

**COOPERATIVE RABIES MANAGEMENT PROGRAM
NATIONAL REPORT 2005**

USDA APHIS

Wildlife Services

National Rabies Management Program



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

**COOPERATIVE RABIES MANAGEMENT PROGRAM
NATIONAL REPORT 2005**

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EXECUTIVE SUMMARY

Operational oral rabies vaccination (ORV) programs in the U.S. began in the early 1990s in New Jersey and Massachusetts to prevent the raccoon (*Procyon lotor*) variant of rabies from reaching the highly populated vacation areas of Cape May and Cape Cod, respectively (Figure 1). The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program first became involved in cooperative ORV in 1995 in south Texas to combat a canine variant in coyotes (*Canis latrans*). One year later, an ORV program began in west-central Texas to prevent rabies in gray foxes (*Urocyon cinereoargenteus*). The following year, WS cooperated to implement ORV projects in Ohio and Vermont to prevent the spread of raccoon rabies. Wildlife Services' National Rabies Management Program (NRMP) continued to grow over the next 8 years and in 2005 included ORV programs targeting raccoon rabies in 16 eastern states and canine and gray fox rabies in Texas. Additionally, WS led pilot ORV projects targeting striped skunks (*Mephitis mephitis*) in Flagstaff, Arizona and feral dogs (*Canis familiaris*) on the Navajo Nation in Arizona. Overall in 2005, WS participated in coordinated ORV programs to distribute nearly 12 million baits over 220,528 km², an area larger than the State of Utah (Figure 1).

