in determining home range size/movement patterns of the raccoons within the study areas. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Non-target Captures

Fifty six non-target animals were captured and released in 2004, they included: 10 feral cats (*Felis catus*), 41 Virginia opossums (*Didelphis virginiana*), 1 Eastern cottontail rabbit (*Sylvilagus floridanus*), 2 Eastern box turtles (*Terrapene carolina carolina*), and 2 gray squirrels (*Sciurus carolinensis*).

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Levels of rabies virus neutralizing antibodies in pre- and post-ORV live-trapped raccoons will be used to help determine the effectiveness of current ORV baiting in Anne Arundel County. The location of recaptures will also aid in determining home range size/movement patterns of the raccoons in the study areas. From 22 July-1 August 2003, WS conducted a raccoon relative density study in the Hanover area of Anne Arundel County. On 22 September 2003, WS initiated post-bait ORV trapping to collect blood and tooth samples to evaluate and monitor project success in Anne Arundel County (Table 2 and Figure 2).

Table 2. Results of pre- and post-bait ORV program evaluation trapping in Anne Arundel County, Maryland, 2003.

	Density study, pre-bait ORV	Fall, post-bait ORV
Trap nights	500	1,075
Unique raccoons	27	133
Recaptured raccoons	8	18
Total raccoons	35	151
Trap success ^a	5.4%	12.4%
Positive rabies antibody response ^b	7.4%	28.3%
Tetracycline presence	No teeth collected	24%

^aunique raccoons

^bCenters for Disease Control and Prevention serum titer = 5

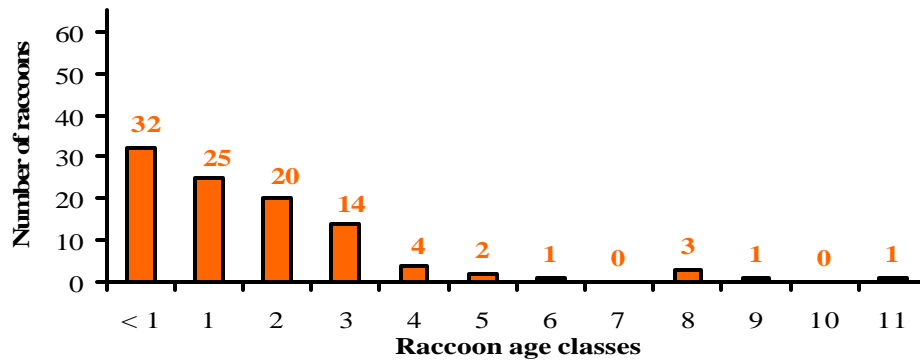


Figure 2. Age class distribution of raccoon biological samples collected during post-bait ORV program evaluation in Anne Arundel County, MD 2003.

SUMMARY

The fall of 2004 marked the second year of the eastward expansion of the Appalachian Ridge ORV program in Maryland, where WS distributed 10,629 FMP baits. The fall of 2004 also marked the fourth year of WS cooperative participation in the Anne Arundel County Department of Health ORV program. To date, 229,057 FMP baits have been distributed in Anne Arundel County.

During the 3 years prior to the beginning of the Annapolis Peninsula ORV program, in October 1998, an average of 19 rabid animals were reported from the Annapolis Peninsula alone. Since 1998, when the ORV program was initiated, 7 rabid raccoons have been reported from the Annapolis Peninsula, 1 in 1999, 1 in 2003, and 5 in 2004. From 2002-2004, the Anne Arundel County Department of Health reported 49 rabid raccoons from Anne Arundel County. Eighteen raccoons were reported in 2002, 14 in 2003 and 17 in 2004.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MASSACHUSETTS 2004

BACKGROUND

In 2004, Wildlife Services (WS) continued to support the Cape Cod Oral Rabies Vaccination program (CCORV) in southeastern Massachusetts. This WS, Tufts University (TU), Massachusetts Department of Public Health (MDPH), and Barnstable County Department of Health and the Environment (BCDHE) cooperative project (1994-present) was originally designed to reduce the incidence of terrestrial rabies in a 420–712 km² area directly adjacent to the Cape Cod Canal, in order to prevent the spread of rabies to Cape Cod, a heavily populated tourist destination south of Boston. In 2001, full-time assistance from WS began and has included bait acquisition and distribution, membership on the Massachusetts state and Barnstable County Rabies Advisory Committees, program evaluation and surveillance trapping, and oral rabies vaccination (ORV) related wildlife research. Additional cooperators in the CCORV program include: Massachusetts Military Reservation; Humane Society of the US (HDUS), Cape Wildlife Center; Elder Services, Senior Environment Corps; Massachusetts Department of Conservation and Recreation; Massachusetts Department of Food and Agriculture; Massachusetts Division of Fisheries and Wildlife; and other university, state, county, and local governments.

ORV PROGRAM 2004

Rabies Epizootic on Cape Cod

In 2002-2003, increased rabies activity had been detected in raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) within the ORV barrier, with approximately 20 rabies cases reported within the barrier during 2003. In late February 2004, the raccoon variant of rabies was reported south of the Cape Cod Canal. This was the first confirmed case of raccoon variant rabies on Cape Cod.

The source of the Cape Cod rabies epizootic is unknown. However, on 9 May 2004, WS was notified that a Nuisance Wildlife Control Officer (NWCO) removed a WS-tagged raccoon from an attic in a Cape Cod home. The raccoon was originally captured in October 2003, during a relative density study north of the Cape Cod Canal. This represented a 20 km, southward, linear movement across the Cape Cod Canal. This case highlights the risk of rabies transmission across the Cape Cod Canal and raises questions about possible translocation of animals to the Cape.

Enhanced Surveillance.--Wildlife Services, MDPH, and BCDHE established a program to support enhanced rabies surveillance efforts on Cape Cod to track the peninsular rabies epizootic. Cooperative surveillance was intensified during 2004, with road kill surveys and notification of sick and strange acting to WS by NWCOs and town officials. Wildlife Services and Barnstable County co-funded the packaging and shipment of town-collected enhanced surveillance rabies specimens from the entire Cape, with special emphasis placed on surveillance specimens from the mid to outer portions of the Cape.

Funding, provided by WS and Barnstable County, was in response to affected towns not having money in their respective budgets to cover costs. In addition, 2 WS Wildlife Disease Program Biologists assisted with developing enhanced rabies surveillance networks, by calling town officials and citizens in critical Cape Cod towns. Surveillance specimens, collected by WS and town officials, were transported to central locations for shipment to the MDPH Laboratory for testing. Test results were used for future ORV planning and other contingency actions (Figure 4). Between March and December 2004, 124 of 640 (19.4%) animals (103 of 470 [21.9%] raccoons, and 20 of 93 [21.5%] skunks) submitted from Cape Cod to the MDPH tested positive for rabies (Figure 1).

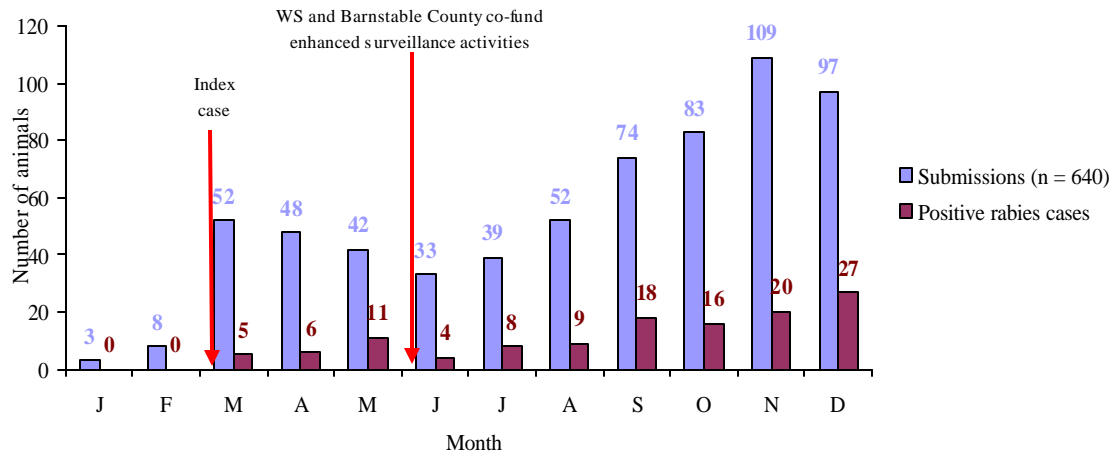


Figure 1. Rabies enhanced surveillance submissions on Cape Cod, Massachusetts, 2004.

Intensive road kill surveys were conducted by WS as part of enhanced surveillance. Mandibles and/or teeth were removed for aging and tetracycline biomarker detection; specimens were sexed, weighed, assessed for reproductive status, and screened for rabies lab-quality. Animals with intact craniums that were not badly decomposed were submitted to the MDPH Laboratory. The prevalence of rabies in road-killed raccoons was low, when compared with enhanced surveillance specimens submitted from residential communities where they were reported as sick-acting (Table 1).

Table 1. Rabies prevalence among enhanced surveillance specimens from various sources on Cape Cod, Massachusetts, 2004^a.

Specimen source	Number	Rabies-positive (%)
Residential	47	29.7
Trapped (deemed sick after capture)	7	28.6
Road kill	14	14.3
Commercial	5	0
Unsuitable for testing (MDPH) ^b	18	-

^anot inclusive of many specimens submitted directly by town officials, via the cooperative surveillance network

^bunsuitable surveillance specimens were excluded from analyses

Trap-Vaccinate-Release.--In response to the Cape Cod rabies outbreak, WS and CCORV cooperators initiated a 13 day trap-vaccinate-release (TVR) program on Cape Cod, from 14-27 April (Figure 2).

During the TVR program, 481 unique raccoons and 20 unique skunks were captured over 3,800 trap nights in the towns of Bourne, Sandwich, Mashpee, and Falmouth (Table 2).

Table 2. Raccoon and striped skunk age and sex structure for the TVR program on Cape Cod, Massachusetts, 2004.

	Adults	Juvenile (< 1 year old)
Unique raccoons (n = 481)	459 (95.4%) ^a	22 (4.6%)
Female	170 (35.3%)	13 (2.7%)
Male	287 (59.7%)	9 (1.9%)
Unique skunks (n = 20)	20 (100.0%)	-
Female	14 (70.0%)	-
Male	6 (30.0%)	-

^a2 adult raccoons were not sexed

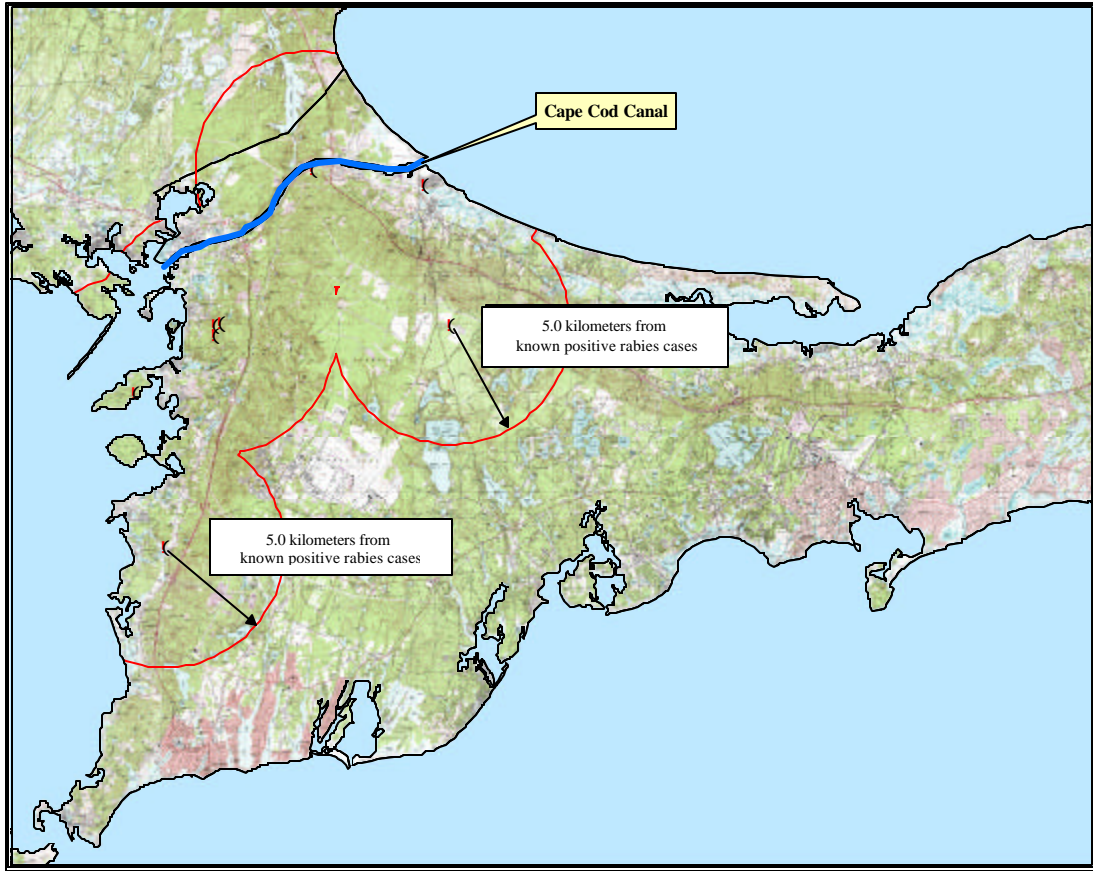


Figure 2. Trap-vaccinate-release zone on Cape Cod, Massachusetts, 2004. (TVR occurred within the zone south of the Cape Cod Canal.)

All raccoons and skunks were injected with 1 cc of Imrab™ rabies vaccine (donated by Merial Limited, Athens, Georgia, USA); sampled for age, sex, weight, reproductive status, ORV bait uptake (tetracycline tooth biomarker), and pre-TVR rabies antibodies levels (Table 3). Results are pending for the tetracycline tooth biomarker. All but 6 animals were ear-tagged and released at the point of capture. Four raccoons were euthanized and 2 additional raccoons were found dead in the traps. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 3. Age and serology results for the TVR program on Cape Cod, Massachusetts, 2004^a.

	Positive rabies antibody response ^b (%)
Unique raccoons ^c (n = 440)	15.1
Adult female (n = 159)	13.2
Adult male (n = 262)	15.6
Juvenile female (n = 13)	15.3
Juvenile male (n = 6)	50.0
Unique skunks (n = 16)	12.5
Adult female (n = 12)	8.3
Adult male (n = 4)	25.0

^amost recent ORV baiting in this area was November 2003, which may affect serology

^bCenters for Disease Control and Prevention (CDC) serum titer = 0.05 International Units (IU)

^cAge and sex was not recorded on 3 raccoons

Bait Distribution.--In March, in response to the Bourne index case, WS and CCORV cooperators distributed fishmeal polymer (FMP) baits containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA) over portions of the Cape (Figure 3). In April and May, concurrent with TVR efforts, WS and CCORV cooperators initiated a second baiting campaign, distributing FMP baits over parts of the Cape by ground and US Coast Guard helicopter. In October, FMP baits were again distributed by ground and air over portions of the mid-Cape after enhanced surveillance revealed a potential new epizootic front around the town of Dennis (Table 4 and Figure 4).

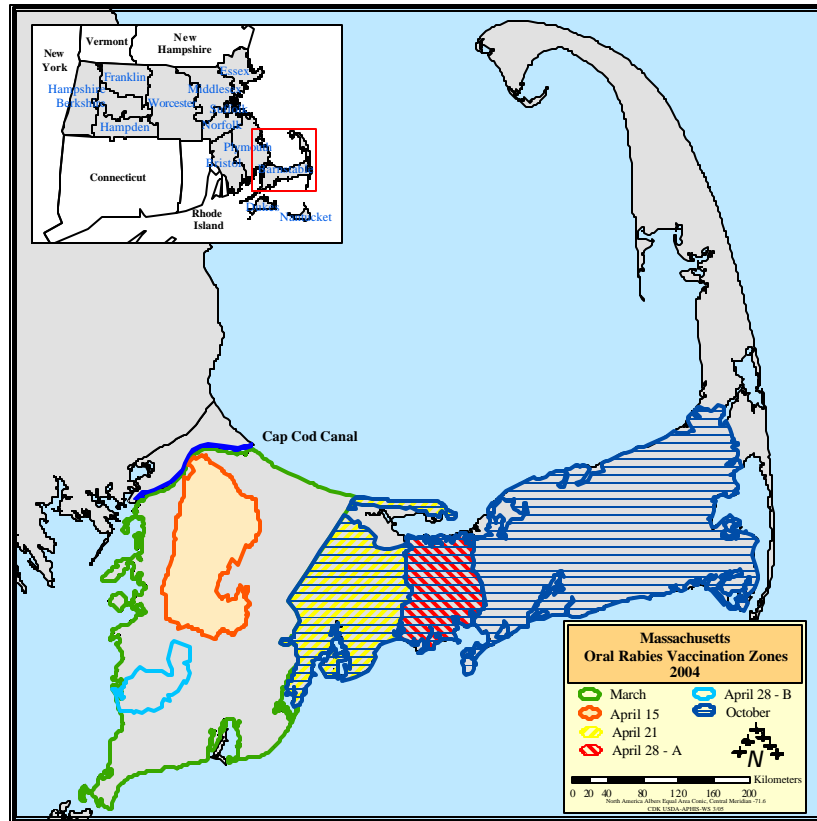


Figure 3. Oral rabies vaccination zones on Cape Cod, Massachusetts, 2004.

Table 4. Oral rabies vaccination baits distributed on Cap Cod, Massachusetts, 2004.

Baiting campaign	Baits distributed	Area baited (km ²)	Baits/km ²
March	31,702	272	116
April	23,007	190	121
April (aerial) ^a	8,640		
May-June	2,717	16 ^c	170
October	44,472	282	158
October (aerial) ^a	2,386		
	Total 101,898	Total 760^{bc}	Average 141

^aincluded with ground baiting

^bsome provided to cooperators; baiting area estimated for May-June distributions

^coverlap in March and April baited areas

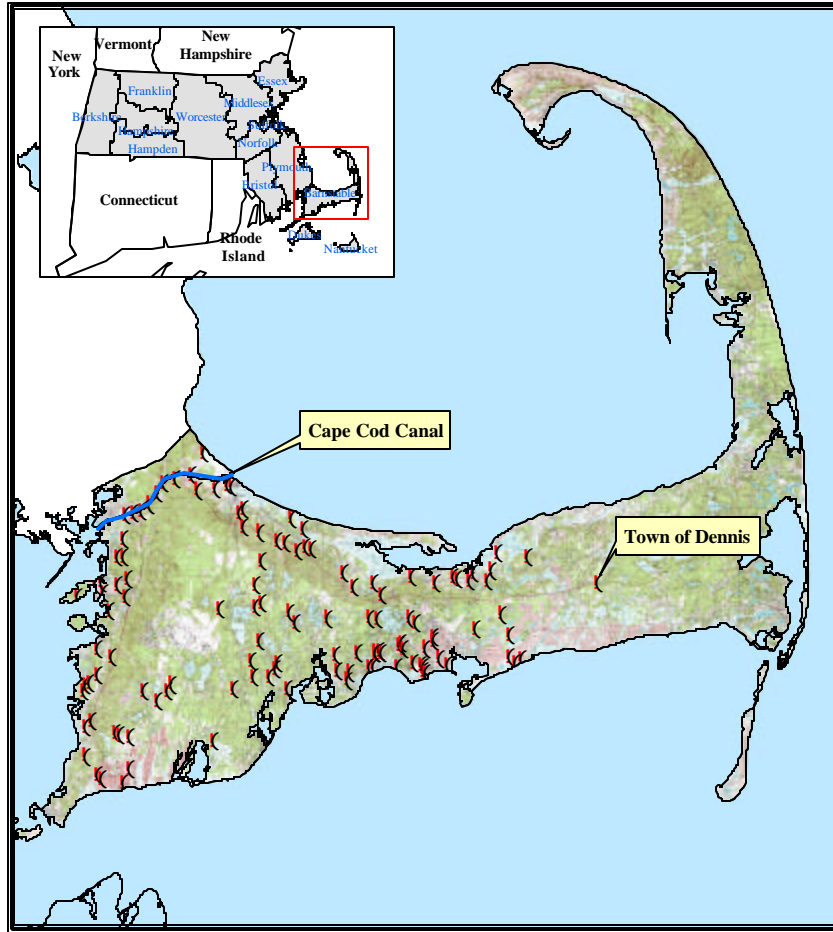


Figure 4. Locations of confirmed raccoon and striped skunk rabies cases in Barnstable County, Massachusetts, 2004.

Post-bait Evaluation

Concurrent with efforts to locate rabies surveillance specimens, WS conducted post-bait ORV surveillance trapping in 5 Cape Cod towns to assess bait uptake and vaccination rates. All raccoons and skunks were injected with 1 cc of Imrab™ rabies vaccine (donated by Merial Limited, Athens, Georgia, USA); sampled for age, sex, weight, reproductive status, ORV bait uptake (tetracycline tooth biomarker), and rabies antibodies levels. Sixty five unique raccoons and 5 unique skunks were captured (Table 5). Two raccoons were euthanized and 2 additional raccoons were found dead in the traps.

Table 5. Age and sex structure of trapped raccoons and striped skunks during post -bait ORV program evaluation on Cape Cod, Massachusetts, 2004.

	Adult	Juvenile (< 1 year old)
Unique raccoons (<i>n</i> = 65)	46 (70.7%) ^a	19 (29.2%)
Female (<i>n</i> = 24)	17 (26.2%)	7 (10.8%)
Male (<i>n</i> = 40)	28 (43.1%)	12 (18.5%)
Sex unknown (<i>n</i> = 1)	1 (100%)	0
Unique skunks (<i>n</i> = 5)	4 (80.0%)	1 (20.0%)
Female (<i>n</i> = 1)	1 (20.0%)	0
Male (<i>n</i> = 4)	3 (60.0%)	1 (20.0%)

Other Rabies Activities

Bait Preference Study.--As part of a national-level research project, WS implemented a pilot study to assess the utility of automatic cameras for assessing ORV bait uptake and fate of baits. In May 2004, automatic cameras were deployed in culverts and wooded areas along the Cape Cod Canal, and in October 2004, cameras were deployed on Myles Standish State Forest. Initial results suggest that this strategy has promise for assessing bait uptake and fate of baits. Vegetation and non-target animals triggering the cameras were problematic throughout the project. This pilot work was conducted in preparation for a larger-scale effort to assess coated sachet ORV bait uptake in raccoons and skunks in the United States and the small Indian mongoose (*Herpestes auropunctatus*) in Puerto Rico.

Tracking Station Utility Study.--Wildlife Services initiated a long-term, track-based relative density index study (2002-2003) to further assess raccoon use of pitch pine (*Pinus rigida*)/scrub oak (*Quercus ilicifolia*) habitats and to test passive and scented track station effectiveness. In March 2004, results were presented and published in the proceedings of the 21st Vertebrate Pest Conference.

Tufts University Skunk Study.--An important development in southeast New England is that, during some years, the prevalence of rabies in striped skunks exceeded that in raccoons. An ongoing TU study, funded by WS (2003-present), is addressing questions concerning rabies strain type in striped skunks in Massachusetts. Results are pending.

Non-target Captures

In 2004, 5 non-target species were captured during TVR and ORV trapping (Table 6).

Table 6. Non-target species captured during TVR and ORV trapping on Cape Cod, Massachusetts, 2004.

Species	Number	Fate
Gray squirrel (<i>Sciurus carolinensis</i>)	6	Released
Red squirrel (<i>Tamiasciurus hudsonicus</i>)	2	Released
Virginia opossum (<i>Didelphis virginiana</i>)	14	Released
Domestic dog (<i>Canis familiaris</i>)	2	Released
Domestic cat (<i>Felis catus</i>)	16	Released

ORV PROGRAM 2003-EVALUATION

During August-December 2003, WS conducted both post-bait ORV program evaluation trapping and trapping as part of 2 small-scale studies. Serum samples, age, sex, reproductive status, and weight were collected from 45 unique raccoons and 14 unique striped skunks. Serology results indicated that 37.5% of the raccoons displayed a positive rabies antibody response (Table 7 and Table 8).

Table 7. Age and sex structure of trapped raccoons and striped skunks during post-bait ORV program evaluation trapping in Massachusetts, 2003.