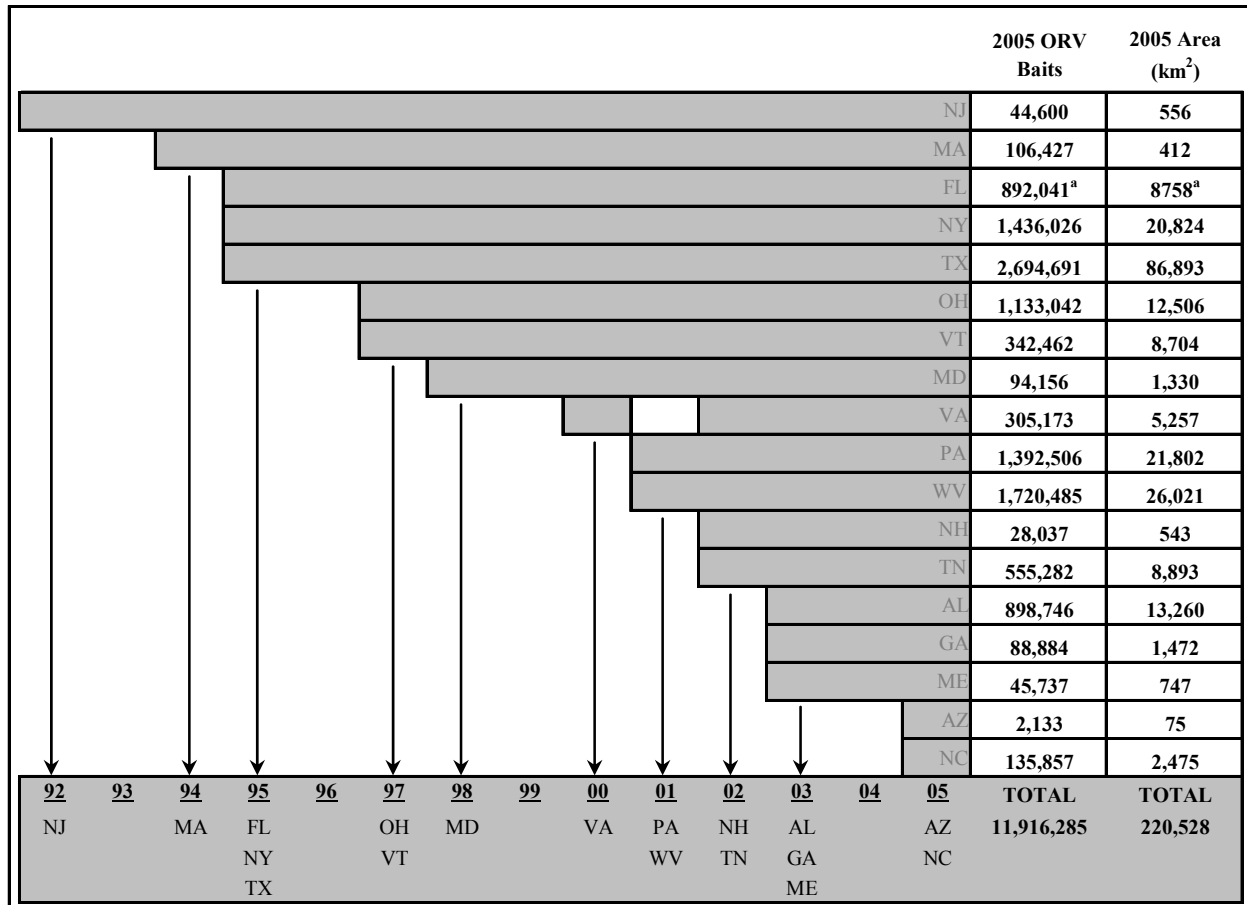


Figure 1. Operational oral rabies vaccination (ORV) history by Wildlife Services and their cooperators in the United States including 2005 ORV bait distribution and area totals (^a includes 240,000 baits distributed over 1,096 km² in Broward County by county officials [not reported on by WS in the Florida annual report]).

In the Northeast, WS continued cooperation with Cornell University, state agencies and international partners in New Brunswick, Quebec, and Ontario, Canada to prevent the northern and western spread of raccoon rabies. These ORV zones extend along a portion of the New Brunswick border with Maine, the Quebec border with New Hampshire and Vermont, and the Ontario border in northern and western New York (Figure 2). Part of this Northeastern effort includes cooperation with the New York State Department of Health led project in the upper Lake Champlain Valley in New York. Wildlife Services' participation in ORV activities in western New York links vaccination zones along the south shore of Lake Erie from New York to Ohio. These projects required close field coordination with our Canadian counterparts.