	Adult	Juvenile (< 1 year old)
Raccoon (n = 45)		
Female (n = 28)	18 (40%)	10 (22.2%)
Male (n = 17)	17 (37.7%)	0
Skunk (n = 14)		
Female (n = 4)	4 (28.5%)	0
Male (n = 10)	6 (42.8%)	4 (28.5%)

Table 8. Serology results of raccoon and striped skunk biological samples collected during post-bait ORV program evaluation trapping in Massachusetts, 2003

	Positive rabies antibody response^a (%)
Raccoon (<i>n</i> = 40)	37.5
Adult female (<i>n</i> = 20)	25.0
Adult male (<i>n</i> = 11)	63.6
Juvenile female (<i>n</i> = 7)	42.8
Juvenile male (<i>n</i> = 2)	0
Skunk ^b (<i>n</i> = 10)	30.0
Adult female (<i>n</i> = 4)	25.0
Adult male (<i>n</i> = 3)	0

^aCDC serum titer = 0.05 IU

^bAge and sex was not recorded on 3 skunks

SUMMARY

In 2004, WS continued to work with CCORV cooperators to develop optimal rabies control strategies to halt the spread of the new Cape Cod rabies epizootic. Location of the epizootic rabies front; enhanced surveillance behind the front, to track epizootic intensity; and public information campaigns remain the priorities of the CCORV program.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MISSISSIPPI 2004

BACKGROUND

Raccoon (*Procyon lotor*) strain of the rabies virus has not been documented in Mississippi. In 1964, rabies was first detected in bats (order *Chiroptera*) within Mississippi. The last indigenous case of rabies in a dog (*Canis familiaris*) occurred in 1961. In 1965, two puppies imported from another state were positive for rabies, but were identified to be infected with the virus before they came into contact with other animals. Since World War II, 13 cases of human rabies have occurred in the state, the last being in 1953. Most of these cases are suspected to have been canine rabies (Dr. Brigid Elchos, Mississippi Department of Health [MDH], personal communication). These cases were located throughout the state. Extensive rabies vaccination programs for dogs have been conducted over the last several decades. As the number of dogs vaccinated against rabies increased, the number of positive specimens confirmed by the MDH Laboratory decreased. Currently, only bat strain rabies is considered endemic within Mississippi (Riecken 1984). The nearest known incident of raccoon strain rabies to Mississippi was located in Clarke County, Alabama.

ORV PROGRAM 2004

Enhanced Surveillance

In 2004, Wildlife Services (WS) emphasis in Mississippi was road kill surveillance of raccoons, coyotes (*C. latrans*), and striped skunks (*Mephitis mephitis*) in Hancock, Harrison, and Jackson Counties. Due to the proximity of the Clarke County, Alabama positive raccoon, George, Greene, Wayne, and Clarke Counties were added to the road kill surveillance program (Figure 1). Eleven raccoons were collected and tested. All raccoons tested negative for rabies.

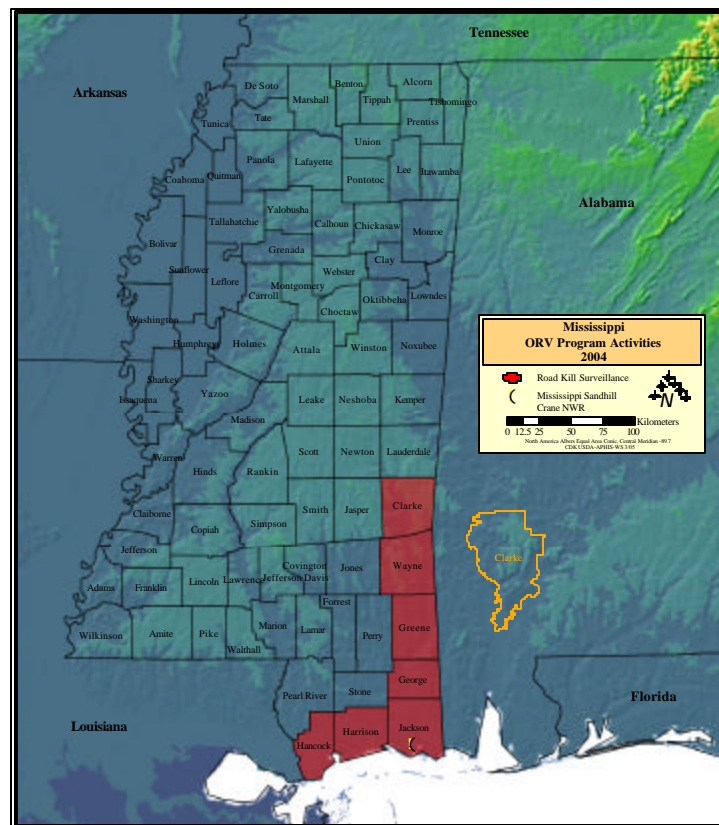


Figure 1. Enhanced rabies surveillance activities in Mississippi, 2004.

A temporary employee was hired for collection of enhanced surveillance animals. However, this employee vacated this position during 2004. The position was temporarily filled with a contract employee who then vacated the position. Training on how to remove brainstems was conducted by the MDH Diagnostic Lab for several current Wildlife Specialists, in order to fill the void being left by the vacated rabies technician position. Wildlife Services has solicited information on sick and strange acting animals from county officials, Wildlife Law Enforcement officers, and city animal control officers. An article written by WS, describing the current status of rabies in Mississippi, appeared in the Mississippi Wildlife Federation magazine. Equipment was purchased for the MDH lab in Jackson as well as supplies for collection of specimens in the field. Freezers were purchased for drop off points in the 4 new counties added to the enhanced surveillance program in 2004.

Other Rabies Activities

Animals currently being removed on a separate project, being conducted on the Mississippi Sandhill Crane Refuge, also have been submitted for testing. All test results have been negative for rabies. Tooth collection has been conducted for all surveillance animals. Results are pending. No serology work has been done at this time.

SUMMARY

This was the second year WS has conducted enhanced rabies surveillance activities in Mississippi. Surveillance was conducted in: Jackson, Harrison, Hancock, George, Greene, Wayne, and Clarke Counties. Eleven raccoons were tested, and approximately 12 more are ready for submission. All animals tested negative for rabies.

LITERATURE CITED

Riecken, Jr., W. E. 1984. Review of Rabies in Mississippi. Mississippi Morbidity Report, June, 1984. Mississippi Department of Health 11:1-3.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW HAMPSHIRE 2004

BACKGROUND

The first case of raccoon (*Procyon lotor*) rabies confirmed in New Hampshire was a bit of an anomaly. In March of 1992, a raccoon entered a local police officer's house in Rumney and began fighting with the family Doberman. The officer was forced to shoot the raccoon under the kitchen table. The raccoon was brought to a local veterinarian's office and was found to be wearing 2 flea collars, likely to be a "pet" of unknown origin (State Veterinarian Dr. Clifford McGinnis, New Hampshire Department of Agriculture, Markets and Food, personal communication). Rumney is approximately 128 km (80 mi) north of the New Hampshire-Massachusetts state border and officials believed the family caring for the raccoon translocated it from a rabies-infected area in southern New England. Fortunately, no additional cases were detected in that area, but raccoon rabies did enter New Hampshire in the fall of 1992, as an extension of the epizootic in southern New England. Once in New Hampshire, rabies continued its northward spread at a rate of about 40 km (25 mi) a year. Raccoon rabies has been confirmed in all 10 counties, with the northernmost case occurring in Lancaster approximately 64 km (40 mi) south of the United States-Canada border.

Just months after the Lancaster, New Hampshire case was documented, a rabid raccoon was confirmed in Lunenburg, Vermont immediately across the Connecticut River (state border) from Lancaster. This prompted concern over the spread of rabies through the Connecticut River Valley in northern New Hampshire and Vermont into Canada. In August 2001, an oral rabies vaccination (ORV) program was initiated in New Hampshire. The goal was to prevent the northward spread of the raccoon variant of the rabies virus. Through aerial and hand bait distribution, over 90,000 fishmeal polymer (FMP) and fishmeal-coated sachet (CS) baits containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA) have been distributed over northern New Hampshire since 2001.

The New Hampshire ORV program has been a cooperative effort lead by Cornell University (CU). Wildlife Services has been the major source of federal funds for project implementation. Wildlife Services also has provided federal wildlife management leadership by continuing to play an active role in: project planning and coordination; organizing ground support for the bait drop; working in and navigating aircraft to distribute baits; coordinating the hand distribution of baits in areas too populated to bait by air; and providing surveillance and follow-up field work by collecting blood and tooth samples from live-trapped and suspect-rabid animals within the New Hampshire ORV bait zone to test program efficacy.

ORV PROGRAM 2004

Bait Distribution

In 2004, New Hampshire baiting activities coincided with the Vermont ORV bait drop. During 3 flights, 36,472 CS baits were distributed by Twin Otter fixed-wing aircraft on 1 September, while 140 FMP baits were distributed by hand in the village of Colebrook, New Hampshire on 3 September (Figure 1). The New Hampshire bait drop was expanded to the south in 2004 and included the town of Lancaster. Total number of baits distributed in New Hampshire during the 2004 field season was 36,612, over a 422 km² (163 mi²) area. Aircraft and flight crew for the 2004 ORV bait drop were provided by the Ontario Ministry of Natural Resources. Ground and aerial baiting support was also provided by WS, CU, and many Vermont citizens.

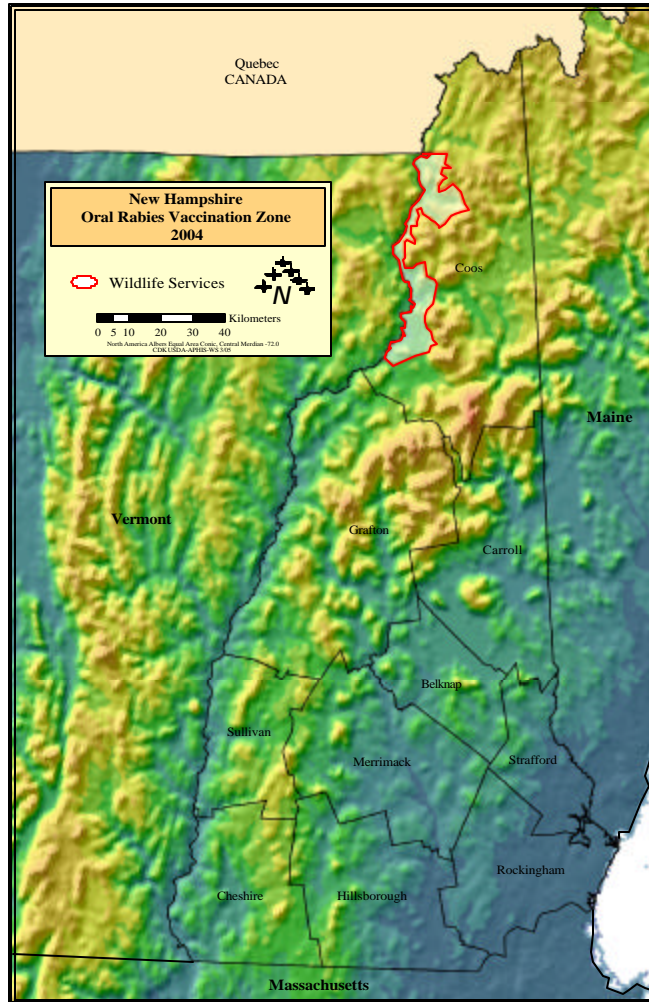


Figure 1. Oral rabies vaccination zone in New Hampshire, 2004.

Post-bait Evaluation

Since 2001, WS has led post-bait ORV sampling, which is an essential component to the evaluation phase of the New Hampshire ORV program. Blood and tooth samples are taken from each live-trapped raccoon; the animal is weighed and marked with a small ear tag and released back into the wild at the point of capture. The blood serum is later analyzed to detect the presence of virus neutralizing antibodies (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth indicates that an animal consumed at least the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for serum evaluation as well.

Wildlife Services live-trapped, sampled, and released 7 unique raccoons, over 215 trap nights (3.3% trap success) during the 2004 post-bait ORV program evaluation phase. Blood and tooth samples were collected from all of these animals. These samples will be used to compare immune status and bait uptake of the raccoon population in the 2004 ORV zone to raccoon populations from 2001-2002 (no samples were collected in 2003). All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Non-target Captures

In 2004, no non-target species were captured.

ORV PROGRAM 2003-EVALUATION

In 2003, no animals were captured for ORV program evaluation.

SUMMARY

The summer of 2004 marked the fourth year of WS cooperative participation in the New Hampshire ORV program. The New Hampshire program is an important part of a larger Northeastern cooperative effort, which in 2004 included: New York; Vermont; Maine; and Ontario, Quebec, and New Brunswick, Canada. The Northeastern cooperative effort is tied to national planning efforts to contain and explore strategies to eliminate the raccoon strain of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW JERSEY 2004

BACKGROUND

In the earlier part of the twentieth century New Jersey had a significant problem with rabies in dogs (*Canis familiaris*); in 1939, 675 dogs and 4 humans died of rabies in the state. In 1942, a rabies management program, consisting of mass vaccination of dogs and the collection of stray animals, was initiated. As a result of these efforts New Jersey experienced its last case of canine rabies in 1956. In 1960, the first case of bat (Order *Chiroptera*) rabies was confirmed in New Jersey.

In 1989, the raccoon (*Procyon lotor*) rabies epizootic spread to New Jersey through Warren and Hunterdon Counties. In 1991, New Jersey led the nation in animal rabies cases per capita. The scale of the outbreak stimulated public support for a safety and efficacy trial of the vaccinia-rabies glycoprotein (V-RG®) oral rabies vaccine (ORV) in wild raccoons by the State of New Jersey and Thomas Jefferson University, Philadelphia, Pennsylvania. Between 1989 and 2004, 4,683 cases of terrestrial rabies have been confirmed. Of these, 3,503 (75%) were raccoons. In 2004, the New Jersey Department of Health and Senior Services (NJDHSS) tested 2,515 rabies specimens. Of the tested animals, 117 were confirmed positive and of those 96 (82%) were raccoons. In 2004, 1 white-tailed deer (*Odocoileus virginianus*) from Hunterdon County also tested positive for rabies.

During 1991-1994, the New Jersey Division of Fish and Wildlife (NJDFW) worked cooperatively with the Cape May County Department of Health (CMDH) and NJDHSS to conduct an experimental ORV program in Cape May County. Since 1995, CMDH has worked independently to distribute baits.

CAPE MAY COUNTY ORV PROGRAM 2004

Bait Distribution

In 2004, the ORV bait zone in Cape May County encompassed 556 km² west of the Garden State Parkway (Figure 1). From 28 September-8 October, 38,310 fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens Georgia, USA) were distributed by a helicopter provided by the New Jersey Mosquito Commission and an additional 1,000 FMP baits were distributed by hand. Since 1991, approximately 257,000 baits have been distributed in Cape May County. Although baits are distributed at a rate of 64 baits/km², emphasis was placed on Upper and Dennis Townships to prevent rabies from crossing from the neighboring Atlantic and Cumberland Counties into Cape May County.

Enhanced Surveillance

Since CMDH's program became operational, there has been only limited enhanced surveillance to determine the effectiveness of the ORV program with most information coming from public health surveillance. In 2002, the NJDFW proposed to coordinate a program to test raccoons for rabies. The purpose of the enhanced surveillance was to compare rabies occurrence in the raccoon population in Cape May County, with its occurrence in the 2 adjacent counties (Atlantic and Cumberland). Wildlife Services (WS) continues to work in partnership with the NJDFW by collecting road-killed raccoons in Cape May, Atlantic, and Cumberland Counties as well as submitting raccoons that are trapped as a result of other projects within these areas.

In 2002, 8 raccoons were collected in Cape May County; in 2003, 5, 1, and 2 raccoons were collected in Cape May, Atlantic, and Cumberland Counties, respectively; in 2004 2 raccoons were collected in Atlantic County and 25 in Cape May County. All specimens were submitted to the NJDFW, Office of Fish and Wildlife Health and Forensics Pathology Laboratory.

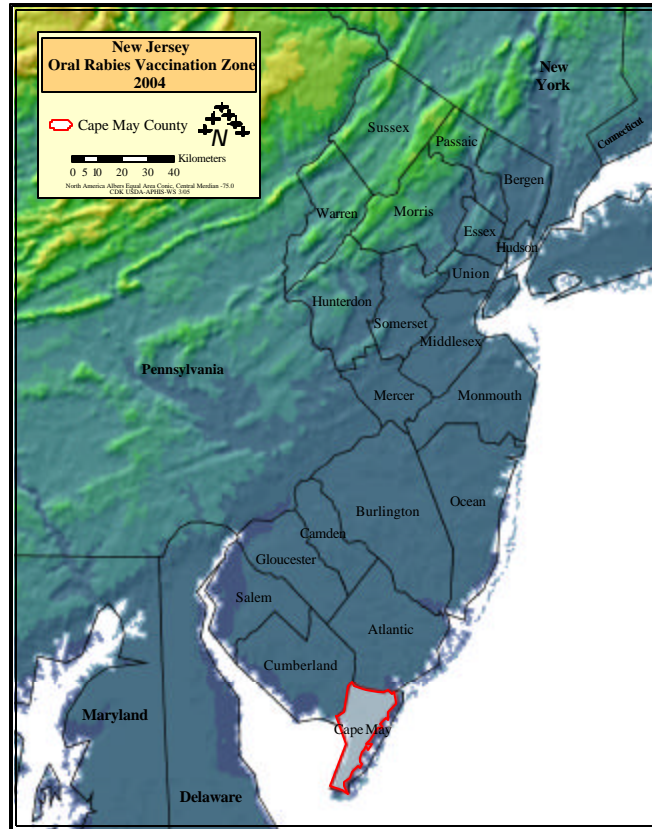


Figure 1. Oral rabies vaccination zone in Cape May County, New Jersey, 2004.

Post-bait Evaluation

In early November 2004, WS conducted approximately 1 week of raccoon trapping within the Cape May ORV bait drop zone. Blood and tooth samples were taken from 25 unique raccoons (Table 1). In addition, all captured raccoons were weighed, ear tagged, and their general health assessed before release at the capture sites. Blood serum will be analyzed for levels of rabies virus neutralizing antibodies and tooth samples have been submitted for tetracycline biomarker screening. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 1. Results of post -bait ORV program evaluation efforts in Cape May County, New Jersey, 2004.

	Cape May County Post-bait ORV
Trap nights	467
Unique raccoons	25
Recaptured raccoons	0
Total raccoons	25
Trap success	5.4%

Non-target Captures

During the 2004 ORV trapping effort, non-target captures included: 10 opossums (*Didelphis virginiana*), 1 striped skunk (*Mephitis mephitis*), 1 Norway rat (*Rattus norvegicus*), and 1 domestic cat (*Felis catus*), all of which were released, unharmed on site.

SUMMARY

The Cape May County ORV program is the longest continuously running ORV program in the nation. Working cooperatively with the NJDFW, NJDHSS, and CMDH, WS designed and implemented the first post-bait ORV program evaluation trapping effort to occur in New Jersey in a decade. Data gathered by WS will provide valuable information to this unique program. Plans for 2005 include an expansion of the trapping effort and continuation of road kill specimen collection to enhance rabies surveillance.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW YORK 2004

BACKGROUND

Rabies remains one of the most important zoonoses in the United States. In the past decade, wildlife rabies has reached historically high levels with a subsequent increase in human rabies post-exposure prophylaxis (PEP). An outbreak that began in the late 1970s, in the Mid-Atlantic States, was attributed to translocation of infected raccoons (*Procyon lotor*) from Florida for use by various hunting clubs. This event is thought to have marked the beginning of a raccoon rabies outbreak that has aggressively spread throughout the Mid-Atlantic and Northeastern United States.

Raccoon rabies first entered New York in 1990. The disease quickly spread and now is present throughout most of the state. In 1994, the New York State Department of Health (NYSDH) began researching the use of oral rabies vaccination (ORV) in an enzootic area, in the Capital Region and demonstrated a decrease in rabid raccoons in the ORV baited area. In 1995, after raccoon rabies made a sudden 70km leap, from southern Essex County in the Adirondacks to mid-Clinton County, NYSDH initiated a point-source control plan for distribution of baits. This was then followed by establishment of an ORV barrier to prevent further northward spread into Quebec, Canada. In 1998, after switching from a biannual baiting in spring and fall to annual baiting in August, along with program support from Wildlife Services (WS), the Lake Champlain Region ORV Program has been highly successful at eliminating raccoon rabies from the area. The immune barrier has since been shifted southward (Essex and Clinton Counties), into the enzootic area, in an attempt to reduce the presence of rabies (Figure 1).

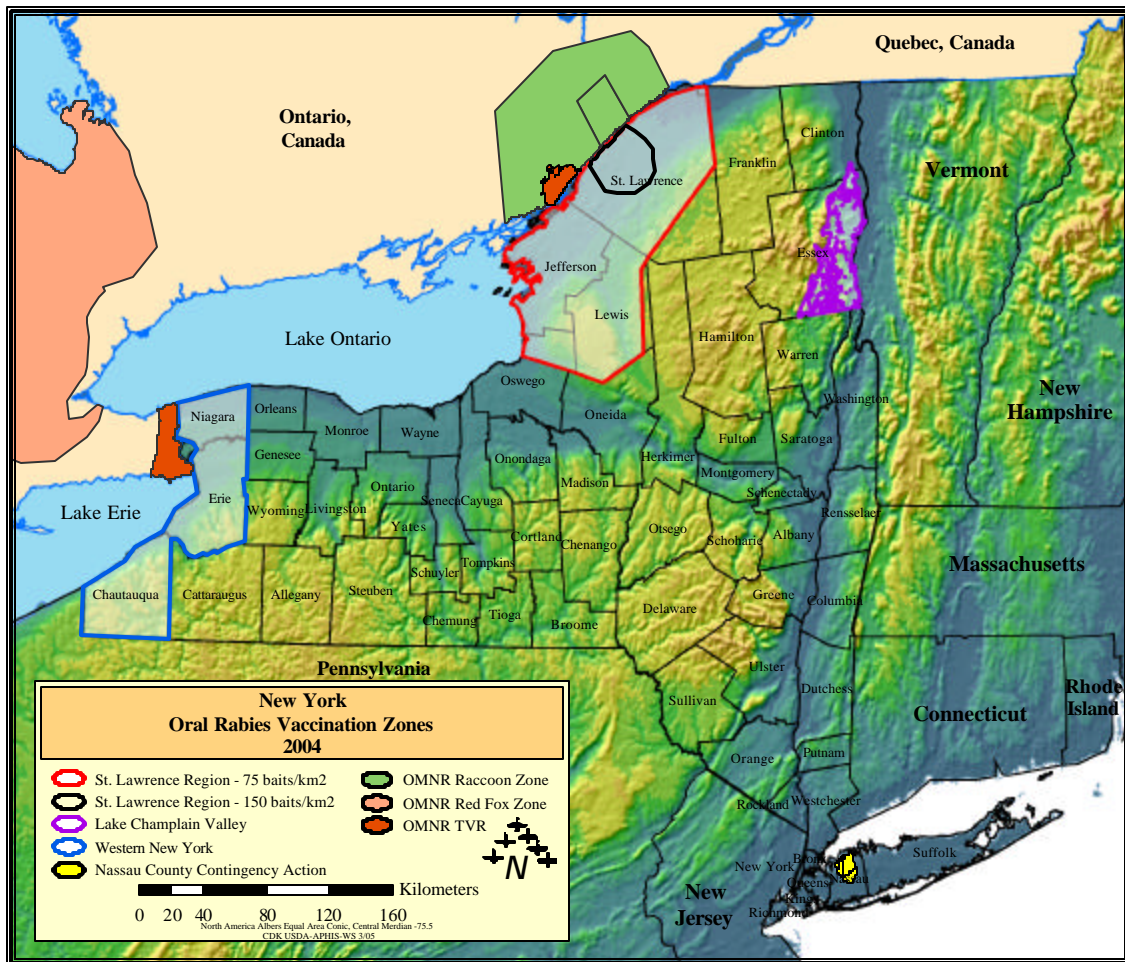


Figure 1. Oral rabies vaccination zones in the St. Lawrence Region, Lake Champlain Valley Region, and western New York, 2004. (Lake Champlain Valley data used with permission from the New York State Department of Health).

In 1997, raccoon rabies was first documented in St. Lawrence County and the following year an epizootic was identified in the county with 148 confirmed wildlife cases. In 1999, the outbreak continued to spread, resulting in 139 cases. Wildlife Services has been actively involved with rabies management in the St. Lawrence Region since 1998. Following the establishment of a rabies immune barrier, there has been a noted decline in wildlife rabies cases in St. Lawrence County. In 2000 there were 13 cases. Over the next two years, the number of rabid raccoons dropped to zero with the last positive case detected in March, 2002. Since that date, no additional raccoon rabies cases have been reported. However, in June 2004, 2 rabid striped skunks (*Mephitis mephitis*) were confirmed in the village of Heuvelton, within the ORV barrier.

Following the epizootic in 1998, an intensive ORV program was initiated in St. Lawrence County in an attempt to prevent further northward spread of the disease through New York and into Canada. Since 1998, the ORV program in northern New York has expanded and currently includes Jefferson County, the northern portions of St. Lawrence, Oswego, and Lewis Counties, as well as the western portion of Franklin County. The bait zone is bounded by the St. Lawrence River to the North, Lake Ontario to the West, the Tug Hill Plateau to the South, and the Adirondack Mountains to the East. Additionally, ORV baits were distributed in Niagara, Erie, and Chautauqua Counties in western New York (Figure 1).

Cornell University (CU) is the lead coordinating agency for the ORV zones in northern and western New York, while the NYSDH Zoonoses Program is the lead agency in the Lake Champlain Valley Region. Wildlife Services remains an active participant, providing major cooperative funding along with federal wildlife management leadership.

ORV PROGRAM 2004

Bait Distribution

Aerial baiting in the St. Lawrence Region occurred from 26-31 August 2004. Two types of baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), were distributed. In the St. Lawrence Region, 881,249 baits (fishmeal polymer [FMP] and coated sachets [CS]) were distributed over 12,848 km² at a density of 75 baits/km² (Figure 1). In an attempt to confine the Heuvelton skunk outbreak, the bait density was increased to 150 baits/km² in a 20 km radius surrounding the 2 cases.

In western New York, 402,336 baits were distributed, over 6,809 km², from 26-27 July 2004 and 24-25 August. In the Lake Champlain Valley Region, 132,000 FMP baits were distributed, over 1,750 km², from 9-13 August 2004 (Figure 1).

Aircraft and flight crew for the 2004 ORV program in the St. Lawrence Region and in western New York were provided by the Ontario Ministry of Natural Resources (OMNR), Canada and the New York State Police Aviation Unit (NYSPAU). Aircraft and flight crew for the 2004 ORV program in the Lake Champlain Valley Region were provided by the NYSPAU. Ground and baiting support was provided by WS, CU, state, county, and local government agencies, and many public volunteers.

Population Monitoring

Since raccoon rabies became established in the Mid-Atlantic region in the late 1970s, it has spread into new areas at approximately 24-29 km/year. Rabies appears to spread rapidly through wildlife populations where raccoon densities are highest. Major physiographic barriers, such as rivers and mountain ranges, potentially impede the spread of rabies. The St. Lawrence River may act as a physical barrier, impeding the northward movement of rabies. In addition, high mountain elevations with contiguous forests, such as those in the Adirondack and Appalachian Mountains, may support low raccoon densities, therefore, acting as barriers to the spread of the rabies virus. In a coordinated effort to monitor raccoon populations, 7 relative density studies have been completed in the St. Lawrence Region of New York since 1999. These studies have been conducted to help document raccoon population density trends in areas of agricultural habitat; areas of higher elevations, in the foothills of the Adirondack Mountains; and in areas of preferred raccoon habitat. These preferred habitats include: islands and shoreline of the St. Lawrence River that may not be easily baited by aircraft. Relative densities varied with habitat and ranged from = 45 raccoons/km² in preferred habitats, to low or absent raccoon populations in poorer habitats of the Adirondack Mountains (Table 1).

Table 1. Estimated relative density indices of raccoon populations in the St. Lawrence Region, New York, 1999-2004.

Year	Location	Elevation (m)	Density index ^a
1999	Louisville (agriculture)	75	9
1999	Colton (foothills)	450	2
2000	Clifton (mountains)	470	0
2000	Colton (river corridor, mountain)	450	2
2001	Hammond (St. Lawrence River shoreline)	100	11
2003	Massena, Barnhart Island (St. Lawrence River)	100	45
2004	Clayton, Grindstone Island (St. Lawrence River)	77	29

^aRaccoons/km²

Post-bait Evaluation

St. Lawrence Region.--On 27 September 2004, WS initiated post-bait ORV program evaluation trapping to collect blood serum and tooth samples, as well as other biological data (Table 2). Blood samples are analyzed for the presence of rabies antibodies by the NYSDH Rabies Laboratory. Tooth samples were sent to Matson's Laboratory for age analysis and tetracycline biomarker testing. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Post -bait ORV program evaluation trapping efforts in the St. Lawrence Region, New York, 2004.

	Bait density	
	75/km ²	150/km ²
Trap nights	784	694
Unique raccoons	113	106
Trap success	14%	15%

Essex County.--From 21-24 September 2004, WS assisted NYSDH with post-bait ORV program evaluation trapping and collected blood serum and tooth samples, as well as other biological data. Ninety one raccoon samples were collected for post-bait ORV program evaluation.

OTHER RABIES ACTIVITIES

St. Lawrence River Study

The inability to aerially distribute baits at prescribed densities along river shorelines, in conjunction with raccoon fidelity for developed shoreline habitat, could possibly result in a significantly under-vaccinated subset of local raccoon populations. These under-vaccinated areas may represent corridors through which raccoon rabies could spread. This could compromise larger ORV efforts because raccoons have been documented crossing major rivers. For example, animals ear tagged in Canada by the OMNR, have been captured in New York by WS staff.

Since 2001, WS has been involved in a multi-year study to assess aerial ORV baiting efficacy along the St. Lawrence River shoreline. Steep topography, numerous small islands, a highly developed shoreline, and a State highway paralleling the river typify the study area, posing challenges for distributing baits to targeted raccoon habitat. In order to avoid a significant loss of baits in the river and striking clustered shoreline houses and residents, baiting machines are turned off as ORV aircraft approach the shoreline.

To address these concerns we first compared pre-bait ORV raccoon serology levels to post-bait ORV serology levels using FMP baits at the standard aerial baiting density of 75 baits/km². In 2003, we then compared aerial baiting to hand baiting at 75 baits/km². In 2004, the hand baiting density was increased to 150 baits/km² and a second study area was established along the river to compare CS baits to FMP baits. The new CS study area was divided into 2 subsections, with 1 section hand baited at 75 baits/km² and the other hand baited at 150 baits/km². Serology level analysis of the various baiting strategies will help determine the most efficient baiting method. Blood serum, tooth samples, and other biological data used to evaluate and monitor program success, was collected between June 2001-November 2004 (Table 3). Information collected will be used to: (1) identify the percentage of the raccoon population in the study areas with detectable levels of rabies virus neutralizing antibodies, (2) identify the number of animals that consumed baits, and (3) assess the impact of hand baiting to augment aerial bait distribution (Table 4). The results of this study may have broader implications to national ORV programs, as human

activities are often associated close to shorelines.

Table 3. Pre- and post-bait ORV program evaluation trapping results for the St. Lawrence River Shoreline Study, 2001-2004.

	Fishmeal polymer						Coated sachet		
	Pre-bait ORV		Post-bait ORV		post-hand bait ORV	post-hand bait ORV	pre-bait ORV	post-hand bait ORV	post-hand bait ORV
	75 baits/km ² 2001	75 baits/km ² 2002	75 baits/km ² 2001	75 baits/km ² 2002	75 baits/km ² 2003	150 baits/km ² 2004	204	75 baits/km ² 2004	150 baits/km ² 2004
Trap nights	1,448 ^a	980	684	731	721	533	284	508	501
Unique raccoons	76	58	33	73	81	80	112	53	50
Trap success	7%	6%	5%	10%	11%	15%	39%	10%	10%

^aincludes Hammond relative density study

Table 4. Serology and tetracycline biomarker results from raccoon samples collected as part of the St. Lawrence River Shoreline Study, New York, 2001-2003.

	Pre-bait ORV 2001	Post-bait ORV 2001	Pre-bait ORV 2002	Post-bait ORV 2002	Post-bait ORV 2003 ^a
Serology					
Unique raccoons captured	76	33	58	73	81
Testable blood samples	76	32	58	73	81
Positive rabies antibody response ^b	11 (14%)	7 (21%)	17 (29%)	19 (26%)	40 (49%)
Tetracycline					
Unique raccoons captured	76	33	58	73	81
Testable tooth samples	69	33	50	69	81
Presence of tetracycline biomarker	21 (30%)	10 (30%)	19 (38%)	23 (33%)	42 (52%)

^ahand baited in 2003

^bNYSDH Rabies Lab serum titer = 0.125 International Units (IU)

Nassau County Contingency Response

On 9 August 2004, the NYSDH Rabies Lab confirmed a rabid raccoon from Nassau County. This is the first documented case of raccoon rabies on Long Island, east of New York City. In response to this outbreak a cooperative emergency rabies surveillance and control program was initiated by the NYSDH Zoonoses Program, WS, the Nassau County Department of Health, and the New York State Department of Environmental Conservation. The program included enhanced surveillance, to identify and document the location and scope of the occurrence and vaccination of raccoons to prevent the further spread of rabies. Two types of vaccination programs were implemented: trap-vaccinate-release (TVR) and ORV. Coated sachet baits were aerially distributed with assistance from the NYSPA. Fishmeal polymer baits were distributed by hand in a zone around the positive cases. In total, 171 km² were baited and 21,000 ORV baits were distributed (Figure 1). Live-trapping was conducted following the baiting to evaluate program efficacy (Table 5). Through many efforts, 10 rabid raccoons were eventually confirmed, with the last reported in December, 2004.

Table 5. Raccoon enhanced surveillance, TVR, and post-bait ORV program evaluation efforts from the Nassau County contingency action, New York, 2004.

	Samples
Enhanced surveillance	353
TVR	352
Post-bait ORV program evaluation	406

The contingency effort was focused on creating a rabies immune population of raccoons in the target zone to prevent additional cases. The spread of raccoon rabies on Long Island is of concern because the high density of raccoons increases the risk of exposure to a human, pet, or farm animal. Enhanced surveillance and vaccination of raccoons will greatly decrease the chance of exposure to rabies.

Non-target Captures

Non-target animals captured and released in 2004 included: 73 striped skunks (*Mephitis mephitis*), 41 opossums (*Didelphis virginiana*), 24 gray squirrels (*Sciurus carolinensis*), 19 feral cats (*Felis catus*), 13 Eastern cottontail rabbits (*Sylvilagus floridanus*), 5 porcupines (*Erethizon dorsatum*), 2 American crows (*Corvus brachyrhynchos*), 2 fishers (*Martes pennanti*), 2 red squirrels (*Tamiasciurus hudsonicus*), 1 ferret (*Mustela putorius furo*), 1 mink (*Mustela vison*), 1 muskrat (*Ondatra zibethicus*), 1 Norway rat (*Rattus norvegicus*), 1 red fox (*Vulpes vulpes*), 1 ruffed grouse (*Bonasa umbellus*), and 1 snapping turtle (*Chelydra serpentina*).

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline Biomarker, and Age Results

St. Lawrence Region.--Two bait types (CS, distributed at 75 baits/km² and FMP, distributed at 75 baits/km²) were tested in the St. Lawrence Region (Table 6). Fishmeal polymer baits contain a tetracycline biomarker that is detectable in teeth when an animal consumes the bait. However, this is not indicative that the raccoon consumed the vaccine sachet, which is located inside the bait block. Tooth samples also were analyzed to determine the age structure within the sampled raccoon populations (Figure 2).

Table 6. Serology and tetracycline biomarker results from raccoon samples collected as part of ORV program evaluation in the St. Lawrence Region, New York, 2003.

	Barnhart Island relative density study (pre-bait ORV)	Barnhart Island (post-bait ORV)	Fishmeal polymer (post-bait ORV)	Coated sachets (post-bait ORV)
Serology				
Unique raccoons captured	136	77	127	109
Testable blood samples	68	77	127	109
Positive rabies antibody response ^a	24 (35%)	28 (36%)	30 (31%)	34 (31%)
Tetracycline				
Unique raccoons captured	136	77	127	109
Testable tooth samples	60	13	124	97
Presence of tetracycline biomarker	CS bait	CS bait	66 (54%)	CS bait

^aNYSDH Rabies Lab serum titer = 0.125 IU

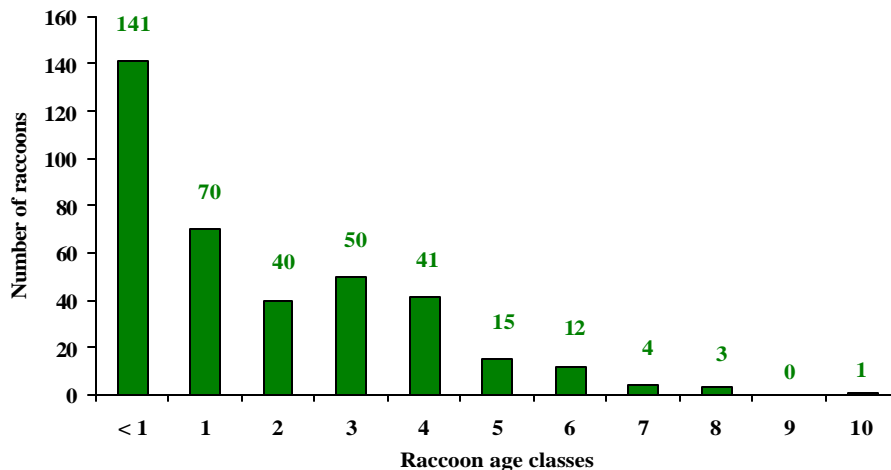


Figure 2. Age class distribution of 377 raccoon tooth samples collected during pre- and post-bait ORV program evaluation trapping in New York, 2003.

SUMMARY

To date, over 4.6 million ORV baits have been distributed across the St. Lawrence Region. Since the program was initiated, a noted decline in positive rabies cases has been recognized. In 1998 and 1999, in the St. Lawrence Region approximately 150 confirmed cases of rabies in wildlife were reported. In the last 3 years, no positive raccoon cases have been confirmed. However, in June 2004, 2 rabies-positive striped skunks were identified within the village of Heuvelton in St. Lawrence County.

Since 1998, WS has cooperatively participated in the New York ORV Program. This project is part of a larger Northeastern ORV effort that includes: Vermont; New Hampshire; Maine; and the provinces of Ontario, Quebec, and New Brunswick, Canada. The Northeastern ORV Program is in turn, tied to a National ORV Program working to contain and eliminate the raccoon variant of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NORTH CAROLINA 2004

BACKGROUND

Nettles et al. (1979) reported rabies positive raccoons (*Procyon lotor*) being translocated into North Carolina from Florida by raccoon hunting clubs. It was not until 1991, however, that significant numbers of rabid raccoons from the wild were being reported. The first counties experiencing the increase occurred in the northeastern portion of the state as the mid-Atlantic epizootic crossed into North Carolina. By 1992, it was evident that a second, distinct epizootic front crossed into North Carolina, in the southeastern portion of the state, with several cases showing up in Brunswick and Bladen Counties. In 1993, the epizootic had clearly moved into the southern piedmont and coastal plains. During 1995, a third distinct epizootic outbreak occurred when the disease spread into the northwestern corner of the state, from southwestern Virginia. This epizootic seems to have originated in the northern mid-Western states. North Carolina has thus become the meeting point for 3 waves of raccoon strain rabies. Presently, 95 of 100 counties have reported cases of raccoon rabies (Figure 1). The remaining 5 counties, not reporting cases, are in the western portion of the state. They are all in rural areas and do not have active animal control agencies.

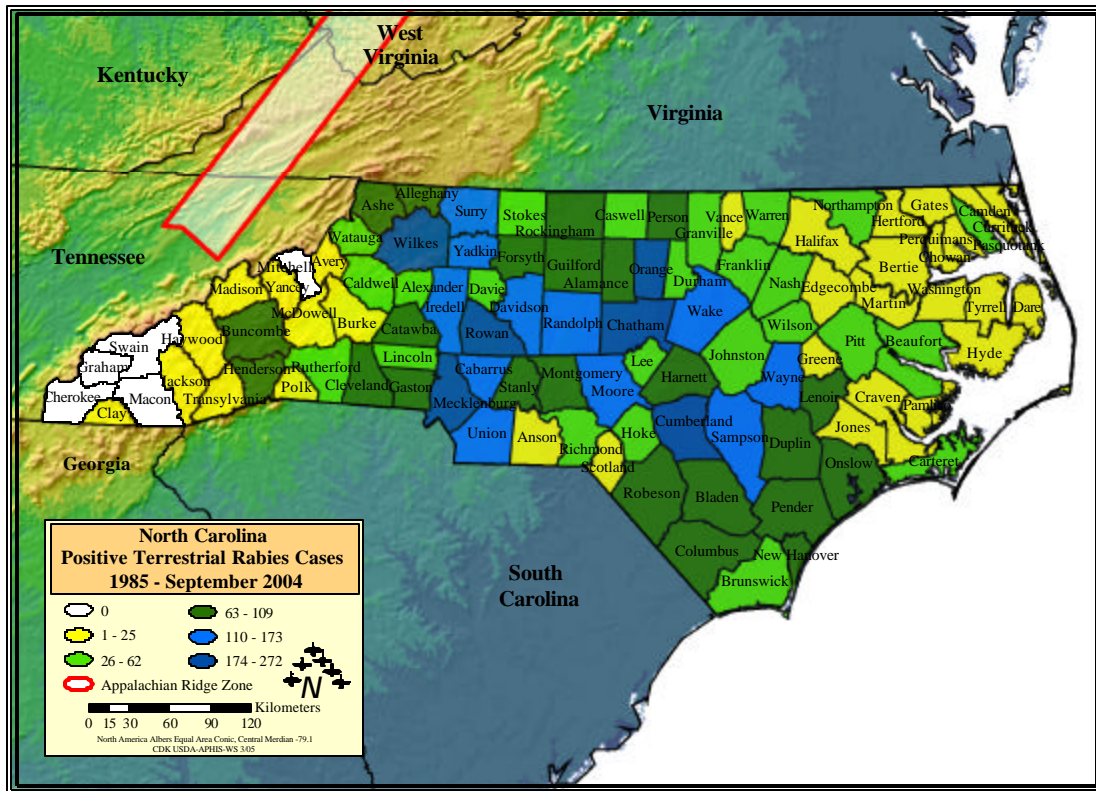


Figure 1. Number of confirmed rabies cases in terrestrial wildlife species in North Carolina, 1985-September 2004.

ORV PROGRAM 2004

Bait Distribution

Currently, there is no distribution of oral rabies vaccination (ORV) baits in North Carolina.

Enhanced Surveillance

In 2004, an enhanced surveillance program was initiated in North Carolina. It was determined that the northwestern counties would receive the highest priority, followed by the remaining Tennessee border counties. All of the Tennessee border counties are along the hypothesized “natural barrier” to westward expansion of raccoon rabies. The goal of the enhanced surveillance was to better document the extent of rabies cases near this western front of the disease. Only 4 of the 10 Tennessee border counties have active animal control agencies and many participate in regional health departments, rather than county level departments. These factors, coupled with the rural nature of the area, have contributed to rather spotty surveillance when compared to the remainder of the state.

In May, a 0.5 staff year Wildlife Specialist was hired to work in the area with local authorities to increase the number of animals tested for rabies. Cooperators were asked to save both road-killed and symptomatic animals, by freezing the whole carcass and completing a data sheet containing some basic information about the animal. Heads were removed from the carcasses and delivered to the Virginia Division of Consolidated Laboratory Services for analysis (Table 1). All positive animals tested were found to be infected with the Eastern Raccoon Variant A, using monoclonal antibody testing. All animals sampled in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 1. Rabies test results from enhanced surveillance animals collected in western North Carolina, 2004.

Species	Positive	Negative	Unsatisfactory sample	Total
Bobcat (<i>Lynx rufus</i>)	0	1	0	1
Gray fox (<i>Urocyon cinereoargenteus</i>)	1	3	1	5
Raccoon	7	9	1	17
Red fox (<i>Vulpes vulpes</i>)	0	1	0	1
Striped skunk (<i>Mephitis mephitis</i>)	0	4	1	5
Total	8 (27.6%)	18 (62.1%)	3 (10.3%)	29

Other Rabies Activities

The North Carolina Department of Health and Human Services (NCHHS) has excellent records on rabies cases dating back to 1952. These data are recorded by county and clearly show the spread of rabies into the state during the 1990s. Monoclonal antibody tests were conducted on all terrestrial wildlife during this time. All positive cases reported in North Carolina were of the raccoon variant (T. McPherson, State Laboratory of Public Health, personal communication). In recent years, policy has been to only test animals with known human or domestic animal exposure; still these data are useful in following the spread of the raccoon variant and outlines a fairly accurate picture of where the greatest human/wildlife rabies interactions occur. These data show an increasing number of rabies cases in the western region of the state. Enhanced surveillance will be important within this region to document the occurrence of rabies cases.

SUMMARY

In 2004, North Carolina participated, for the first time, in an enhanced rabies surveillance program. Twenty nine animals were tested from the western Tennessee border counties, with 28% positive for the raccoon variant of rabies. Analysis of past historical records indicates an increasing number of cases within the French Broad River basin, indicating a potential for a breach in the natural barrier along the Appalachian Ridge.

LITERATURE CITED

Nettles, V. F., J. H. Shaddock, R. K. Sikes, and C. R. Reyes. 1979. Rabies in translocated raccoons. Am. J. Public Health 69:601-602.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM OHIO 2004

BACKGROUND

In 1996, the presence of raccoon (*Procyon lotor*) strain rabies was first documented in Mahoning County, Ohio. Rabies cases continued to escalate and in April 1997, an epizootic of raccoon strain rabies was identified in northeastern Ohio, with 62 positive cases reported by year's end. Due to this rabies epizootic and a peak in public interest, an oral rabies vaccination (ORV) program was initiated in Ohio in an attempt to prevent the further westward spread of raccoon strain rabies. The original baited ORV zone included: Trumbull, Mahoning, and Columbiana Counties, which encompassed 1,780 km² (688 mi²). Raccoon rabies cases were identified outside the ORV bait zone, through the use of increased enhanced surveillance. Subsequently, in the fall 1999, the ORV bait zone in Ohio more than tripled in size and included: Ashtabula, Trumbull, Mahoning, Columbiana, Carroll, and Jefferson Counties and encompassed 6,497 km² (2,509 mi²). In 2004, the ORV program encompassed 11,845 km² (4,573 mi²) and included: Ashtabula, Trumbull, Columbiana, Mahoning, Jefferson, Carroll, Harrison, Belmont, Monroe, and Washington Counties (Figure 1). However, during 2004, Ohio identified its first case of raccoon strain rabies west of the existing ORV barrier. The outbreak triggered a contingency action response, which encompassed a 2,471 km² (954 mi²) area and included Cuyahoga, Geauga, Lake, Portage, and Summit Counties (Figure 1).

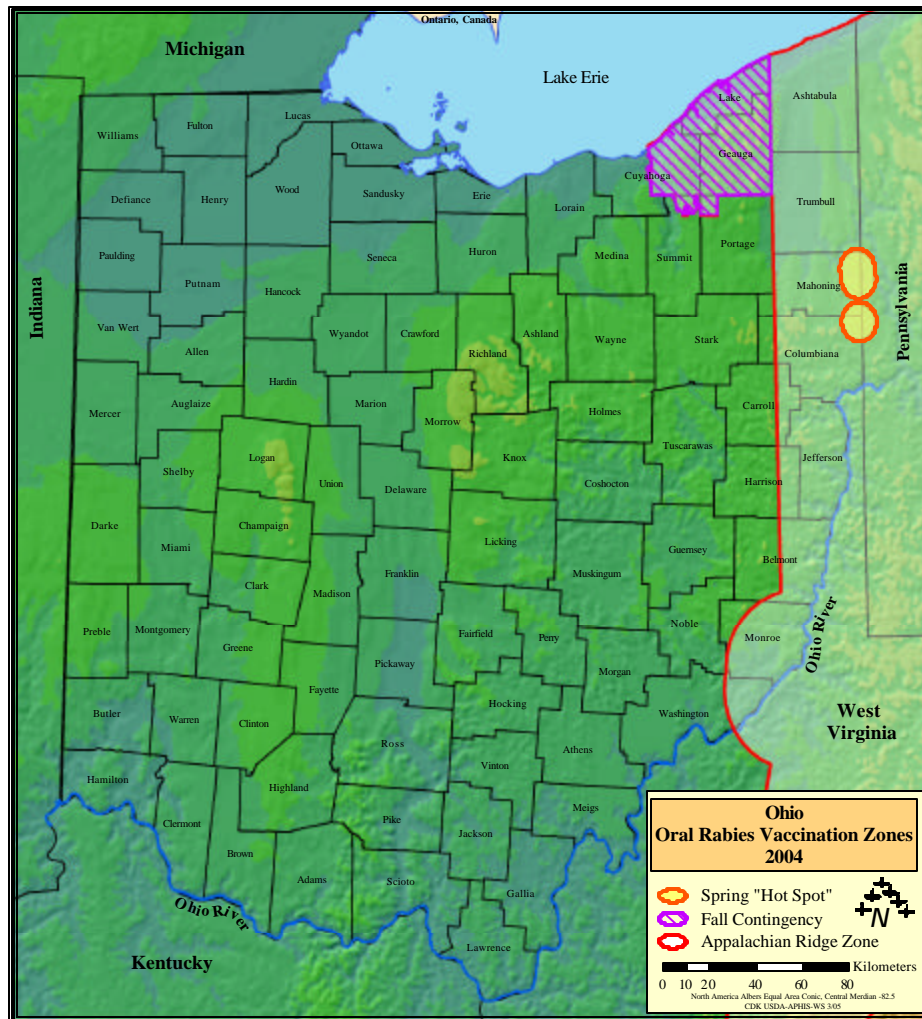


Figure 1. Oral rabies vaccination zones in Ohio, 2004.

The ORV bait zone and contingency area are part of what is now referred to as the Appalachian Ridge Barrier (ARB); which uses natural barriers (Ohio River and Lake Erie), supplemented with rabies ORV bait distribution, to prevent the westward spread of raccoon strain rabies.

The Ohio Department of Health (ODH) is the lead agency for Ohio's ORV Program. Wildlife Services (WS) is a major cooperator, providing cooperative funding and federal wildlife management leadership. Additional cooperators include Ohio Department of Agriculture (ODA), Ohio Division of Wildlife (ODW), Centers for Disease Control and Prevention (CDC), Ohio State University, and local and county health departments.

ORV PROGRAM 2004

Prior to the 2004 ORV season, the Ohio ORV Program prepared to move the existing 25 mile ORV barrier 5 miles east. This existing ORV barrier has been maintained and considered successful in nearly eliminating raccoon strain rabies from the state. The only exceptions have been isolated cases of rabies occurring in "hot spots" = 1 mile from the Ohio-Pennsylvania border. In the spring 2004, these "hot spots" were subsequently baited (Figure 1). However, on 20 July 2004 the ODH confirmed that a raccoon, which walked into a home in Lake County, Ohio, was rabid. On 23 July 2004 the CDC confirmed that the Lake County raccoon was positive for raccoon strain rabies. This was the first time raccoon strain rabies had been documented in Lake County. This case was 10.6 km (6.6 miles) west of Ohio's existing ORV barrier.

On 26 July 2004 WS initiated a cooperative emergency rabies surveillance and control program in Lake County, in cooperation with ODH, ODW, Lake County Health District, and CDC. The program included: enhanced surveillance, to better document the location and scope of the rabies outbreak; a trap-vaccinate-release (TVR) program; and ORV, to prevent the westward spread of raccoon rabies.

Bait distribution

In April and September, 2 ORV baiting campaigns were conducted. The first baiting campaign was conducted on 20 April and was completed in 1 day. This was a special baiting action, in response to rabies "hot spots" or areas of special concern in Ohio, where rabies persisted between Ohio and Pennsylvania. During the April bait drop 24,120 fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (Merial Limited, Athens Georgia, USA), were distributed by fixed wing aircraft at rates of 75-150 baits/km². Additionally 4,232 FMP baits were distributed by hand. Fishmeal polymer baits were distributed over a 293 km² (113 mi²) area.

On 7 September the second baiting campaign was initiated. This campaign took 13 days to complete. During the September bait drop 765,193 FMP baits were distributed by fixed wing aircraft (Figure 1). In addition, 23,400 FMP baits were distributed by rotary aircraft (helicopter) and 111,971 FMP baits were distributed by hand. During the fall 2004 baiting campaigns, the total number of FMP baits distributed within the Ohio barrier (excluding contingency actions) was 900,564. During the fall 2004 bait drops, FMP baits were distributed by air at a rate of 75 baits/km² over a 11,845 km² (4,573 mi²) area.

Aircraft and flight crew for the 2004 ORV program (excluding contingency actions) were provided by the Ontario Ministry of Natural Resources (OMNR). Ground and baiting support were provided by WS, ODH, ODW, ODA, Ohio National Guard, and local and county health departments. To date (including contingency actions) 7,029,612 FMP baits and 132,000 coated sachets (CS), containing rabies vaccine, have been distributed across eastern Ohio.

Enhanced Surveillance

Throughout 2004, WS conducted enhanced surveillance activities and assisted ODH with the collection of raccoon rabies samples, which were submitted for rabies testing. During the 2004 trapping season all raccoons which appeared to have puncture wounds (bite marks), exhibited disorientation, or showed signs of illness were euthanized and submitted for testing. In addition, any live wildlife that showed signs of sickness and disorientation, obtained from concerned Ohio residents, were submitted to the ODH for rabies testing. Wildlife Services also conducted multiple road kill surveys and submitted any mammal that was found in suitable condition for rabies testing. Additionally, WS monitored "hot spot" areas where raccoon strain rabies persisted along the borders between Ohio and Pennsylvania. Monitoring of these areas, included road kill surveys, along with notifying and educating police, fire, and postal workers of the rabies threat in the area. In 2004, Ohio WS collected 42 animals in areas of special concern ("hot spots"); 10 animals were considered un-testable by ODH lab and 32 animals tested

negative for rabies. All raccoons trapped during 2004 were handled according to the American Veterinary Medical Association guidelines. In 2005, WS will continue to provide enhanced surveillance in these areas.

Population Monitoring

During the spring 2004, WS conducted 1 relative density study in Mahoning County (Lowellville, Ohio). This area was representative of the habitat found in northeastern Ohio (agricultural and suburban). The study was conducted after the spring, “hot spot” ORV baiting and during scheduled post-bait ORV program evaluation surveillance trapping. Fifty six unique raccoons were captured and a relative density index of 18.7 raccoons/km² was estimated. One raccoon was euthanized and submitted for rabies testing, after being identified as having a puncture/bite wound.

Pre-bait Evaluation

On 29 March 2004, in Mahoning and Columbiana Counties, WS initiated a trapping campaign designed to evaluate and monitor program success; through the collection of raccoon biological data, blood serum, and tooth samples. Trapping efforts focused on “hot spot” areas where raccoon strain rabies persisted along the borders between Ohio and Pennsylvania.

Samples were collected from 35 unique raccoons, over 336 trap nights (Table 1). One raccoon was euthanized and 1 raccoon was found dead in a trap during pre-bait ORV trapping; both animals were submitted for rabies testing. The data collected during pre-bait ORV trapping may help determine if raccoon populations are maintaining a level of viral immunity, beyond 4-9 weeks post-baiting (where titer/antibody levels are detectable).

Table 1. Results of spring pre-bait ORV program evaluation surveillance trapping in Ohio, 2004.

	Spring pre-bait ORV
Trap nights	336
Unique raccoons	35
Recaptured raccoons	1
Total raccoons	36
Trap success ^a	10.4%
Non-target captures	3

^aunique raccoons

Post-bait Evaluation

On 17 May 2004, in Mahoning and Columbiana Counties, WS initiated post-bait ORV surveillance trapping designed to evaluate and monitor project success, through the collection of raccoon biological data, blood serum, and tooth samples. Trapping efforts again focused on “hot spot” areas. Samples were collected from 144 unique raccoons, over 1,036 trap nights (Table 2). Seven raccoons were euthanized and submitted for rabies testing during post-bait ORV trapping.

Table 2. Results of spring post-bait ORV program evaluation surveillance trapping in Ohio, 2004.

	Spring post-bait ORV
Trap nights	1036
Unique raccoons	144
Recaptured raccoons	50
Total raccoons	194
Trap success ^a	13.9%
Non-target captures	13

^aunique raccoons

Other Rabies Activities

In 2004, WS trapped 1,280 raccoons as part of enhanced surveillance efforts in Ohio. All raccoons that WS captured and released were ear-tagged with a unique number. These ear tags also included a phone number and a

label which read “reward”. Twenty dollars was paid to residents who trapped these raccoons and submitted 1 of the labeled ear tags. In return, WS gained information on raccoon biology and movements. In 2004, WS collected 12 (< 1%) ear tags. The majority of the 12 trapped animals moved = 1 mile from the original site of capture.

Prior to the contingency action on 19 July 2004, in Cuyahoga and Summit Counties, WS conducted raccoon trapping along portions of the Ohio Turnpike. Trapping was in preparation of reducing the existing 25 mile ORV barrier by 5 miles to the east and was focused at gathering data in support of the reduction of the current rabies barrier, which was scheduled for the fall 2004. Samples were collected from 77 unique raccoons over 328 trap nights (Table 3). Four raccoons were euthanized and submitted for rabies testing after puncture/bite wounds were identified.

Table 3. Results of summer enhanced surveillance trapping along the Ohio Turnpike, Ohio, 2004.

	Ohio Turnpike enhanced surveillance
Trap nights	328
Unique raccoons	77
Recaptured raccoons	5
Total raccoons	82
Trap success ^a	23.5%
Non-target captures	3

^aunique raccoons

Non-target Captures

Ninety nine non-target animals were captured in 2004 during all trapping campaigns (including contingency actions); they included: 57 opossums (*Didelphis virginiana*), 24 woodchucks (*Marmota monax*), 7 domestic cats (*Felis catus*), 7 striped skunks (*Mephitis mephitis*), 2 Eastern cottontail rabbits (*Sylvilagus floridanus*), 1 muskrat (*Ondatra zibethica*), and 1 red squirrel (*Tamiasciurus hudsonicus*). Eighty two animals were released and 17 non-targets were euthanized.

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline Biomarker, and Age Results

During the fall 2003, in Mahoning, Columbiana, Jefferson, Belmont, and Harrison Counties, WS participated in a post-bait ORV program evaluation trapping designed to evaluate and monitor project success through the collection of raccoon biological data, blood serum, and tooth samples. Blood and tooth samples were collected from 167 unique raccoons (Table 4). Blood serum samples from 143 of 167 raccoons were analyzed by the CDC for the presence of antibodies against the rabies virus. Tooth samples from 162 of 167 raccoons were tested by Matson’s Lab, for the presence of the tetracycline biomarker (Table 4). Fishmeal polymer baits contain a tetracycline biomarker that is detectable in teeth when an animal consumes a bait. However, this is not indicative that the animal consumed the vaccine sachet, which is located inside the bait block. Additionally, 157 of 167 tooth samples were analyzed for age (Figure 2).

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected post -bait ORV program evaluation trapping in Ohio, 2003.

	Fall, post-bait ORV
Serology	
Unique raccoon captures	167
Testable blood samples	143
Positive rabies antibody response ^a	43 (30.1%)
Tetracycline	
Unique raccoon captures	167
Testable tooth samples	162
Presence of tetracycline biomarker	62 (38.3%)

^aCDC serum titer = 5 IU

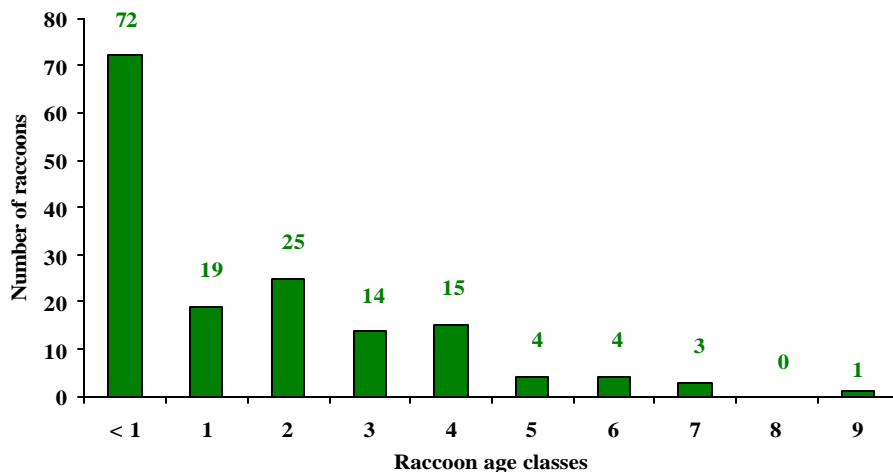


Figure 2. Age class distribution of 157 raccoon tooth samples collected during post-bait ORV program evaluation in Ohio, 2003.

CONTINGENCY ACTION 2004

Bait distribution

Two ORV baiting campaigns were conducted the weeks of August 1st and September 12th. During the week of August 1st, WS and ODH distributed 132,000 CS baits by fixed wing aircraft over Geauga and Lake Counties (Figure 1). In addition, 32,000 FMP baits were distributed by hand in Cuyahoga, Geauga, and Lake Counties, utilizing personnel from ODH, ODW, WS, and local and county health departments. During the week of September 12th, 44,965 FMP baits were distributed by hand in Portage, Cuyahoga (Cleveland), and Summit Counties, utilizing personnel from the Cuyahoga Valley National Park (CVNP) and local and county health departments. An additional, 21,600 FMP baits were distributed by the ODW helicopter, in the CVNP, located in Cuyahoga and Summit Counties. During the 2004 contingency action, CS and FMP baits were distributed over a 2,471 km² (954 mi²) area. Aircraft and flight crew for the 2004 contingency action was provided by Dynamic Aviation.

Enhanced Surveillance

Throughout the 2004 contingency effort, WS conducted enhanced surveillance activities to assist with raccoon submissions for rabies testing. As raccoon rabies spread in Lake, Geauga, and Cuyahoga Counties, and as the cooperative rabies surveillance and control program continued, cooperation from 6 local county health departments in 5 different counties added to enhanced surveillance efforts. As a result of surveillance efforts 1,071 samples were collected for rabies testing (1,012 raccoons, 47 striped skunks, 3 coyotes [*Canis latrans*], 3 red fox [*Vulpes vulpes*], 2 domestic cats, and 2 woodchucks). Of the 1,071 samples submitted, 927 came from counties in or adjacent to the contingency action zone (Table 5). Enhanced and public health surveillance (submitted due to human or pet exposures) was conducted during 2004 contingency actions. Surveillance efforts revealed 45 raccoons and 1 skunk positive for raccoon strain rabies within 3 counties: Cuyahoga-1, Lake-22, and Geauga-23. In 2005, WS will continue to conduct enhanced surveillance in the contingency action zone.

Table 5. Rabid raccoons identified through enhanced and public health surveillance in the contingency action zone in Ohio, 2004.

County	Specimens Collected	Enhanced surveillance	Passive Surveillance
Cuyahoga	449	1	0
Gauga	158	14	9
Lake	240	15	7
Portage	77	0	0
Medina	2	0	0
Total	926	30	16

Trap-Vaccinate-Release and Pre-bait Evaluation

In response to the case of raccoon strain rabies confirmed in the contingency area, a large scale TVR program was initiated. The TVR program, conducted by WS, was conducted from 26 July-12 August 2004. During the 2004 TVR program, Ohio WS utilized supplies and 18 WS personnel from 13 different states. Trapping efforts produced 956 unique raccoons. Of the 956 raccoons captured, 723 were vaccinated and released, 9 were released without vaccination, and 224 were euthanized and submitted for rabies testing after being identified as sick, acting strange, or found with puncture/bite wounds (Table 6).

Table 6. Results of TVR and pre-bait ORV contingency trapping in Ohio, 2004.

	TVR and pre-bait ORV
Trap nights	4,401
Unique raccoons	956
Recaptured raccoons	98
Total raccoons	1,054
Trap success ^a	21.7%
Non-target captures	70

^aunique raccoons

Post-TVV and Post-bait Evaluation

During the fall 2004, WS participated in a post-bait ORV trapping designed to evaluate and monitor TVR and ORV program success; through collection of raccoon biological data, blood serum, and tooth samples. Additionally, data collected during this period will help compare CS and FMP bait uptake.

On 12 October 2004, in Geauga County, WS initiated fall post-bait ORV contingency action trapping. Samples were collected from 68 unique raccoons, over 424 trap nights (Table 7). Sixty-seven raccoons were euthanized and 1 raccoon was found dead in a trap. These animals were submitted for rabies testing as part of enhanced surveillance activities.

Table 7. Results of post-TVV and post-bait ORV contingency action trapping in Ohio, 2004.

	Post-TVV and post-bait ORV
Trap nights	424
Unique raccoons	68
Recaptured raccoons	0
Total raccoons	68
Trap success ^a	16.0%
Non-target captures	10

^aunique raccoons

SUMMARY

The spring of 2004 marked the eighth year of WS cooperative participation in the Ohio ORV Program. This program is part of a larger ORV ARB effort that includes: West Virginia, Virginia, Tennessee, and Pennsylvania. Ohio is an integral part of the National ORV Program.

To date 7,029,612 FMP and 132,000 CS baits have been distributed across eastern Ohio. Since program inception, in 1997, there has been a noted decline in reported positive raccoon strain rabies cases within the ORV zone. In 1997, 62 positive cases were reported, which declined to 26 positive cases in 1998. From November 1999-October 2001, there were no raccoon strain rabies cases reported in Ohio.

On 6 November 2001, Ohio had 1 documented case of raccoon strain rabies, which was located approximately = 1 mile from the Ohio-Pennsylvania border. In 2003, 2 cases of raccoon strain rabies were identified, which were also located = 1 mile from the Ohio-Pennsylvania border. Raccoon rabies remains enzootic in Pennsylvania. Therefore, it is not surprising that rabies cases occurred near the Ohio-Pennsylvania border.

In 2004, Ohio experienced an outbreak of raccoon strain rabies in an area that had been considered rabies free. This outbreak was of great concern in Ohio, not only because of the high densities of raccoons in the northeast,

but because this outbreak occurred on the western side of an existing ORV barrier, which had been maintained and considered successful in nearly eliminating raccoon rabies from the state.

The 2004 contingency effort in Ohio was focused on creating a rabies immune raccoon population in target counties to prevent the further westward spread of raccoon rabies. Enhanced surveillance and vaccination of raccoons will greatly decrease the chance of rabies exposure to humans and domestic animals, as well as prevent the westward spread of raccoon rabies. This breach does not represent a failure of the National ORV Program. Rather, it reinforces our need for enhanced and passive surveillance and public education about translocation of wildlife.

The rabies cases west of the ORV barrier, as well as those in “hot spot” areas near the Ohio-Pennsylvania border, are still a reminder that the continuation of ORV, supported by enhanced surveillance is necessary. This will allow WS to contain, reduce, and potentially eliminate the raccoon strain of the rabies virus in Ohio and throughout the Eastern United States.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM PENNSYLVANIA 2004

BACKGROUND

Raccoon (*Procyon lotor*) rabies was first reported in Pennsylvania in 1982. The first documented cases occurred in Bedford, Fulton, and Franklin Counties. Twelve years later raccoon rabies had become enzootic throughout the Commonwealth's 67 counties. Since 1995, > 350 animals are positively diagnosed for rabies annually. During the fall 2001, the first oral rabies vaccine (ORV) baits were distributed in Pennsylvania. Pennsylvania expanded its baiting program in 2002 and 2003 to cover 25,189 km² in 18 western counties bordering Maryland, Ohio, and West Virginia. In 2004, Pennsylvania WS distributed baits across 24,016 km² in addition to the 543 km² naïve area in Cambria, Indiana, Somerset, and Westmoreland counties (Figure 1). The naïve area in Pennsylvania was baited in the spring of 2004 as a spring bait efficacy study coupled with a raccoon density study. The Pennsylvania Department of Agriculture (PDA) provided the state leadership for the baiting effort and Wildlife Services (WS) provided wildlife management leadership and contributed significant funding.

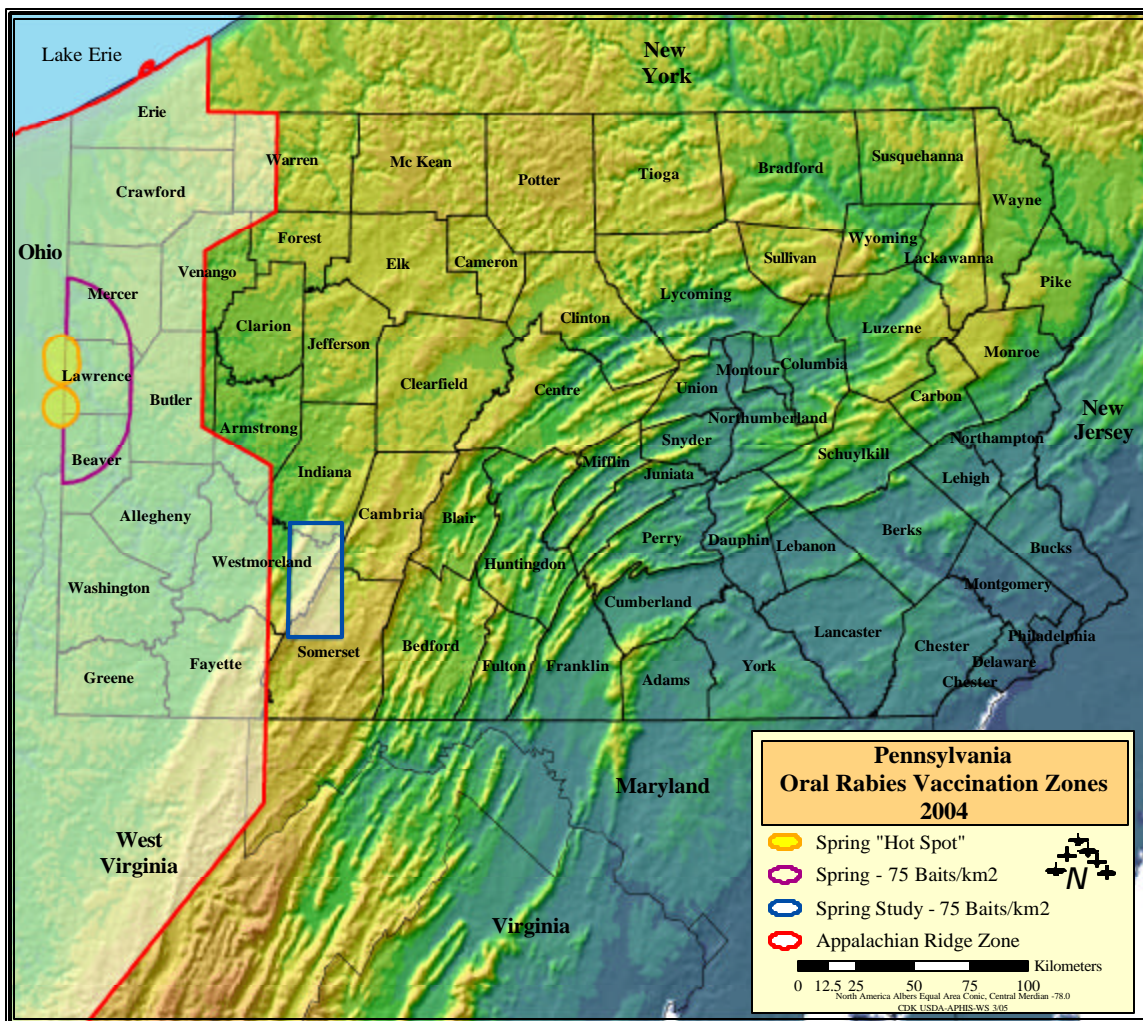


Figure 1. Oral rabies vaccination zone and location of spring research area in western Pennsylvania, 2004.

ORV PROGRAM 2004

Bait Distribution

To date, over 4.8 million fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (Merial, Athens, Georgia, USA), have been distributed in western Pennsylvania. Large cities and towns were baited by hand between 19-28 April and 9-25 August 2004; 314,807 baits were distributed (Figure 1). Personnel for the following agencies participated in hand baiting: WS, PDA, Pennsylvania Department of Health (PDH), Erie County Department of Health, and Allegheny County Health Department.

During the spring of 2004, WS distributed 252,960 aerial baits from 19 April-28 April as part of the “hot spot” response in eastern Ohio as well as the naïve area in Pennsylvania. Aerial baiting during the fall, from fixed wing aircraft, was conducted from 24 August-19 September; 1,213,476 baits were distributed across 18 counties. The objective of the naïve area was to determine spring bait efficacy in a previously unbaited area (Figure 1).

Aircraft and flight crews for the 2004 ORV program were provided by the Ontario Ministry of Natural Resources and Dynamic Aviation. Ground support for the flights was provided by the Pennsylvania, Maryland, Ohio, and West Virginia WS, Ohio Department of Health, Ohio National Guard, Pennsylvania Game Commission, PDA, and PDH.

Enhanced Surveillance

During 2004, WS placed greater emphasis on rabies enhanced surveillance. From March-December, 2 employees were devoted solely to rabies surveillance; traveling 37,280 km (23,155 miles), covering 20 counties. Road kill surveillance efforts (5,989 km [3,720 miles] driven) were concentrated within the 15 mile buffer strip between the Pennsylvania and Ohio border. Wildlife Services, in cooperation with the Pennsylvania Game Commission, local animal control businesses, and local and state police departments submitted 462 animals for rabies testing (Table 1).

Table 1. Animals collected for rabies testing from enhanced and passive surveillance in Pennsylvania, March-December, 2004.

Species	Number collected	Number positive
Bat (Order <i>Chiroptera</i>)	1	0
Feral cat (<i>Felis catus</i>)	9	0
Coyote (<i>Canis latrans</i>)	1	0
Fisher (<i>Martes pennanti</i>)	1	0
Gray fox (<i>Urocyon cinereoargenteus</i>)	6	0
Long-tailed weasel (<i>Mustela frenata</i>)	2	0
Mink (<i>Mustela vison</i>)	2	0
Raccoon	411	29
Red fox (<i>Vulpes vulpes</i>)	7	0
Striped skunk (<i>Mephitis mephitis</i>)	20	0
Woodchuck (<i>Marmota monax</i>)	2	0
Total	462	29 (6.3%)

Population Monitoring

The goal of the Pennsylvania ORV Program is to strengthen the existing ORV barrier in eastern Ohio and to expand this barrier eastward to reduce the area where raccoon rabies occurs. This cooperative initiative has created a vaccinated area of sufficient scope and allowed the exploration of methods to eliminate raccoon rabies in Pennsylvania.

From June-October 2004, raccoon relative density studies were conducted on 5 study sites. Study sites in Allegheny, Erie, Greene, and Venango Counties were selected for this research project in addition to the naïve area east of the ORV zone. In 2004, 876 unique raccoons were captured (Table 2). Three raccoons were found dead in the trap during post-bait ORV trapping. Thirty eight raccoons were euthanized during trapping activities due to rabies threats. All raccoons euthanized were submitted to PDA for rabies testing. All animals trapped in 2004 were handled according to the American Veterinary Medical Association’s guidelines.

Table 2. Estimated relative density indices of raccoon populations on 5 study sites in Pennsylvania, 2004.

Study site	Density index	Trap success ^a
Naïve area	25	11.4%
Allegheny Co.	70	23.4%
Erie Co.	14	9.2%
Greene Co.	23	15.0%
Venango Co.	12	7.8%

^aunique raccoons

Pre-bait Evaluation

Pre-bait ORV program evaluation trapping occurred from 23 March-16 April and pre-bait ORV research trapping occurred from 1 June-6 August 2004 (Table 3).

Table 3. Results of pre-bait ORV program evaluation trapping in Pennsylvania, 2004.

	Pre-bait ORV random	Pre-bait ORV research
Trap nights	1,115	467
Unique raccoons	133	70
Recaptured raccoons	2	15
Total raccoons	135	85
Trap success ^a	11.9%	15.0%
Non-target animals ^b	69 (6.2%)	39 (8.4%)

^aunique raccoons

^breleased unharmed

Post-bait Evaluation

Post-bait ORV program evaluation trapping occurred from 1 June-6 August and post-bait ORV research trapping occurred from 4 October-5 November 2004 (Table 4).

Table 4. Results of post-bait ORV program evaluation trapping in Pennsylvania, 2004.

	Post-bait ORV random	Post-bait ORV research
Trap nights	1,770	2466
Unique raccoons	312	361
Recaptured raccoons	4	115
Total raccoons	316	476
Trap success ^a	17.6%	14.6%
Non-target animals ^b	102 (5.8%)	117 (4.7%)

^aunique raccoons

^breleased unharmed

Non-target Captures

In 2004, 327 non-target animals were captured during 5,818 trap nights in 2004. Of those 327 non targets, there were 13 mammal species, 3 avian species, and 2 reptiles or amphibians (Table 5). One Gray catbird (*Dumetella carolinensis*) and 2 red squirrels (*Tamiasciurus hudsonicus*) were found dead in traps, all other non-targets were released.

Table 5. Non target species captured and released during random and research trapping in Pennsylvania, 2004.

Species	Pre-bait ORV random	Post-bait ORV random	Pre-bait ORV research	Post-bait ORV research	Total
American robin (<i>Turdus migratorius</i>)	1	0	0	0	1
Black bear (<i>Ursus americanus</i>)	0	1	0	0	1
Blue jay (<i>Cyanocitta cristata</i>)	0	0	0	1	1
Box turtle (<i>Terrapene carolina</i>)	0	1	0	1	2
Eastern cottontail rabbit (<i>Sylvilagus floridanus</i>)	2	5	0	4	11
Feral cat	16	11	0	9	36
Frog (species unknown)	2	0	0	0	2
Gray catbird	0	0	0	2	2
Gray squirrel (<i>Sciurus carolinensis</i>)	0	0	0	1	1
Long-tailed weasel	0	0	0	1	1
Muskrat (<i>Ondatra zibethica</i>)	0	1	0	0	1
Opossum (<i>Didelphis virginiana</i>)	44	61	22	59	186
Porcupine (<i>Erethizon dorsatum</i>)	0	1	0	1	2
Red squirrel	1	4	0	9	14
Rat (species unknown)	2	0	0	1	3
Stripped skunk	0	4	0	4	8
Woodchuck	1	13	17	24	55
Total	69	102	39	117	327

ORV PROGRAM 2003-EVAULATION

During 2003 pre- and post-bait ORV program evaluation trapping in Pennsylvania 634 unique raccoons were captured, through general random trapping for samples and as a part of research study sites. Blood and tooth samples were taken from most of these animals for ORV program evaluation (Table 6 and Figure 2).

Table 6. Serology and tetracycline biomarker results of raccoon biological samples collected during pre- and post-bait ORV program evaluation in Pennsylvania, 2003.

	Pre - and post-bait results
Serology	
Unique raccoon captures	634
Testable blood samples	338
Positive rabies antibody response ^a	91 (27%)
Tetracycline	
Unique raccoon captures	634
Testable tooth samples	563
Presence of tetracycline biomarker	169 (30%)

^aCDC serum titer = 5 IU

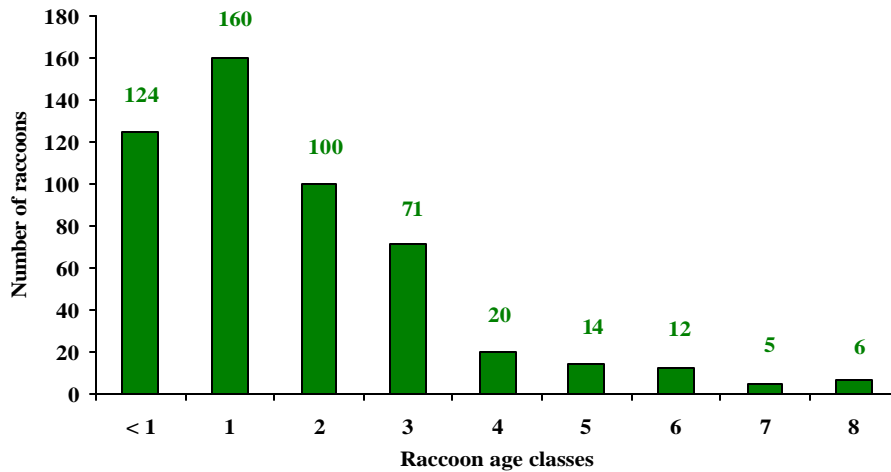


Figure 2. Age class distribution of 512 raccoon tooth samples collected in Pennsylvania, 2003.

SUMMARY

During 2004, WS completed the third year of cooperative participation in the Pennsylvania ORV Program, distributing 1,760,688 ORV baits. Baits were distributed by hand and from aircraft, across 19 counties, encompassing 24,559 km². Since program inception in 2001, > 4.8 million ORV baits have been distributed in Pennsylvania.

Pennsylvania's baiting effort is an integral part of the larger Appalachian Ridge cooperative effort (Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia), which in turn, is tied to national planning efforts to contain raccoon rabies and explore strategies to eliminate this unique variant of the rabies virus.

In 2005, the Pennsylvania ORV Program will continue to distribute baits across the same 19 county area covered in 2004, with even greater emphasis placed on enhanced rabies surveillance.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM TENNESSEE 2004

BACKGROUND

In 2002, the oral rabies vaccination (ORV) program in Tennessee became a part of the National Rabies Management Program to stop the westward spread of the raccoon (*Procyon lotor*) strain of rabies. Prior to 2002, raccoon strain rabies had not been found in Tennessee. In June, 2003, the rabies front, which had stalled in North Carolina, finally crossed over into northeastern Tennessee. Four positive cases were discovered in raccoons in Carter County and 1 positive case was found in a feral cat (*Felis catus*) in Johnson County. In January 2004, the rabies front, approaching from northern Georgia, crossed over into southeastern Tennessee. During 2004, in Hamilton County, 14 positive rabies cases were documented in wildlife.

The Tennessee WS program conducted ORV programs on two fronts during 2004. The Appalachian Ridge ORV program extends from Lake Erie into Tennessee. Seven counties in the northeast corner of the state and the high elevations of the Appalachian Mountains serve as the southern anchor of this barrier. The Georgia-Alabama-Tennessee (GAT) ORV program begins in 8 counties in the southeast corner of the state and extends southward into Georgia and Alabama. Ultimately, the GAT ORV zone may be extended south through Alabama and north through Tennessee, and together with the Appalachian Ridge barrier, will create a continuous barrier from Lake Erie to the Gulf of Mexico.

The Tennessee ORV Program is being conducted by WS, in cooperation with the Tennessee Department of Health, Tennessee Department of Agriculture, Chattanooga/Hamilton County Department of Health, and the Centers for Disease Control and Prevention (CDC). The Tennessee Valley Authority, Holston Army Ammunition Facility, Volunteer Army Ammunition Facility, Phipps Bend Industrial Park, Tennessee River Gorge Trust Association, Chattanooga Audubon Society, Chattanooga Parks and Recreation, Chattanooga Municipal Airport, Moccasin Bend Mental Health Institute, CSX Transportation, Hamilton County Board of Education, Hamilton County Real Property, Tennessee Wildlife Resources Agency, Warrior's Path State Park, Booker T. Washington State Park, Harrison Bay State Park, Chester Frost County Park, and separate individual landowners provided access to private and government owned properties for ORV program trapping and monitoring.

ORV PROGRAM 2004

Bait Distribution

Appalachian Ridge ORV Program.--The ORV program in Tennessee in 2004 was conducted on two fronts, the Appalachian Ridge area in northeast Tennessee and the GAT area in southeast Tennessee. The 2004 Appalachian Ridge bait zone covered 2,863 km² (1,105 mi²) in 7 counties (Figure 1). Aerial distribution of 142,790 baits occurred from 10-19 August and hand distribution of 20,080 baits occurred from 20-21 August. Fishmeal polymer baits (FMP), containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), were used for both ORV programs. Aircraft and flight crew for the 2004 ORV programs were provided by the Ontario Ministry of Natural Resources and Dynamic Aviation.

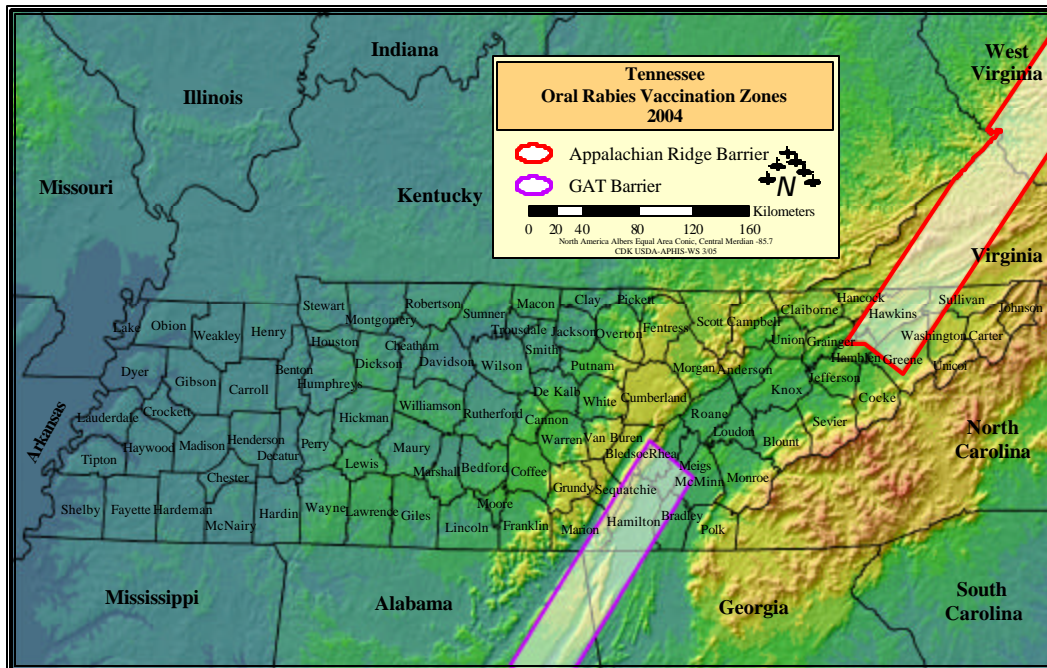


Figure 1. Oral rabies vaccination zones in Tennessee, 2004.

Georgia-Alabama-Tennessee ORV Program.--The April 2004 GAT area bait zone covered 378 km² (146 mi²) in Hamilton county. Hand distribution of 56,700 FMP baits occurred from 12-13 April. The November 2004 GAT area bait zone covered 3,211 km² (1,240 mi²) in 8 counties (Figure 1). Aerial distribution of 161,267 FMP baits occurred from 6-8 November and hand distribution of 110,160 FMP baits occurred from 7-9 November.

Enhanced Surveillance

In 2004, WS continued enhanced surveillance for the raccoon strain of the rabies virus in Tennessee. Wildlife Services personnel continued to recruit state and local agencies to collect suspect animals for testing. An emphasis was placed on raccoons, striped skunks (*Mephitis mephitis*), gray foxes (*Urocyon cinereoargenteus*), red foxes (*Vulpes vulpes*), and coyotes (*Canis latrans*) that displayed unusual behavior, were found dead in unusual places, or were fresh road-killed animals. The enhanced surveillance area was expanded from 21 to 28 counties, creating a surveillance corridor along the borders with Virginia, North Carolina, Georgia, and Alabama. These efforts resulted in the collection and testing of 356 raccoons, 48 striped skunks, 27 gray foxes, 10 red foxes, and 8 coyotes and revealed 7 additional positive animals.

Population Monitoring

No relative density studies were conducted in Tennessee during 2004.

Post-bait Evaluation

Appalachian Ridge ORV Program.--After the August bait drop, WS conducted post-bait ORV trapping of raccoons to collect blood and tooth samples and measure program success. During September 2004, trapping occurred on 11 study sites (2 forested, 8 agriculture, and 1 urban/suburban), yielding 131 unique raccoons.

Georgia-Alabama-Tennessee ORV Program.--After the April and November bait drops, WS conducted post-bait ORV trapping of raccoons to collect blood and tooth samples and measure program success. During May 2004, trapping occurred on 5 study sites (1 forested and 4 urban/suburban), yielding 129 unique raccoons. During December 2004, trapping occurred on 11 study sites (3 forested, 1 agriculture, and 6 urban/suburban), yielding 138

unique raccoons. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Other Rabies Activities

Georgia-Alabama-Tennessee Focal Point Trapping.--In response to the first positive case of raccoon strain rabies inside the GAT baiting area, WS conducted intensive trapping during 10-18 February, 2004. Twenty-six raccoons and 5 skunks were captured, euthanized, and submitted for rabies testing. All samples tested negative for rabies.

Georgia-Alabama-Tennessee Trap-Vaccinate-Release Efforts.--WS conducted an intensive trap-vaccinate-release program in response to the second positive case. Trapping occurred from 29 March-2 April, 2004, yielding 13 raccoons. All raccoons were vaccinated and released. A single striped skunk was captured, euthanized and submitted for rabies testing. This skunk tested positive for the raccoon strain of rabies.

Non-target Captures

Appalachian Ridge ORV Program.--Non-target species that were captured and released during the post-bait ORV trapping included: 113 opossums (*Didelphis virginiana*), 6 feral cats, 4 Eastern box turtles (*Terrapene carolina carolina*), 1 Eastern cottontail rabbit (*Sylvilagus floridanus*), and 1 woodchuck (*Marmota monax*).

Georgia-Alabama-Tennessee ORV Program.--Non-target species that were captured and released during the focal point trapping and post-bait drop trapping included: 137 opossums, 49 feral cats, 3 Eastern snapping turtles (*Chelydra serpentina serpentina*), and 1 Eastern box turtle. In addition, 6 striped skunks were captured and euthanized.

ORV PROGRAM 2003 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Appalachian Ridge ORV Program.--Trapping of raccoons was conducted as part of the relative density studies and for post-bait ORV evaluation. Blood and tooth samples were collected from captured raccoons to measure program success. Eighty unique raccoons were captured as part of the relative density studies conducted during July 2003 and 153 unique raccoons were captured as part of the post-bait ORV evaluation during late November and early December 2003 (Table 1 and Figure 2).

Table 1. Serology and tetracycline biomarker results of raccoon biological samples collected during pre- and post-bait ORV evaluation in Tennessee, 2003.

	Collection period	
	Summer, pre-bait ORV	Fall, post-bait ORV
Serology		
Unique raccoon captures	80	153
Testable blood samples	79	153
Positive rabies antibody response ^a	7 (8.9%)	34 (22.2%)
Tetracycline		
Unique raccoon captures	80	153
Testable tooth samples	70	132
Presence of tetracycline biomarker	5 (7.1%)	50 (37.9%)

^aCDC serum titer = 5 IU

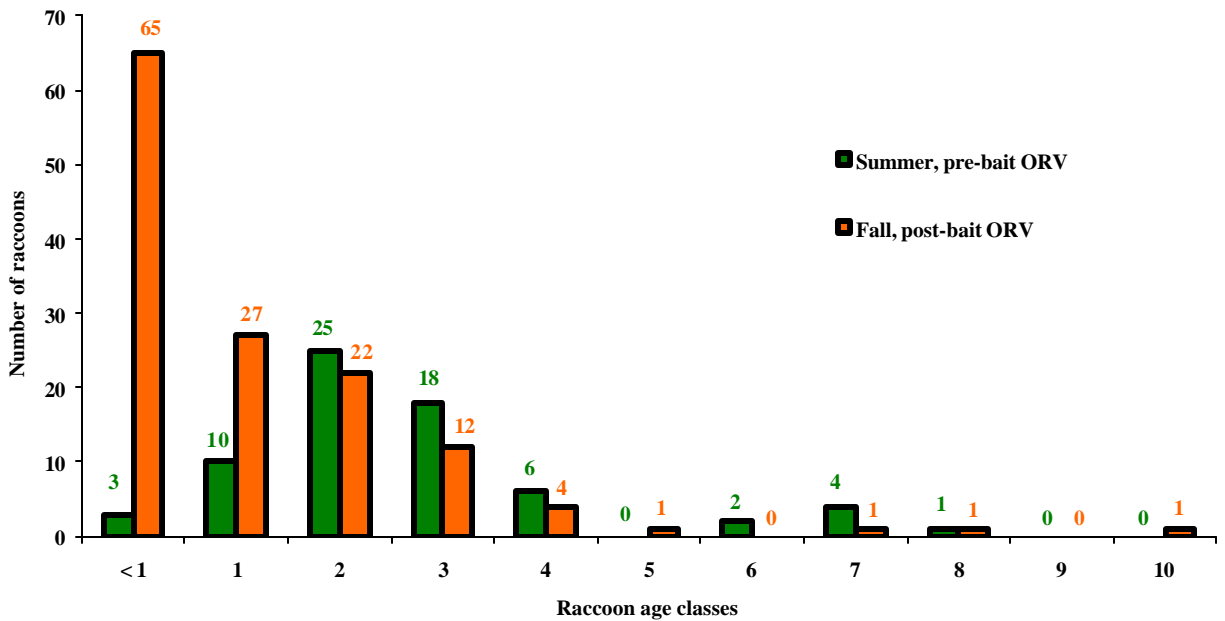


Figure 2. Age class distribution of 233 raccoon tooth samples collected during pre- and post-bait ORV program evaluation in Tennessee, 2003.

Georgia-Alabama-Tennessee ORV Program.--Trapping of raccoons was conducted as part of the relative density study and for post-bait ORV evaluation. Blood and tooth samples were collected from captured raccoons to measure program success. Sixty four unique raccoons were captured as part of the post-bait ORV evaluation during late December 2003 and early January 2004 (Table 2 and Figure 3).

Table 2. Serology and tetracycline biomarker results of raccoon biological samples collected post -bait ORV program evaluation in Tennessee, 2003.

	Post-bait ORV
Serology	
Unique raccoon captures	64
Testable blood samples	64
Positive rabies antibody response ^a	17 (26.6%)
Tetracycline	
Unique raccoon captures	64
Testable tooth samples	50
Presence of tetracycline biomarker	8 (16.0%)

^aCDC serum titer = 5

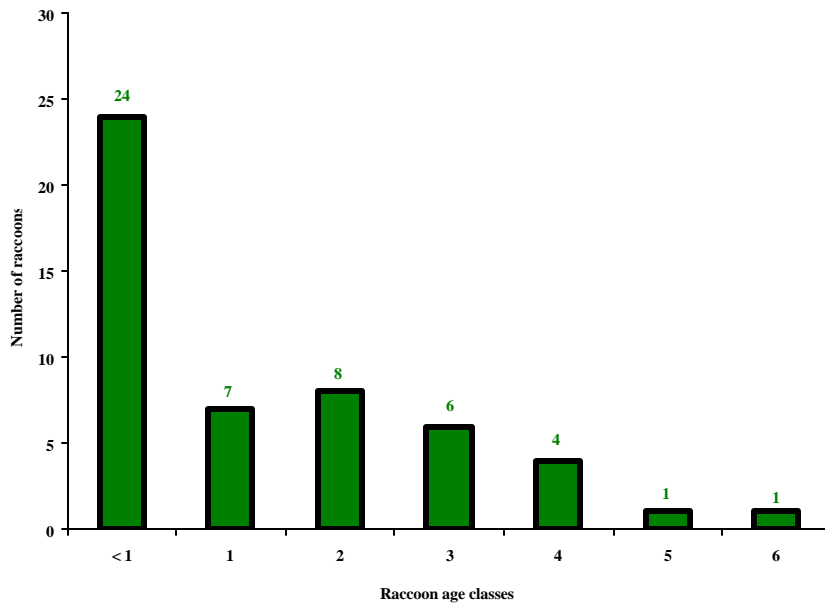


Figure 3. Age class distribution of 64 raccoon tooth samples collected during post-bait ORV program evaluation in Tennessee, 2003.

SUMMARY

In 2004, Tennessee WS conducted its third year of rabies control activities in the Appalachian Ridge ORV program and its second year in the GAT area. During the bait drops, 186,940 FMP baits were distributed by hand and 304,057 FMP baits were distributed by air in portions of 15 east Tennessee counties. Post-bait drop trapping resulted in the collection of 398 animals for virus neutralizing antibody testing. Enhanced surveillance efforts resulted in the collection and testing of 449 animals and revealed 7 additional positive cases in Hamilton County.

During 2005, WS will continue to conduct and coordinate enhanced surveillance for raccoon strain rabies in east Tennessee. Efforts will be made to recruit additional local law enforcement agencies, Tennessee Wildlife Resources personnel, and the general public to report and/or collect suspected rabid animals in 28 counties in east Tennessee. Additional relative density study areas and monitoring sites will be secured to look at potential differences in raccoon population trends among different habitats, elevations, and ORV areas.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM TEXAS 2004

BACKGROUND

Since 1980, > 90% of reported rabies cases have involved wild animals. In the United States several different strains of the rabies virus are present. Each strain is spread predominantly by 1 wildlife species, but all strains are capable of infecting warm-blooded mammals, including humans. Currently, raccoons (*Procyon lotor*) and skunks (family *Mustelidae*) spread most reported rabies cases in the United States. However, bats (order *Chiroptera*), gray foxes (*Urocyon cinereoargenteus*), and coyotes (*Canis latrans*) also have a significant impact as wildlife carriers of rabies.

In 1998, 2 canine rabies epizootics (epidemics in animals) emerged in Texas, 1 involving coyotes and dogs (*C. familiaris*) in south Texas and the other involving gray foxes in west central Texas. The south Texas epizootic has resulted in 2 human deaths and required > 3,000 people to receive post exposure rabies treatment. In 1994, the public health threat created by these 2 expanding epizootics prompted the Governor of Texas to declare rabies a state health emergency. By 1996, the 2 epizootics expanded to involve 69 Texas counties. In February 1995, an oral rabies vaccination program (ORVP) was initiated as a multiyear effort, with a goal of creating zones of vaccinated coyotes and gray foxes (January 1996) along the leading edges of the epizootics, thereby halting the spread of the virus. The ORVP is a cooperative program involving Wildlife Services (WS); Texas Department of State Health Services (TDSHS), formerly the Texas Department of Health; Texas Cooperative Extension-Wildlife Services; Texas National Guard; the Centers for Disease Control and Prevention (CDC); United States Army Veterinary Laboratory, located at Ft. Sam Houston; and other local, state, and federal agencies.

ORV PROGRAM 2004

Bait Distribution-Coyote

During January 2004, WS participated as a member of the ORVP in the aerial distribution of 734,400 oral rabies vaccine (ORV) baits to prevent the spread of canine rabies in coyotes in south Texas. Fixed-wing aircraft services, used for the aerial distribution of baits, were provided by Dynamic Aviation. Coyote baits were composed of fishmeal polymer (FMP), containing 150 milligrams (mg) of tetracycline biomarker and a 2 milliliter (ml) sachet of Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA). Total area baited for coyotes was 33,670 km² (Figure 1).

Bait Distribution-Gray Fox

During January 2004, WS also participated as a member of the ORVP in the aerial distribution of 1,982,740 ORV baits to contain an outbreak of rabies unique to gray foxes in west central Texas. In addition, 3,280 ORV baits were distributed by hand in the cities of Ft. Stockton and Sanderson. Gray fox baits were composed of dog food, containing 150 mg of tetracycline biomarker and a 2 ml sachet of Raboral V-RG® vaccine. Total area baited for gray foxes was 56,203 km² (Figure 1). With the 1.93 million ORV baits supplied by WS during 2004, the Texas ORVP cooperative effort was able to continue the encirclement of the gray fox rabies epizootic and apply ORV baits within Big Bend National Park and adjacent areas.

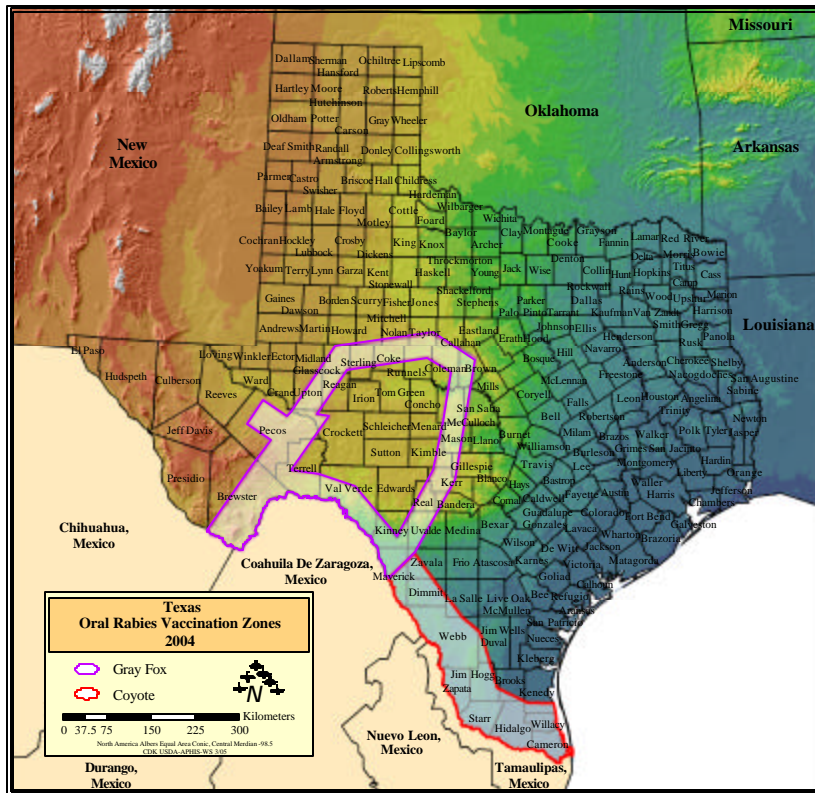


Figure 1. Coyote and gray fox ORV bait zones in Texas, 2004 (Bait zone data provided by TDSHS).

ORV PROGRAM 2004-EVALUATION

The Texas ORVP bait distribution occurred in January 2004. Therefore, data and results presented in this report are for 2004. Data and results reports in all other reports, with the exception of Florida, are from 2003. Annual evaluations of the ORVP are based on 3 criteria: (1) the detection of the tetracycline biomarker in dental tissue, which can be used to demonstrate the number of baits eaten, in a given year and the annual bait consumption by animals, over a period of multiple years. However, presence of tetracycline does not confirm that the vaccine sachet has been punctured or consumed; (2) the number of positive rabies antibody responses from animals collected within the vaccination zone (CDC serum titer = 5); and (3) the epidemiology of rabies cases in the target area. All biological samples, collected to evaluate the success of the ORVP, were obtained from target animals. No non-target animals were taken. All animals collected in 2004 were handled according to the American Veterinary Medical Association guidelines.

Serology, Tetracycline, and Age Results

Coyote.--In 2004, TDSHS and WS collected 100 coyotes, for ORVP evaluation, from within the coyote vaccination zone. Eighty (80%) of 100 coyotes tested were positive for the tetracycline biomarker included in the bait material (Figure 2 and Table 1). Fifty (50%) of 100 coyotes tested within the surveillance area showed a positive rabies antibody response to the vaccine (Table 1). Since the initiation of the ORVP in south Texas, canine rabies cases have declined from 166, reported during the pre-program year in 1994, to 0 in 2000. During 2004, a single canine rabies case involving a stray dog was confirmed in Laredo, Texas. This isolated case occurred within 1.61 km (1 mile) of the United States-Mexico border. In response, the City of Laredo Health Department's Animal Control Division implemented an aggressive isolation and vaccination protocol. Additional control measures included the increased vaccination clinics for domestic pets throughout the city. No additional rabies cases have been reported.

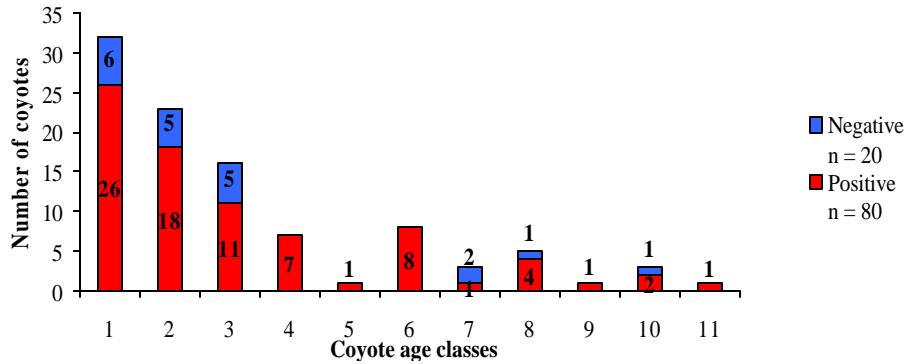


Figure 2. Age class distribution and presence/absence of tetracycline biomarker for 100 coyotes collected during post-bait ORVP evaluation in south Texas, 2004.

Table 1. Serology and tetracycline biomarker results of biological samples collected during post-bait ORVP evaluation in south and west central Texas, 2004.

Species	Presence of tetracycline biomarker	Positive rabies antibody response ^a	Total
Gray fox	72 (53%)	88 (65%)	136
Coyote	7 (17%)	9 (21%)	42
Mountain lion (<i>Puma concolor</i>)	0 (0%)	0 (0%)	1

^aCDC serum titer = 5 IU

Gray Fox.--During the evaluation phase of the gray fox 2004 ORVP in west central Texas, WS and the DSHS collected 136 gray foxes. Blood and tooth samples were taken from captured animals for ORVP evaluation (Table 1 and Figure 3).

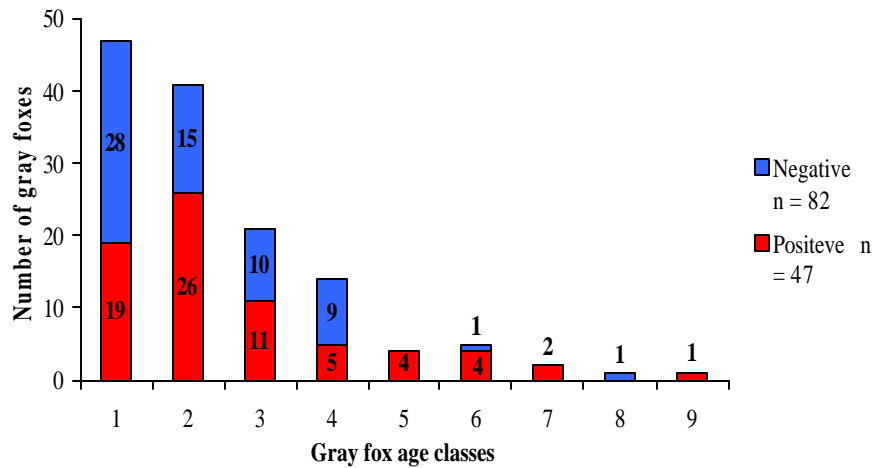


Figure 3. Age class distribution and presence/absence of tetracycline biomarker for 136 gray foxes collected during post-bait ORVP evaluation in west central Texas, 2004.

The gray fox ORVP in west central Texas has shown program success with 244 rabies cases reported during the pre-program year in 1995, 101 in 1996, 24 in 1997, 36 in 1998, 66 in 1999, 58 in 2000, 20 in 2001, and 65 in 2002. In 2002, of 65 total cases of gray fox rabies reported, 18 cases occurred in Pecos County, outside the western edge of the gray fox ORV zone. Several factors may have contributed to the breach in the ORV barrier during 2002. One factor may have been the interruption of the ORV baiting program for 2 consecutive years. During 2000 and 2001, reduced funding for ORVP only allowed for the distribution of vaccine baits along the eastern edge of the epizootic to protect the state's major metropolitan areas. In 2002, with restored levels of ORVP funding, the northern and western edge of the gray fox vaccination zone were re-established. Increased ORVP funding for 2003 enabled the blanket treatment of the Pecos County foci, as well as the encirclement of the gray fox

rabies epizootic area. In 2003, only 4 (6.6%) of 61 cases of gray fox rabies were reported in Pecos County. The remaining 57 cases were inside the ORV barrier. During 2004, no gray fox variant rabies cases were identified in Pecos County.

In 2004, of the 22 confirmed gray fox variant cases reported by TDSHS, all but 1 case occurred within or inside the ORV barrier. On 9 February 2004, a case of gray fox rabies was confirmed in a gray fox outside the 2004 ORV zone in Kerr County. The case was located approximately 8 km (5 miles) outside the ORV bait drop zone, but within the 2003 ORV zone. During 2004, passive surveillance of the area and the 6 counties contiguous to Kerr County revealed no additional rabies cases. This area is scheduled to receive a blanket treatment of ORV baits in January 2005.

SUMMARY

Since 1995, 10.08 million vaccine baits have been distributed over south Texas by the ORVP, which has proved to be highly effective in the elimination of the canine rabies strain in that area. A maintenance strategy has been developed to sustain a zone of immunized wildlife along the southern Texas border, with only 2 incursions into the zone at Laredo since 2001, thus preventing the re-emergence of the virus. With continued support for the cooperative ORVP effort, similar success is sought in the gray fox epizootic in west central Texas where 12.59 million fox baits have been distributed since 1996.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM VERMONT 2004

BACKGROUND

Raccoon (*Procyon lotor*) rabies first entered Vermont in 1994. It quickly spread and has been confirmed in all 14 counties in the state. In < 2 years, raccoon rabies had spread through 8 counties in Vermont and by spring 1996 was approximately 73 km (45.5 miles) south of the United States-Canada border. In May 1997, an intensive oral rabies vaccination (ORV) program was initiated with the goal of preventing the northward spread of raccoon rabies into Canada. In 1997, 1,637 km² (632 mi²) were baited in Vermont. That area has more than quadrupled in size to the current 2004 program of 7,102 km² (2,742 mi²). The 2004 ORV bait zone utilized potential natural barriers (Lake Champlain to the west and the Connecticut River to the east) to contain the spread of rabies and encompassed approximately 37% of the state (Figure 1). Since 1997, through aerial and hand bait distribution, over 1.8 million fishmeal polymer (FMP) and fishmeal-coated sachet (CS) baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA) have been distributed over northern Vermont.

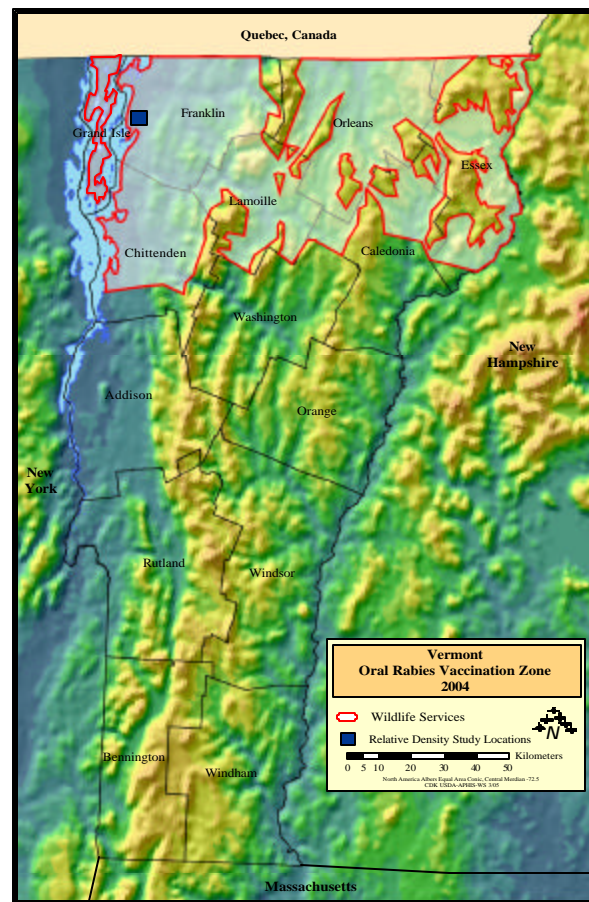


Figure 1. Oral rabies vaccination zone in Vermont, 2004.

This cooperative ORV effort is lead by Cornell University (CU). Wildlife Services (WS) has been the major source of federal funds for project implementation. Wildlife Services has also provided federal wildlife management leadership by continuing to play an active role in: project planning and coordination; organizing ground support for the bait drop; working in and navigating aircraft to distribute baits; coordinating the hand distribution of baits in areas too populated to bait by air; evaluating if the Green Mountains serve as a natural barrier to the movement of raccoon rabies; and providing surveillance and follow-up field work, by collecting blood and tooth samples from live-trapped and suspect-rabid animals, within the ORV bait zone, to test program efficacy.

ORV PROGRAM 2004

Bait Distribution

The summer of 2004 marked the eighth consecutive year of the Vermont ORV program. The 2004 bait zone was expanded to the south in Chittenden County (in the Lake Champlain valley) and included 2 new towns. The zone was also expanded to the south in Caledonia and Essex counties (in the Connecticut River Valley) and included 8 new towns. During 21 flights, 339,098 CS baits were distributed by Twin Otter and Piper Navaho fixed-wing aircraft from 2-3 September, while 9,120 FMP baits were distributed by hand from 27 August-8 September. Total number of baits distributed in Vermont during the 2004 field season was 348,218. Aircraft and flight crew for the 2004 ORV bait drop were provided by the Ontario Ministry of Natural Resources. Ground and aerial baiting support was also provided by WS, CU, and many Vermont citizens. Wildlife Services receives formal permission to conduct aerial bait drops from the Vermont Department of Health (VDH), the Vermont Fish and Wildlife Department (VFWD), and the Vermont Agency of Agriculture, Food, and Markets.

Population Monitoring

From 1997-2003, WS has conducted 36 raccoon relative density studies in northern Vermont to establish population trends in areas of common agricultural habitat and to determine density indices at higher elevations (> 500 m). Other states with ORV programs have conducted 61 similar studies, totaling 97 studies nationwide. Each study has been conducted using an established protocol of 50 cage traps over 10 consecutive nights (500 trap nights) on a 3 km² study area. Relative density indices, from nationwide studies, ranged from 0– 38 raccoons/km².

Based on the growth of the National ORV Program (that now spans from Maine to the Gulf of Mexico and includes many different habitats, supporting varying raccoon densities), and based on relative density study data collected from 1997-2003, we recognized the need to refine our national density study protocol to include areas supporting less typical low or high raccoon population densities.

During data analyses, we acknowledged that the current protocol (trapping for 10 consecutive days) may be too short of duration to capture the majority of raccoons in a 3 km² area, especially in areas with excellent raccoon habitat. Therefore, WS wanted to look at 10 days versus 20 consecutive days of trapping.

On 22 September 2004, WS initiated a 20-day raccoon relative density study on 3 adjacent sites in the town of St. Albans (near the Quebec, Canada border). Each of the 3 studies used the same protocol: 50 traps on 3 km² for 20 consecutive days.

In cooperation with WS personnel from Illinois, 141 unique raccoons were captured on the 3 contiguous sites, representing 9 km², over 3,000 trap nights. More importantly, however, is the number of unique raccoons captured during days 1-10 versus days 1-20 (Table 1). This study will need to be replicated to draw any definite conclusions, but preliminary data suggest that 10 days is long enough to capture the majority of raccoons in an area, but that more raccoons may be trapped by extending the study to 20 days. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 1. Raccoon population monitoring efforts in St. Albans, Vermont, 2004.

	Site 1		Site 2		Site 3	
	Days 1-10	Days 1-20	Days 1-10	Days 1-20	Days 1-10	Days 1-20
Trap nights	500	1,000	500	1,000	500	1,000
Unique raccoons	23	30	41	55	52	56
Recaptured raccoons	6	14	13	39	14	26
Trap success ^a	4.6%	3.0%	8.2%	5.5%	10.4%	5.6%
Non-target captures	16	27	6	10	11	15
Average relative density index	7.7	10.0	13.7	18.3	17.3	18.7

^aunique raccoons

Post-bait Evaluation

Since 1997, WS has led post-bait ORV program evaluation trapping, which is an essential component to the evaluation phase of the Vermont ORV Program. Blood and tooth samples are taken from each live-trapped raccoon; the animal is weighed and marked with a small ear tag and released back into the wild at the point of

capture. The blood serum is later analyzed to detect virus neutralizing antibodies (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth indicates that an animal consumed at least the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for serum evaluation as well.

In 2004, WS live-trapped 329 raccoons during the evaluation phase. Blood and tooth samples were collected from most of these animals. These samples will be used to compare immune status and bait uptake of the raccoon population within the 2004 ORV zone to raccoon populations from 1997-2003. In addition, WS live-trapped 30 striped skunks (*Mephitis mephitis*) during the evaluation phase. Blood samples were taken from 16 of these skunks; no tooth samples were collected.

In addition to 329 raccoons and 30 skunks, 24 additional animals (representing 9 species) were live-trapped as non-targets, for a total of 383 individuals captured during the 2004 ORV evaluation phase (Table 2). Thirty four of 329 raccoons captured were euthanized. The majority (25) of these raccoons were removed from State-owned land, at the request of the VFWD, to reduce raccoon egg predation on nesting State-threatened Eastern spiny softshell turtles (*Apalone spinifera*). Six raccoons were removed (and euthanized) from farms within the ORV zone for nuisance reasons. Three raccoons were found dead, each in a separate cage trap; there were no visible wounds on 2 of the raccoons, while the third had massive injuries near its posterior. All raccoons that were not released were submitted to the VDH and all tested negative for the rabies virus. One ruffed grouse (*Bonasa umbellus*) and 1 red squirrel (*Tamiasciurus hudsonicus*) were each found dead in a cage trap. Three striped skunks were removed (and euthanized) from farms within the ORV zone for nuisance reasons. All other animals captured were released unharmed.

Table 2. Non-target animals trapped during the Vermont ORV evaluation phase, 2004.

Species	Number	Species	Number
Cat (<i>Felis catus</i>)	7	Muskrat (<i>Ondatra zibethicus</i>)	4
Chicken (<i>Gallus gallus</i>)	4	Rat, Norway (<i>Rattus norvegicus</i>)	1
Cottontail, Eastern (<i>Sylvilagus floridanus</i>)	1	Squirrel, gray (<i>Sciurus carolinensis</i>)	2
Fisher (<i>Martes pennanti</i>)	1	Squirrel, red	1
Grouse, ruffed	3	Total	24

OTHER RABIES ACTIVITIES

Throughout 2004, WS provided assistance to the VDH by collecting and submitting wild animals exhibiting rabies-like symptoms, wildlife involved in human exposure cases, and road-killed wildlife. Sixty six animals (46 raccoons, 13 skunks, 6 little brown bats [*Myotis lucifugus*], and 1 red fox [*Vulpes vulpes*]) were submitted by WS, from 7 counties to the VDH; 7 skunks and 2 raccoons tested positive for the raccoon strain of the rabies virus.

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline Biomarker, and Age Results

In 2003, during the evaluation phase of the Vermont ORV program, 344 raccoons (35 pre-bait and 309 post-bait ORV) were live-trapped within the ORV bait zone. Blood and tooth samples were taken from most of these animals for ORV program evaluation (Table 3, Table 4, and Figure 2). In addition, blood samples were taken from 46 skunks (2003 post-bait ORV). No skunks showed the presence of a positive rabies antibody response.

Table 3. Serology results of raccoon biological samples collected during pre- and post-bait ORV program evaluation in Vermont, 2003.

	Pre -bait ORV	Post-bait ORV
Unique raccoons captured	35	309
Testable blood samples	34	309
Positive rabies antibody response ^a	10 (29.4%)	69 (22.3%)

^aNYSDH serum titer = 0.125 IU

Table 4. Tetracycline biomarker results of raccoon tooth samples collected during pre- and post-bait ORV program evaluation in Vermont, 2003 (2% [129 km² of 6,403 km²] of total area baited in Vermont was baited with FMP baits, containing the tetracycline biomarker).

	Pre-bait ORV	Post-bait ORV
Unique raccoons captured	35	309
Testable tooth samples	34	294
Total presence of tetracycline biomarker	4 (11.8%)	18 (6.1%)
Year of detection:		
Year of detection unknown	1 (25.0%)	4 (22.2%)
2000/2001	1 (25.0%)	0
2002	2 (50.0%)	7 (38.9%)
2002/2003	0 ^a	1 (5.6%)
2003	0 ^a	6 (33.3%)

^a2003 bait drop had not yet occurred

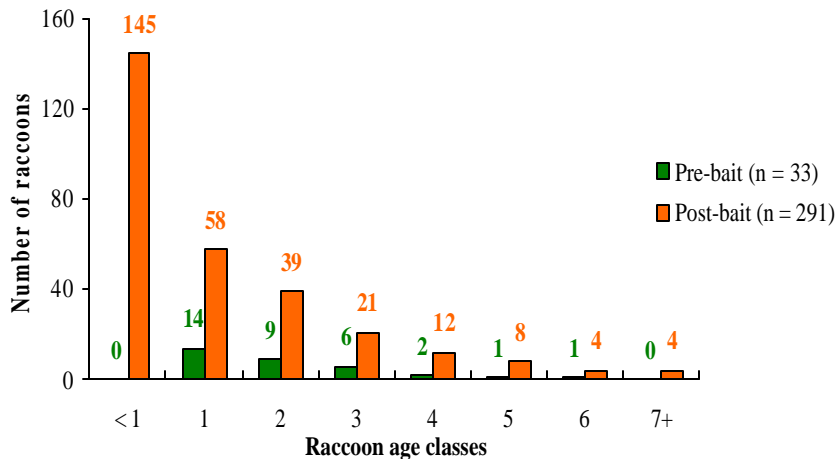


Figure 2. Age class distribution of 324 raccoon tooth samples collected during pre- and post-bait ORV program evaluation in Vermont, 2003.

SUMMARY

The summer of 2004 marked the eighth year of WS cooperative participation in the Vermont ORV Program. Over those 8 years, the VDH has confirmed 556 cases of the raccoon strain of rabies in Vermont; only 18 (3.2%) of those cases occurred within the ORV zone. Based on the annual spread rate of about 56 km/year, raccoon rabies was expected to have crossed the Vermont-Quebec, Canada border by 1999. Intervention with 1,830,640 ORV baits, containing Raboral V-RG®, over northern Vermont since 1997, has been instrumental in preventing raccoon rabies from spreading northward.

During the 2004 field season, Vermont WS cooperated with New Hampshire WS to coordinate ORV baiting and trapping efforts along the Connecticut River in northern Vermont and New Hampshire. The Vermont and New Hampshire programs are an integral part of a larger Northeastern cooperative effort (that in 2004, included New York, Maine, and Ontario, Quebec, and New Brunswick, Canada), which in turn, is tied to national planning efforts to contain and explore strategies to eliminate the raccoon strain of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM VIRGINIA 2004

BACKGROUND

Wildlife Services (WS) has been involved with cooperators in an oral rabies vaccination (ORV) program to control raccoon (*Procyon lotor*) rabies in Virginia since 2001. The ORV program in Virginia is part the Appalachian Ridge ORV project and of a larger, cooperative effort to stop the westward spread of the raccoon variant of rabies in the eastern United States.

In 1978-79, raccoon rabies was first introduced to the mid-Atlantic region of the United States with the translocation of infected raccoons from Florida to Hardy County, West Virginia and Shenandoah County, Virginia. From these counties, the disease spread rapidly along the east coast and has now become enzootic in all of the East Coast states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and eastern Ohio.

In Virginia, raccoon rabies occurs throughout the state, with the exception of 4 counties (Buchanan, Dickenson, Lee, and Wise) on the southwestern border with Kentucky. According to the Virginia Department of Health, Office of Epidemiology, infected raccoons accounted for 251 (56.3%) of 446 animal rabies cases reported in Virginia from 1 January-27 November 2004. During the past 7 years (January 1998-November 2004) raccoons have accounted for 2,185 (57.7%) of 3,785 laboratory confirmed cases of animal rabies statewide. Wildlife Services is working in cooperation with the Virginia Department of Health (VDH), the Virginia Department of Game and Inland Fisheries, and local animal control officers to provide as many surveillance specimens as possible.

ORV PROGRAM 2004

Bait Distribution

Aerial Baiting.--Aerial distribution of fishmeal polymer (FMP) ORV baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), occurred throughout the vaccination zone from 10-19 August 2004. Baits were distributed from low-flying, fixed-wing aircraft, along flight lines spaced approximately 500 meters apart. The ORV zone in southwest Virginia covered an area of 5,359.7 km² (Figure 1). Baits dropped in southwest Virginia during the aerial portion of bait distribution totaled 353,773. All or part of 9 cities and counties were included in the ORV zone (Figure 1 and Table 1).

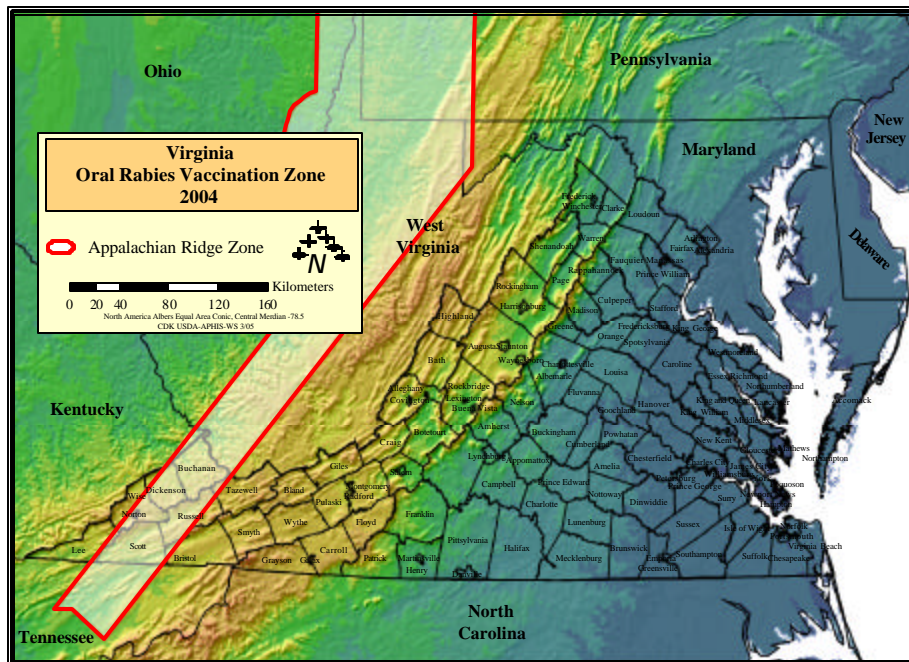


Figure 1. Oral rabies vaccination zone in southwest Virginia, 2004.

Table 1. Oral rabies vaccination aerial bait distribution in southwest Virginia, 2004.

County/city	Area (km ²)	Number of baits distributed
Buchanan	1,304.3	91,096
Dickenson	722.7	53,037
Lee	59.2	6,461
Norton	18.8	643
Russell	1,040.5	60,610
Scott	1,392.3	95,213
Tazewell	161.6	6,608
Washington	159.5	5,887
Wise	500.8	34,218
Total	5,359.7	353,773

Hand Baiting .--On 31 August 2004, WS distributed 11,880 ORV baits by hand from vehicles in many of the urban and suburban areas of southwest Virginia (Castlewood, Clinchco, Clintwood, Coeburn, Gate City, Grundy, Haysi, Lebanon, Norton, St. Paul, Weber City, and Wise) that were within the ORV bait distribution zone. These areas were too densely developed for aerial bait distribution. Baits distributed included: 1,440 in urban and suburban areas within Buchanan County; 1,800 in Dickenson County; 3,240 in Russell County; 2,160 in Scott County; 2,160 in Wise County; and 1,080 in the City of Norton.

Enhanced Surveillance

During 2004, WS conducted enhanced surveillance activities with the assistance of local county animal control officers. This surveillance resulted in 20 samples from 3 counties, in or near the ORV barrier, being submitted to the VDH lab for testing. These samples came from fresh road-killed animals and animals that appeared to be sick or strange-acting. Samples included 2 striped skunks (*Mephitis mephitis*) and 18 raccoons; of these, 3 raccoons from Tazewell County, east of the current ORV barrier, tested positive for rabies, 1 sample was unsatisfactory for testing, and the remainder tested negative.

Population Monitoring

Standard WS protocol was used to estimate the relative density of raccoons on 3 sites in southwest Virginia during June and July 2004. Five hundred trap nights on an agricultural area, in Russell County, resulted in the capture of 39 unique raccoons. A density index calculation, using the study area size of 3 km² and the number of individual raccoons captured, resulted in an estimated relative density index of 13.0 (Table 2). An additional 500 trap nights on an agricultural area, in Tazewell County, resulted in the capture of 51 unique raccoons and an estimated relative density index of 17.0 (Table 2). The third study was conducted on a high elevation, forested area in Smyth County. Five hundred trap nights on this area resulted in the capture of 9 unique raccoons and an estimated relative density of 3.0 (Table 2). All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Estimated relative density indices of raccoons/km² in Virginia, 2001-2004.

Date	Location	Habitat	Elevation (m)	Density
June 2004	Russell County	Agricultural	700-820	13.0
July 2004	Tazewell County	Agricultural	730-850	17.0
July 2004	Smyth County	Forested	950-1,100	3.0
July 2003	Russell County	Agricultural	530-640	7.7
July 2003	Russell County	Agricultural	700-820	19.7
November 2003	Russell County	Agricultural	700-820	12.0
July 2002	Wise County	Forested	850-1,100	4.2
August 2002	Russell County	Agricultural	530-640	6.9
July 2001	Tazewell County	Forested	730-850	4.6
July 2001	Tazewell County	Agricultural	700-800	8.1

On the Russell County agricultural study area, trap success for unique raccoons, over 500 trap nights, was 7.8%, while overall trap success (including recaptures and non-target captures) was 14.2%. On the Tazewell County agricultural study area, trap success for unique raccoons, was 10.2%, while overall trap success (including recaptures and non-target captures) was 24.2%. On the Smyth County forested study area, trap success for unique raccoons, was 1.8%, while overall trap success (including recaptures and non-target captures) was 3.2%.

Post-bait Evaluation

From 13 September-8 October 2004, approximately 4 weeks after completion of the aerial distribution of baits, WS began trapping raccoons within the baited area to collect blood and tooth samples. This post-bait ORV program evaluation trapping was conducted to collect data which will allow WS to evaluate the effectiveness of the ORV program. Blood serum samples, taken from raccoons within the baited area, will be analyzed for the presence of antibodies against the rabies virus. Tooth samples will be analyzed for the presence of the tetracycline biomarker, which would indicate consumption of the outer portion of the bait and may indicate consumption of the included vaccinia sachet.

Raccoons were live-trapped for approximately 4 weeks during September 2004-October 2004. Traps were set on private and public lands in Dickenson, Russell, Scott, and Wise Counties. Trapping efforts resulted in 1,590 trap nights and the capture of 129 unique raccoons (Table 3). Trap success for unique raccoons was 8.1%, while trap success for all raccoons was 8.5%. Overall trap success (inclusive of non-target captures [172] and re-captured raccoons [6]) was 19.3%.

Table 3. Post-bait ORV program evaluation trapping in 4 southwest Virginia counties, 13 September-8 October 2004.

County	Trap nights	Raccoons captured	Serum samples collected	Tooth samples collected
Dickenson	312	34	34	33
Russell	703	46	46	46
Scott	416	37	37	37
Wise	159	12	12	12
Total	1,590	129	129	128

Non-target Captures

The combined total of non-target captures during 2004 (including all pre- and post-bait ORV distribution trapping activities) was 249 animals. Non-target captures were released, except as noted, and included: 1 beaver (*Castor canadensis*); 1 coyote (*Canis latrans*), euthanized; 3 feral dogs (*C. familiaris*); 2 feral cats (*Felis catus*); 1 fox squirrel (*Sciurus niger*); 3 gray squirrels (*Sciurus carolinensis*), of which 1 was found deceased in the trap; 36 woodchucks (*Marmota monax*), 32 of which were euthanized; 184 opossums (*Didelphis virginiana*), 93 of which were euthanized; 13 Eastern cottontail rabbits (*Sylvilagus floridanus*); and 5 striped skunks.

ORV PROGRAM 2003-EVALUATION

Serology, Tetracycline Biomarker, and Age Results

In 2003, during the Virginia, post-bait ORV program evaluation phase of the ORV program, 110 raccoons were live-trapped within the ORV bait zone. An additional 71 raccoons were captured during pre-bait ORV, relative density studies. Blood and tooth samples were collected from these animals for ORV program evaluation (Table 4, Figure 2, and Figure 3).

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected during post -bait ORV program evaluation in Virginia, 2003.

	2003
Serology	
Unique raccoons captured	110
Testable blood samples	110
Positive rabies antibody response ^a	38 (34.5%)
Tetracycline biomarker	
Unique raccoons captured	110
Testable tooth samples	107
Presence of tetracycline biomarker	46 (43.0%)

^aCenters for Disease Control and Prevention (CDC) serum titer = 5 IU

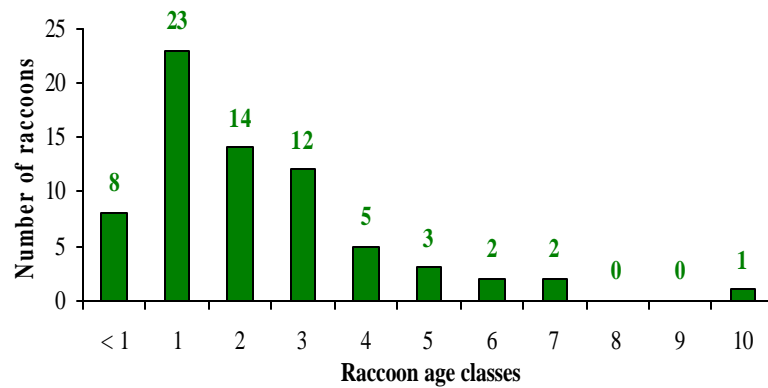


Figure 2. Age class distribution of 70 of 71 raccoon biological samples collected during 2 relative density studies in Virginia, July 2003.

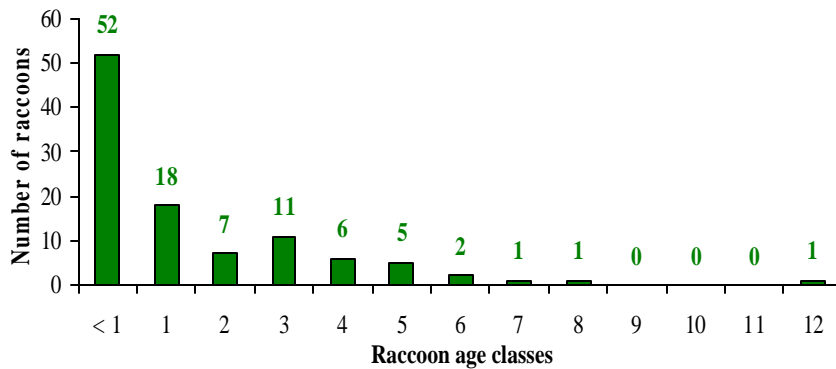


Figure 3. Age class distribution of 104 of 110 raccoon biological samples collected during post-bait ORV program evaluation in Virginia, October-December 2003.

SUMMARY

The ORV bait distribution and trapping activities conducted in 2004 marked Virginia's fourth year of involvement in the Appalachian Ridge ORV project, and the third year of actively distributing ORV baits. Since bait distribution began in 2002, 1,160,651 baits have been distributed in southwest Virginia. In 2004, approximately 366,000 of those baits were distributed from the air and by hand from vehicles across a 5,359.7 km² area in southwest Virginia. Following the ORV bait distribution, WS trapped raccoons to collect serology and biomarker data to assess raccoon population response to ORV. Wildlife Services also conducted relative density trapping studies to provide an index of raccoon population densities in and near the baited area and to collect additional serology and tetracycline biomarker data.

In 2005, the ORV program will be continued in Virginia, with the distribution of additional ORV baits in southwest Virginia. Wildlife Services will conduct relative density studies for population monitoring and will continue enhanced surveillance efforts to monitor the movement of the raccoon strain of rabies in southwestern Virginia and to monitor the success of the ORV bait distribution program.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM WEST VIRGINIA 2004

BACKGROUND

The oral rabies vaccination (ORV) program was undertaken in West Virginia as part of a nationwide, cooperative effort to stop the westward spread of raccoon (*Procyon lotor*) strain rabies. Raccoon strain rabies was first introduced into West Virginia in 1977, from raccoons translocated from the southern United States to Hardy County. The virus then spread along the leeward side of the Appalachian Mountains into Pennsylvania, Maryland, and Virginia until it breached the Appalachian Mountain front and began spreading in the cardinal directions through West Virginia. In 2004, 73 confirmed cases of rabies were reported in West Virginia, 45 of which were found in raccoons. Striped skunks (*Mephitis mephitis*) were the second most common carrier of rabies in West Virginia, with 10 cases confirmed in 2004, but other species include; 6 feral cats (*Felis catus*), 4 foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), 4 bats (order *Chiroptera*), 1 woodchuck (*Marmota monax*), 1 feral dog (*Canis familiaris*), 1 horse (*Equus caballus*), and 1 cow (*Bos taurus*).

The West Virginia ORV program is coordinated by the West Virginia Department of Agriculture (DOA), while surveillance is being conducted by the West Virginia Department of Health and Human Resources (DHHR), Wildlife Services, and county Departments of Health. Wildlife Services provided funding and operational support, including coordinating bait drops, raccoon population monitoring, and program evaluation, through live trapping efforts. The West Virginia Division of Natural Resources (DNR) provided permits for handling wildlife, access to state owned property, and expertise in raccoon ecology and management.

ORV PROGRAM 2004

Bait Distribution

In 2004, the ORV bait zone covered 25,842 km² (9,978 mi²) (Figure 1). During the August-September bait drop, 1,368,928 fishmeal polymer baits (FMP), containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA), were distributed by air, while 28,014 FMP baits were distributed by hand. Since program inception in 2001, 5,384,880 FMP baits have been distributed by air and 144,952 FMP baits have been distributed by hand. Aircraft and flight crew for the 2004 ORV program were provided by the Ontario Ministry of Natural Resources (OMNR) and Dynamic Aviation. Ground support was provided by WS personnel from West Virginia, Virginia, Tennessee, Kentucky, Ohio, and Pennsylvania, as well as the DHHR, DOA, the DNR, the Ohio National Guard, and the Ohio Department of Health. West Virginia's WS program currently has 6 full-time employees working on the rabies project. Four additional employees assisted during the bait drop and post bait drop trapping.

Enhanced Surveillance

In 2002, WS began to recognize the need for additional surveillance throughout much of the West Virginia ORV bait zone. In 2003, 2 Wildlife Specialists were added to respond to sick acting raccoon complaints and to collect brain stem samples from road-killed animals. In 2004, 1 additional Specialist was added to provide enhanced surveillance to areas in southern West Virginia. In 2004, 346 raccoons, 18 striped skunks, 4 red foxes, 4 gray foxes, and 1 opossum (*Didelphis virginiana*) were collected by WS (Table 1). Of the 373 animals, 48 raccoons, 1 gray fox, and 1 opossum were sick-acting animals and euthanized. The remaining samples were collected during road kill surveillance.

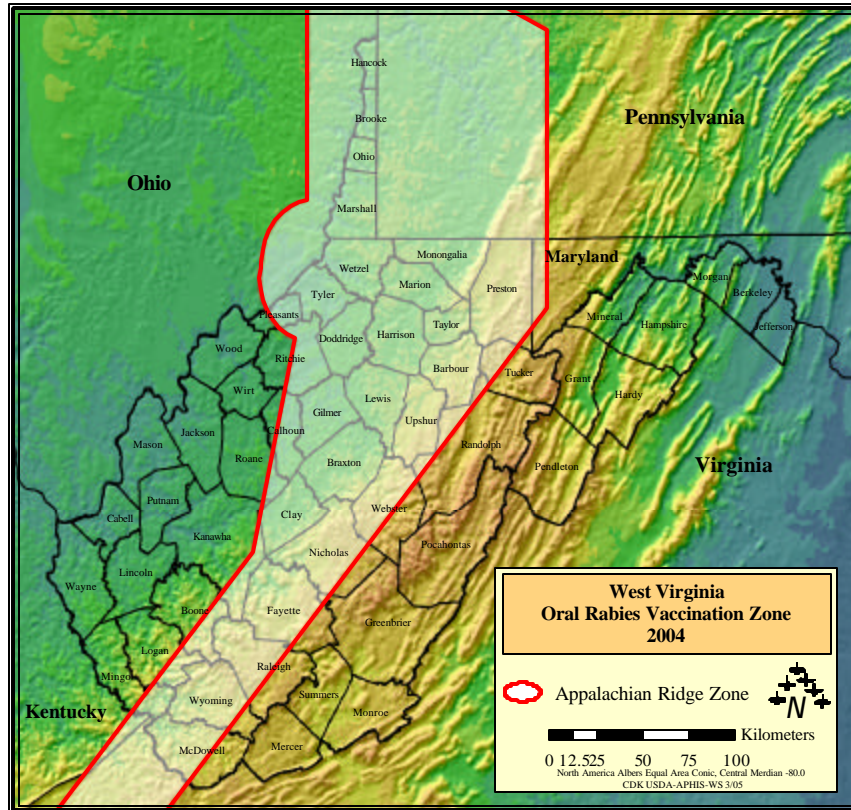


Figure 1. Oral rabies vaccination bait zone in West Virginia, 2004.

Table 1. Brain stem samples, per county, collected by Wildlife Services, 2004.

County	Samples collected	Number positive
Braxton	3	0
Brooke	9	0
Calhoun	10	0
Clay	1	0
Doddridge	1	0
Gilmer	10	0
Hancock	9	0
Jackson	17	0
Kanawha	7	0
Lewis	3	0
Lincoln	1	0
Marion	1	0
Marshall	16	0
Monongalia	13	0
Ohio	5	0
Pleasants	27	0
Randolph	1	1 (raccoon strain)
Ritchie	23	0
Roane	7	0
Tyler	71	0
Wetzel	35	0
Wirt	26	0
Wood	77	0
Total	373	1

Population Monitoring

In 2004, WS protocol for relative density population estimates was used to estimate abundance in 6 areas within West Virginia during the summer. These included 4 areas previously trapped during 2001, 2002, and 2003 (Table 2). Three areas were wildlife management areas, managed by the West Virginia DNR and were representative of habitat found throughout much of the state, with forested rolling hills and permanent streams. The 2 sites in Grant and Mercer Counties also were forested, with pastures and permanent streams. The remaining area in Hardy County was an agricultural site composed of forest, pasture, and corn fields. In 2004, indices were slightly higher than those in 2003 (Table 2). One hundred nineteen unique raccoons were captured and all but 1 was released. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Estimated relative density indices of raccoon populations in selected counties, West Virginia, 2001-2004.

County	Habitat	Elevation (m)	Density indices ^a				
			2001	2002	2003 (Summer)	2003 (Fall)	2004
Jackson	Agriculture	300	16.2	NA	NA	NA	NA
Clay	Forested	300	8.9	6.6	7.7	NA	NA
Wetzel	Forested	300	16.6	7.3	8.8	3.1	9.2
Braxton	Agriculture	550	13.1	6.6	NA	NA	NA
Lewis	Forested	400	NA	7.7	NA	NA	NA
Nicholas	Forested	550	NA	5.8	NA	NA	NA
Barbour	Agriculture	350	NA	12.3	11.9	NA	15.3
Hardy	Agriculture	300	NA	NA	8.1	NA	10.3
Wyoming	Forested	400	NA	NA	0.8	NA	1.5
Grant	Forested	630	NA	NA	NA	NA	5.3
Mercer	Forested	400	NA	NA	NA	NA	3.8
Average		383	13.7	7.72	7.46	3.1	7.57

^aRaccoons/km²

Post-bait Evaluation

In 2004, following the August-September bait drop, WS live-trapped raccoons to collect blood and tooth samples to measure program success. During the months of September-November, 245 unique raccoons were trapped and biological samples collected. Of these 245 raccoons, 97 were euthanized and 148 were released.

Other Rabies Activities

During 2004, WS continued collecting habitat data to determine impacts of habitat composition and elevation on raccoon relative abundance (Table 3). A 7.97m (26.3 ft) diameter plot was sampled at each trap site, with the trap centered in each plot. Habitat characteristics are important variables that need further research, because the historical spread of rabies through West Virginia appeared to be slowed by the higher elevations of the Appalachian Mountains. Wildlife Services will continue to collect these data in 2005.

Non-targets Captured

In 2004, non-target species captured and released unharmed during population monitoring included: 40 opossums, 5 fox squirrel (*Sciurus niger*), 4 mink (*Mustela vison*), 16 woodchucks, 3 Eastern cottontail rabbits (*Sylvilagus floridanus*), and 1 black bear (*Ursus americanus*). Non-target species captured and euthanized included: 7 woodchucks.

In 2004, non-target species captured and released unharmed during post-bait ORV program evaluation included: 83 opossum, 1 striped skunks, 2 woodchucks, 3 fox squirrels, 2 river otters (*Lutra canadensis*), and 2 feral cats. Non-target species captured and euthanized included: 53 opossums and 1 woodchuck.

Table 3. Mean habitat characteristics calculated at successful and unsuccessful capture sites in West Virginia, 2002-2004.

Habitat Characteristics	2002		2003		2004	
	Capture	No capture	Capture	No capture	Capture	No capture
Basal Area ^a	3.23	4.15	2.5	3.15	3.56	4.88
Trees > 11 diameter at breast height (dbh)	2.48	2.60	2.0	1.89	2.23	2.41
Trees < 11 dbh	13.10	13.37	6.47	8.35	7.70	7.31
Ground vegetation cover (%)	63.24	61.66	70.10	63.53	58.01	44.22
Canopy cover (%)	53.54	61.41	47.71	55.53	54.24	60.80
Distance (m) to water-intermittent	23.28	32.28	4.00	7.60	9.68	41.96
Distance (m) to water-permanent	38.13	53.51	53.66	27	52.76	66.59
% Slope	8.16	10.77	9.26	7.69	6.69	7.33
Elevation (ft)	1,251	1,242	1,003	860	1,244	1,584
Den Sites	0.30	0.06	0.70	0.16	.25	.34
Tree/shrub Species						
Red oak (<i>Quercus rubra</i>)	2.17 ^b	2.27	2.20	1.92	3.06	2.45
White oak (<i>Quercus alba</i>)	2.06	2.54	3.89	1.61	5.73	2.68
Beech (<i>Fagus grandifolia</i>)	2.92	2.04	2.0	2.10	2.75	3.75
Hickory (<i>Carya spp.</i>)	1.67	2.25	2.00	3.33	1.83	2.17
Black walnut (<i>Juglans nigra</i>)	1.54	1.54	2.00	1.5	1.92	1.83
Common apple (<i>Malus sylvestris</i>)	7.4	1.94	1.40	1.38	3.18	2.80
Pear (<i>Pyrus communis</i>)	1.00	1.00	0.00	3.00	5.00	0
Black cherry (<i>Prunus serotina</i>)	2.73	2.77	2.00	2.24	2.67	2.15
Flowering dogwood (<i>Cornus florida</i>)	1.00	2.06	0.00	0.00	4.00	1.83
Blackberry (<i>Rubus spp.</i>)	4.62	6.50	1.00	4.46	11.17	12.50
Grape (<i>Vitis spp.</i>)	2.44	2.24	5.64	2.45	4.00	2.41
Autumn olive (<i>Elaeagnus umbellata</i>)	2.82	3.76	3.89	4.90	4.68	2.18

^acalculated using a 20-factor prism

^btree/shrub species per plot

ORV PROGRAM 2003- EVALUATION

Serology and Tetracycline Biomarker

In 2003, blood and tooth samples were collected from captured raccoons to measure program success. Ninety two blood samples and 29 tooth samples were collected during relative density studies and 189 blood samples and 185 tooth samples were collected as part of the post-bait ORV program evaluation.

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected during relative density and post-bait ORV program evaluation in West Virginia, 2003.

	Pre -bait ORV	Post-bait ORV
Serology		
Testable blood samples	92	189
Positive rabies antibody response ^a	29 (31.5%)	61 (32.3%)
Tetracycline biomarker		
Testable tooth samples	29	185
Presence of tetracycline biomarker	11 (37.9%)	70 (37.8%)

^aCenters for Disease Control and Prevention (CDC) serum titer = 5 IU

SUMMARY

In 2001, West Virginia became involved in the National ORV Program, as a key state in establishing a national barrier to prevent the westward spread of raccoon rabies. During the bait drop, which began on 9 August 2004, 1,368,928 FMP baits were distributed by air and 28,014 FMP baits were distributed by hand. Post-bait ORV program evaluation results from 2003 revealed that 61(32%) of 189 raccoons captured had a positive rabies antibody response and 70 (37.8%) of 185 tooth samples had a tetracycline biomarker present.

In 2005, the bait zone in West Virginia will remain the same. Also during 2005, West Virginia WS will continue to investigate the influence of elevation and habitat by collecting pertinent habitat data at each trap location, as well as, conducting relative density estimates at sites > 1,067 meters in elevation. Enhanced surveillance and trapping efforts will continue to be expanded during pre- and post- bait ORV program evaluation to increase sample size.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM WYOMING 2004

BACKGROUND

Historically, Wyoming Wildlife Services (WS) has not played a significant role in rabies control and surveillance in the state due to lack of funding and constraints of our cooperative agreements to provide services to individual county predatory animal boards on a yearly basis. A majority of our cooperative services have been directed toward the management of predators, primarily coyotes (*Canis latrans*), to protect sheep (*Ovis aries*) and cattle (*Bos taurus*).

During 2003-2004, 3 oral rabies vaccination (ORV) rabies placebo bait projects were completed. The first was in Weston County (2003) and the remaining 2 two were in Big Horn (2003) and Goshen Counties (2004). The objective of these projects was to determine which bait will be suitable to use for oral rabies vaccination (ORV), aimed primarily at striped skunks (*Mephitis mephitis*) in Wyoming and other western states.

During 2004, WS conducted its first year of enhanced surveillance trapping to help determine if the rabies virus was present in skunks. The initial plan was originally developed during 2002-2003, as part of a partnership between the Wyoming Animal Damage Management Board (ADMB) and the Wyoming State Veterinary Laboratory (WSVL).

ORV PROGRAM 2004

Skunk Oral Rabies Placebo Bait Study

During 2004, WS continued to participate in a multi-state study (Wyoming, Arizona, Texas, Louisiana, and California), coordinated by the WS, National Wildlife Research Center (NWRC), to evaluate ORV bait acceptance by skunks. Activities included: the preparation, planning, and completion of the 2004 ORV study in Goshen County and the completion of the 2003 ORV study in Big Horn County (Figure 1).

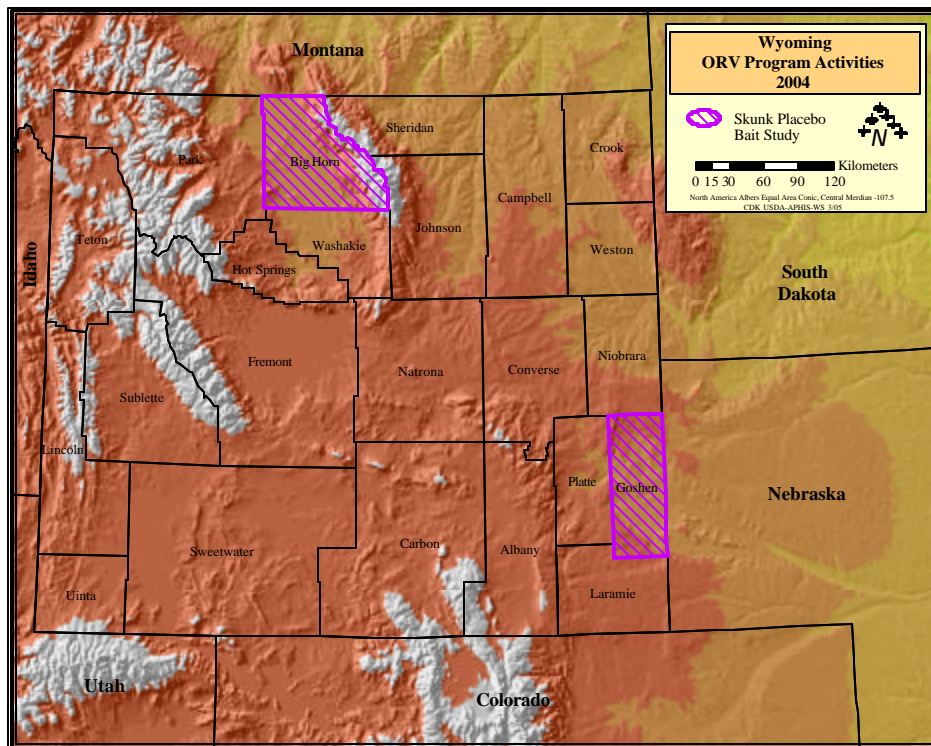


Figure 1. Oral rabies vaccination program activities in Wyoming, 2004.

Results.--On 8 August 2003, baits were placed by vehicle and on foot by WS and NWRC personnel on 2 study areas in Big Horn County (Figure 1). Study areas were 4 km x 10 km in size and baits were placed every 13.3 meters, along 3 transect lines. Transect lines were oriented lengthways within the study areas. Artemis Ontario Slim baits (Artemis Technologies, Inc., Guelph, Ontario, Canada) were distributed in the west study area and Merial Cylindrical baits (Merial Limited, Athens, Georgia, USA) were distributed in the east study area. From 10-20 November 2003, trapping occurred on the 2 study areas. Tru-Catch live traps (Manufacturing Systems, Inc., Belle Fourche, SD, USA), baited with sardines in oil, were utilized. Traps were placed at suitable locations, along the 3 transect lines, at a rate of 1 trap every 0.5 km. Fifty seven live traps were set in each of the 2 study areas. At the conclusion of trapping, 41 striped skunks, 84 raccoons (*Procyon lotor*), 20 feral cats (*Felis catus*), and 1 porcupine (*Erethizon dorsatum*) were captured and euthanized. All animals trapped in 2004 were handled according to the American Veterinary Medical Association guidelines.

No animals captured on the west or east study areas in Big Horn County tested positive for rabies. On the west study area 2 of 22 (9.1%) skunks, 22 of 45 (48.9%) raccoons, and 1 of 7 (14.3%) feral cats tested positive for the presence of the tetracycline biomarker. On the east study area 13 of 19 (68.4%) skunks, 1 of 25 (4.0%) raccoons, and 5 of 13 (38.5%) feral cats tested positive for the presence of the tetracycline biomarker.

On 30 August 2004, baits were placed by vehicle and on foot by WS and NWRC personnel on 2 study areas in Goshen County. Merial fishmeal coated sachet baits were placed in the Springer study area and Artemis Ultralight blister pack, wax coated baits were placed in the Table Mountain study area (Figure 1). From 27 September-7 October 2004, trapping occurred on the 2 study areas. Trapping protocols were the same as those listed above. At the conclusion of trapping 51 skunks, 39 raccoons, 10 feral cats, and 9 Virginia opossums (*Didelphis virginiana*) were captured and euthanized.

Biological data collected from each animal were sent to NWRC for analysis and included: jaws, for tetracycline biomarker presence; blood serum, for rabies titer testing; and DNA samples for any future research needs. All heads were sent to the WSVL for rabies testing.

No animals captured on the Springer or Table Mountain study areas in Goshen County tested positive for rabies. On the Springer study area 12 of 40 (30%) skunks, 1 of 14 (7.1%) raccoons, and 3 of 7 (42.9%) feral cats tested positive for the presence of the tetracycline biomarker. On the Table Mountain study area 2 of 10 (18.2%) skunks, 4 of 25 (16%) raccoons, 0 of 3 (0%) feral cats, and 3 of 9 (33.3%) opossums tested positive for the presence of the tetracycline biomarker.

Enhanced Surveillance

During 2004, in Campbell County, WS continued to participate in rabies enhanced surveillance and monitoring work. The Wyoming ADMB provided the WSVL funding to test all heads submitted by WS personnel throughout the state, as part of a scheduled rabies surveillance program that has been implemented on the ground in spring 2004. This funding has been used to purchase specimen shipping containers, postage, and any miscellaneous costs that might be incurred such as testing results notification and rabies strain typing.

Equipment (e.g., traps, shipping containers with ice packs, and data sheets) was distributed to all WS Specialists throughout the state during February and March 2004. Specialists acquired animals as part of their normal duties, collecting specimens from 10 March-22 November 2004. Of the 213 specimens submitted, 210 were suitable for testing, they included: 185 skunks, from 17 of Wyoming's 23 counties; 21 raccoons from 5 counties; 3 feral cats from 1 county; 1 bat (family *Chiroptera*); 1 coyote; 1 mink (*Mustela vison*); and 1 opossum.

One skunk specimen from northern Crook County tested positive for rabies. Additional trapping at this site provided 5 more skunks specimens, all of which tested negative for rabies.

SUMMARY

During 2004, WS rabies activities continued to be focused on the development of cooperative working agreements with local, state, and federal agencies. Oral rabies vaccination placebo bait studies were completed in Big Horn (late 2003) and Goshen Counties (2004). Equipment, such as live traps, and other miscellaneous supplies were purchased for enhanced surveillance and monitoring trapping efforts. With the completion of the final ORV rabies placebo bait studies and having completed 1 season of rabies surveillance trapping, significant progress has been made in training WS personnel and in initiating groundwork for future rabies work.

NATIONAL WILDLIFE RESEARCH CENTER CONTROLLING WILDLIFE VECTORS OF RABIES 2004

BACKGROUND

The National Wildlife Research Center (NWRC), located in Fort Collins, Colorado, is the research arm of Wildlife Services. To assist the National Rabies Management Program, oral rabies vaccination (ORV) project, the NWRC, Wildlife Disease Program, was requested to conduct a 5-year research project to study the ecology of rabies, assess the risk of rabies transmission among wildlife, domestic animals, and humans, and develop methods that reduce or eliminate such transmission. The goal is to obtain basic information on rabies in wildlife reservoirs and vectors. Studies have involved research on bait development to better deliver rabies vaccines (V-RG®) (Merial Limited, Athens, Georgia, USA) for raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*), ecology of raccoons, gray fox (*Urocyon cinereoargenteus*), and striped skunks in rural and urban areas, better use of biomarkers to evaluate vaccine uptake by target and non-target wildlife, evaluate geographic barriers for wildlife dispersal that may effect the spread of rabies, determine long-term efficacy of V-RG® vaccine in raccoons, evaluate the bio-safety of the V-RG® vaccine in non-target wildlife, determine if infrared thermography can be used as a surveillance tool to detect rabies infected wildlife, and others. Fiscal Year 2005 will end this 5-year project. Depending on funding, another 5-year project may begin in October 2005.

University Research in collaboration with NWRCs Wildlife Disease Research Program

Pennsylvania State University: NWRC is funding and collaborating with Pennsylvania State University on a study, "Zoogeography of raccoons in Pennsylvania" (Figure 1). Dr. Gary San Julian is the major advisor, and Mr. Justin Compton is the PhD graduate student. The objective is to determine the home range size, den-site fidelity, movement patterns, and dispersal rates of raccoons within the study site in Pennsylvania. The study site consists of forested and mixed agriculture. Preliminary results in 2004 are: (1) the landscape does not inhibit movements of raccoons; (2) in a 500-m ORV flight line, a raccoon's home range is crossed 2-5 times; (3) some male raccoons denned together in the same tree; and (4) movement patterns of raccoons shift depending on food (harvested versus un-harvested corn fields) and onset of trapping. This study will provide critical information on the most effective habitats to apply ORV baits, the pattern of baiting, and the spacing of flight lines.

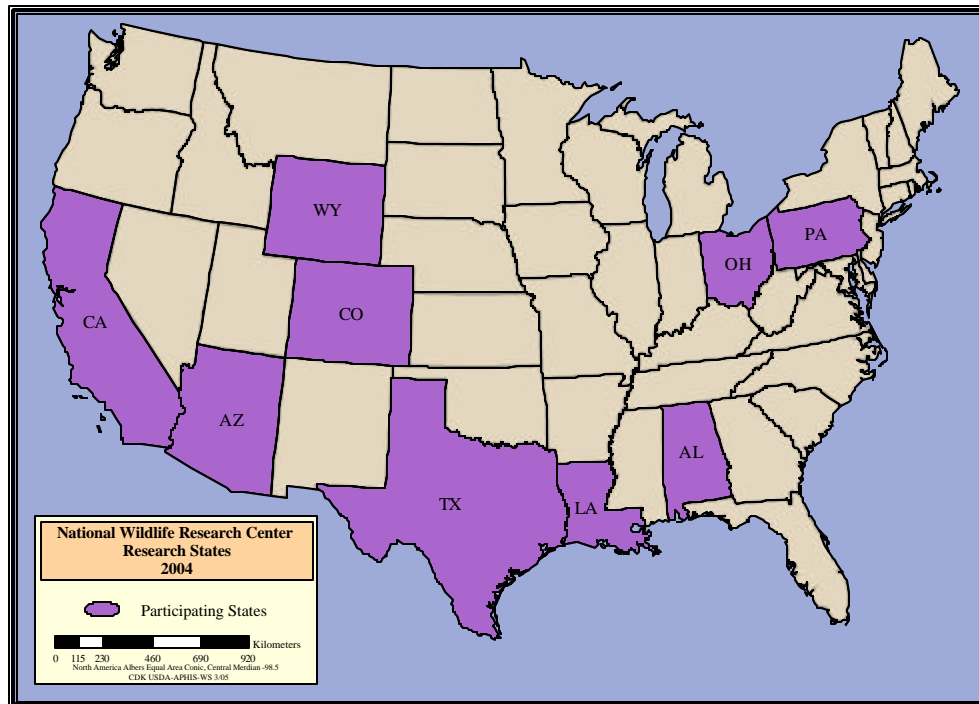


Figure 1. Cooperative NWRC rabies research conducted in the United States, 2004.

Ohio State University: NWRC is funding and collaborating with Ohio State University and NWRC Sandusky Field Station on a study, "Efficacy of oral rabies vaccination relative to bait density and raccoon density in northern Ohio", (QA 998). Dr. Robert Gates is the major advisor, and Mr. Paul Ramey is the MS graduate student. Objectives are to: (1) estimate the density of raccoons on the study site (NASA Plumb Brook Station), (2) quantify background sero-prevalence of rabies virus, (3) quantify ingestion/encounter rates of ORV baits, (4) quantify post-bait ORV drop sero-prevalence, and (5) quantify sero-prevalence 1 year after bait drop. Preliminary results in 2004 (2003 data) were: (1) data suggests that at a bait density of 75 km², at a raccoon density of 61.7 km², that 1.14 baits/raccoon would not be sufficient to effectively vaccinate the raccoon population on the study area. Upon post-baiting, 8% displayed a positive rabies antibody response rabies antibody positive and 17% biomarker positive. Field studies were completed in 2004.

Texas A & M: NWRC is funding and collaborating with Texas A & M and Caesar Kleberg Wildlife Research Institute, on a study, "Behavioral ecology of striped skunks within urban and suburban areas". Dr. Scott Henke is the major advisor and Ms. Denise Ruffino is the PhD graduate student. The objectives are: (1) to determine movements, habitat utilization, seasonal food habits of striped skunks in urban and suburban areas of Houston; (2) compare behavioral patterns of urban/suburban skunks with those of adjacent rural areas; and (3) ascertain the presence of rabies antibodies in captured skunks. Preliminary results in 2004 were: (1) skunks spend a significant amount of time foraging in large, watered, short grass areas (school yards, city parks, golf courses, and church yards) and (2) areas such as park gazebos are used for shelter and to raise young. Beginning 1 January 2005, we will begin evaluation of dispersal using genetic analysis and evaluate food habits using stomach analysis. Data gained from this work will help develop baiting strategies for the ORV program.

Northern Arizona University: NWRC is partially funding, in conjunction with Arizona WS, a study, "Home range and long-distance movements of urban skunks and intra- and inter-specific use of skunk resting sites in Flagstaff, Arizona: implications for rabies transmission". Dr. Tad Theimer is the major advisor and Mr. Mark Weissinger is the MS graduate student. The objectives are: (1) determine den locations and denning behavior, home range, sensitivity to re-location, daily and seasonal movements of skunks in Flagstaff and (2) determine the optimal time of year to vaccinate for rabies. Preliminary results in 2004 were: over half of the radio-collared skunks (11 of 17) in the study made long-distance movements into wildlands surrounding the city. Thirty three percent of sites monitored by cameras showed use by multiple skunks, dogs (*Canis familiaris*), cats (*Felis catus*), fox, and raccoons investigating these sites. Striped skunks could act as vectors transferring disease across the wildland-urban interface and skunk resting sites may be important locations for disease transmission both within skunks and between skunks and other wild and domestic animals. This study was begun to assist in the control of a bat rabies variant that became established in striped skunks. These data will provide insights on how rabies in Flagstaff skunks became established and increased in prevalence, and potential methods for controlling rabies in this area.

Auburn University: NWRC is funding and collaborating with Auburn University and Alabama WS on a study, "Raccoon movements in Alabama and the effect of natural barriers on preventing the western spread of rabies". The co-advisors are Dr. Jim Armstrong and Dr. Wendy Arjo. Ms. Christine Fischer is the MS graduate student who is conducting a portion of the work in central Alabama. In addition, in cooperation with WS, an additional study area outside the rabies enzootic area also is being monitored. Objectives are: 1) describe and compare movement patterns, home range size, and habitat use of raccoon populations within and outside rabies enzootic areas in Alabama. Preliminary results are: (1) over 100 raccoons between the 2 sites were captured and blood samples are currently being analyzed; (2) 35 animals are radio-collared in the western site, both north and south of the Alabama River and preliminary data does not suggest that they are moving across the river; (3) 24 animals are currently radio-collared in the western site (outside enzootic area) and mortality rates are mostly attributed to hunting; (4) density between the 2 sites is similar, 7.3 animals/km² at the central site and 6.3 animals/km² at the western site; and (5) most dens in central Alabama are in older hardwood trees and not conifer trees.

NWRC, Wildlife Disease Research Program Research Studies

The study, "Biosafety of Raboral V-RG® in non-target wildlife species" (QA 119) was conducted in 2004 by scientists at the NWRC. The objective was to: (1) assess the biosafety and potential for mechanical transmission of recombinant vaccinia virus expressing the rabies virus glycoprotein to selected wildlife species. The study focused on deer mice, fox squirrels, mallards, and gulls. A typical field dose of V-RG 10X® was used. Preliminary results are: (1) all animals survived and no outward lesions were observed from initial dose of V-RG® or from contact with those dosed with V-RG®.

The study, "Manipulation and uptake by skunks of baits intended for use in large-scale oral rabies vaccination" (QA 1044) was completed in 2004 by scientists at the NWRC. The objective was to: (1) use penned striped skunks to evaluate the palatability and attractiveness of different shapes and flavors of baits. Results indicated the best bait for skunks are small and thin, fish or meat flavored, and direct coating of the sachet. The fishmeal-coated sachet was determined to be the best bait, to date, for use by skunks in the ORV program.

The study, "Comparison of bait consumption by raccoons exposed to four densities of Raboral V-RG® rabies vaccine" (QA 983), in collaboration with Pennsylvania WS, was completed in 2004 by scientists at the NWRC. Objectives of the study were to: (1) estimate density of raccoon populations in 4 ORV bait zones and (2) determine bait consumption and resulting vaccination rates for 4 ORV baiting densities. Summary of results were: (1) doubling of a bait density from 37/km² to 75/km² resulted in a 90% increase of bait acceptance, 75 to 150/km² resulted in a 23% increase, and 150 to 300/km² resulted in a 20% increase in bait acceptance; (2) treatment had little effect on the number of baits eaten/raccoon; and (3) population density estimates ranged from 11 to 17 raccoons/km². This study will provide the ORV program with critical data on the most efficient baiting strategy for raccoons. At this raccoon density, the baiting density of 75 km², appeared adequate to sufficiently vaccinate the raccoon population.

The study, "Rabies oral rabies vaccination efficacy and antibody profiles in raccoons" (QA 1218) began in 2004 by NWRC scientists in collaboration with Colorado State University. The objectives of the study were to: (1) determine the humoral antibody response of raccoons after the oral administration of 1 versus 2 doses of V-RG®, (2) determine duration of protective antibody up to 18 months, (3) determine if 2 concurrent doses of V-RG® produces more protection than 1 dose, and (4) determine if administration of a booster of V-RG® 1 year after the single dose gives more protection compared to a single dose or 2 concurrent doses. Sixty nine raccoons are involved in the study. Some raccoons were vaccinated in late 2004. No results are yet available.

The study, "Ecology of the gray fox in relation to oral rabies vaccination programs in Texas" (QA 1223) began in 2004 by NWRC scientists in collaboration with Texas WS and the Texas Department of State Health Services. The overall objective of this study is to provide ecological information on gray fox and the gray fox strain of rabies virus to support ORV operations in west-central Texas. Specific objectives include: (1) evaluate movements, dispersal, and/or home ranges of gray fox via radio telemetry at and near breaks in the ORV zone; (2) analyze gray fox gene flow at and away from breaks in the ORV zone; (3) Determine background seroprevalence of gray fox and bobcats for rabies and orthopoxvirus antibodies and for other etiologic agents, such as canine distemper, in areas out of the ORV zone if evidence indicates they might be present; (4) evaluate non-target effects of ORV; (5) evaluate survival of adult and sub-adult gray fox; (6) evaluate absolute densities and/or abundances of gray fox populations; and (7) examine habitat layers in relation to gray fox home range, movements, and abundance using GIS software. Scientists expect to trap and radio-collar 40 gray fox and utilize samples collected by WS personnel in conjunction with their trapping efforts to evaluate post-bait ORV exposure of the rabies vaccine in the ORV program. A term Wildlife Biologist was hired to conduct the majority of the field work and is stationed in Kerrsville, Texas. Field studies will begin in January 2005. Also, in conjunction with this study, NWRC scientists are assisting Merial Limited, Inc. in conducting a field study to evaluate baits (dog food polymer versus fishmeal polymer) for gray fox in relation to the ORV program.

The study, "Use of infrared technology to detect rabies infection in raccoons" (QA 1227), began in 2004 by NWRC scientists. The study utilizes a Therma CAM® E65 infrared camera (FLIR Systems, Boston, MA, USA) to monitor body surface temperature and is compared with body temperature using a remote body temperature transmitter, implanted subcutaneously and recorded with a Advanced Telemetry Systems (ATS) R4500S Digital Signal Processing receiver/datalogger (ATS, Inc., Isanti, Minnesota, USA). The objective is to determine if the use of infrared thermography can detect changes in body surface temperature at specific sites on the body associated with experimental infection of raccoon strain of rabies in captive raccoons. Preliminary work began in late 2004. It was determined that infrared thermography can quantify minor changes in body surface temperature at different sites on the body of raccoons. Changes in temperature associated with sleep, stress, inflammation, and activity apparently can be detected. Results suggest that inflammation, especially in the area of the nose and rostrum, due to rabies infection can be detected and thermal signatures appear distinct compared to that produced by canine distemper infection in raccoons. Field application of this technique may be the detection of rabid raccoons, and possibly other mesocarnivores, in areas where other methods of evaluation (trapping, close observation) are not feasible. In many situations, inexperienced observers using causal observation are unreliable in detecting mild clinical signs of rabies. This technique will allow rapid monitoring of rabies infected raccoons and possibly other mesocarnivores infected with rabies. It is anticipated that this technology can be developed for different disease infections in wildlife and domestic animals. This study is scheduled for completion in early 2005.

The study, “Tetracycline stability in rabies baits”, (QA 1034 and QA 1068) was completed by NWRC scientists in 2004. This study was conducted because correlation between bait uptake and tetracycline biomarking needed to be improved. The objectives were to: (1) develop improved biomarkers for assessing bait uptake by target and non-target species, (2) determine the concentration and stability of tetracycline in rabies baits; and (3) determine the potential for combining tetracycline biomarker with vaccine. Results were: (1) canola oil and fishmeal appear to be the most promising for generating fatty acid biomarkers in a variety of tissues; (2) tetracycline has potential as a rapid response biomarker for consumption of rabies vaccine baits, especially in feces, however, feces will need to be monitored over time to determine the time versus detection rate; and (3) tetracycline in baits can be converted to epitetracycline through the manufacturing process. Epitetracycline is a poor biomarker, which results in a significant number of raccoons eating baits and not being bio-marked.

The study, “Acceptance of placebo rabies baits by skunks”, (QA 1040) entered its second year of field trials in 2004. This study seeks to further skunk ORV research by testing bait acceptance of several commercially available baits in skunks. Once an optimal bait delivery system is found, the time frame for implementing an ORV rabies program in skunks will depend only on the availability of an effective vaccine. In 2003, 10 sets of bait comparisons in 5 western states (Arizona, Louisiana, Wyoming, California, and Texas) using Merial Limited, Inc. fishmeal cylindrical baits versus Artemis’ Ontario Slim baits were completed. Analysis of the 10 comparisons shows that skunks always prefer the fishmeal cylindrical bait over the Ontario Slim bait. In most instances, more than 3 times the number of skunks had eaten the fishmeal cylindrical baits than had eaten the Ontario Slim baits. On average, scientists were able to reach 45% of the skunks using the fishmeal cylindrical baits. A second set of comparisons were initiated in 4 western states in 2004, using Merial Limited, Inc. fishmeal coated sachets versus the Artemis Ultralight baits. These baits are much slimmer than those used in 2003 and may provide even better acceptance as well as vaccine delivery in skunks (Figure 2). Preliminary results show that these baits are accepted at similar levels by skunks and that we can expect to reach more skunks overall (59% average) using these 2004 baits when compared to the baits investigated in 2003 (32% average).

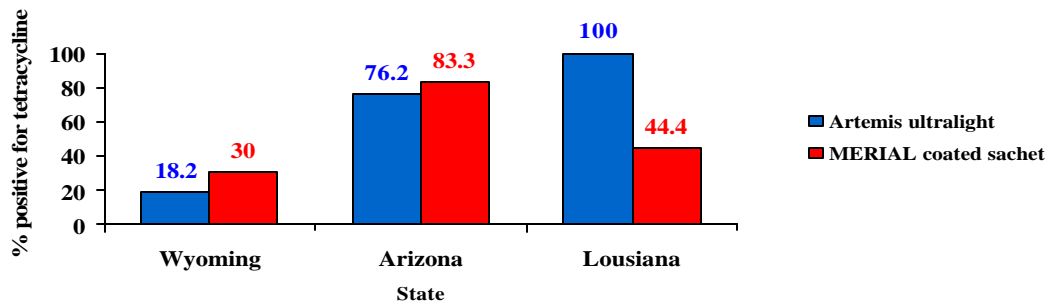


Figure 2. Bait acceptance of striped skunks, 2004

The study, “Manipulation and consumption of ORV baits by raccoons” (QA 1217) was initiated by NWRC scientists in 2004. Oral rabies vaccination programs have been successful in helping to control rabies in raccoons, foxes, and coyotes (*Canis latrans*). This success does not preclude the need to further enhance and improve on existing ORV programs. Often serology and biomarker results do not coincide when monitoring the success of the raccoon ORV program. One explanation for this is that the raccoons are consuming the bait matrix and are becoming biomarked without eating or effectively puncturing the sachet containing the vaccine and becoming vaccinated. This results in a population having a higher biomarker prevalence versus positive rabies antibody prevalence. There has also been concern due to preliminary serology evidence that the current raccoon ORV program may not be vaccinating the juvenile age class of raccoons as well as adults. This may be due to differences in the acceptance or ability of juvenile raccoons to effectively manipulate the currently used fishmeal polymer bait and hence puncture the sachet and expose themselves to the vaccine. This study seeks to look at these possible explanations in a pen setting and will provide insight into whether they play a role in the monitoring discrepancies mentioned above. Manipulation, consumption, and video documentation of 3 ORV baits (fishmeal polymer, coated sachet, and Artemis Ultralight bait) are complete and analysis is underway. Preliminary data suggests that in over 50% of feeding occurrences, both juvenile and adult raccoons tend to break open the fishmeal polymer bait resulting in the sachet popping out and remaining untouched. This would be viewed as an unsuccessful vaccination had these baits contained V-RG®. Analysis of the manipulation and consumption of the other baits is still underway.

SUMMARY

National Wildlife Research Center scientists are conducting research and working/collaborating with others to assist the National Rabies Management Program to carry out its mission of eliminating terrestrial rabies in North America. Obtaining basic information on rabies in wildlife reservoirs and vectors, developing methods that decrease transmission of rabies among wildlife, livestock, and humans, and developing a method to evaluate the effectiveness of management practices on reducing the prevalence of rabies in wildlife are the objectives of the Wildlife Disease Program of the NWRC. The understanding of the ecology of target and non-target species affected by the National Rabies Management Program, developing better baits and vaccine delivery systems, and developing more efficient baiting strategies are but a few of the strategies that are being used to accomplish our mission. Future studies will continue to provide answers to these and many other questions identified by the National Rabies Management Program.