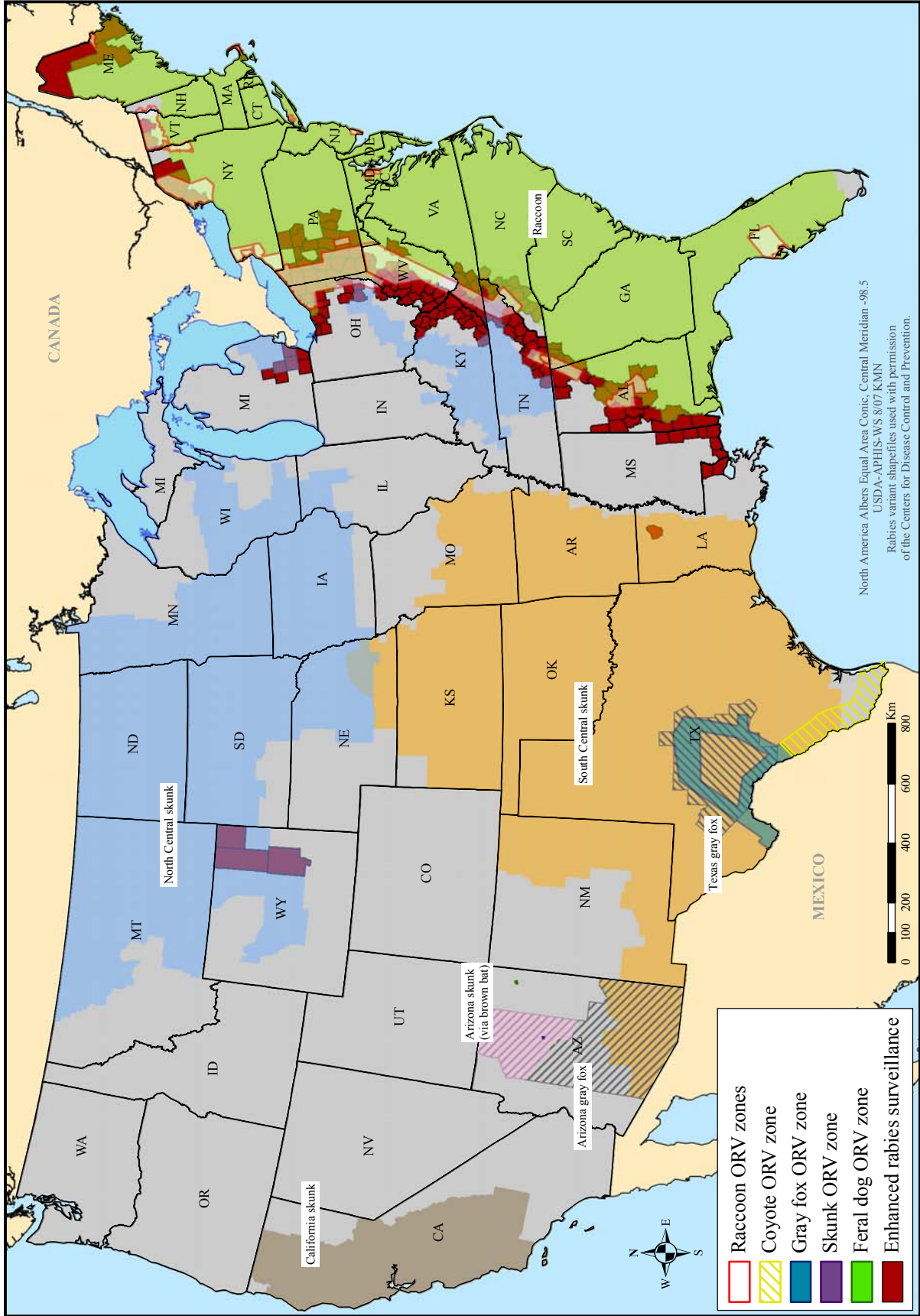


Figure 2. Terrestrial wildlife rabies variants with species-specific cooperative oral rabies vaccination (ORV) zones and Wildlife Services enhanced rabies surveillance counties in the United States, 2005.

North Carolina was added to the series of states along the Appalachian Ridge (AR) where ORV is being conducted to prevent the westward spread of raccoon rabies. This measure was taken in response to rabies activity that suggested potential for future westerly spread through highway and/or river corridors along the North Carolina-Tennessee border. The AR ORV zone extends from Lake Erie in Ohio and Pennsylvania, south through West Virginia and western Virginia, to northeastern Tennessee and North Carolina where it articulates with the high mountainous habitats that generally do not support high density raccoon populations (Figure 2). The AR zone, along with the Georgia-Alabama-Tennessee (GAT) ORV zone spanning the 3 state borders, baiting operations near Birmingham and Montgomery, Alabama, and natural barriers make up ORV programs targeting raccoons that reach from Lake Erie to the Gulf of Mexico.

In 2005, WS continued to participate in cooperative ORV projects in Massachusetts, New Jersey, eastern Maryland, Florida, and on Long Island, New York (Figures 1 and 2). These projects provide valuable information on ORV and surveillance strategies. The “barrier” created along the Cape Cod Canal was compromised in late winter 2004. Contingency actions are planned to continue that may integrate trap-vaccinate-release (TVR) with ORV. The new cooperative goal for the Cape Cod program 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. New Jersey is the longest running operational ORV project in the U.S. (Figure 1) and WS' role continues to be post-ORV evaluation. The Maryland project is designed to investigate if ORV can be used to eliminate raccoon rabies from peninsulas on Chesapeake Bay. The Florida ORV program is an extension of the long-standing Pinellas County project, with a near-term goal of determining if rabies-free areas can be created and maintained, with the initial attention to Pinellas County. Raccoon rabies was detected on Long Island in August 2004. Enhanced surveillance, TVR and ORV were implemented around the initial focus. Planning for future actions includes input from county, state, federal and university cooperators.

Wildlife Services continues to assume an important cooperative role with the Texas Department of State Health Services (TDSHS) and several other agencies and organizations in ORV efforts that began in Texas in 1995 (Figure 1). The coyote program has consisted of maintaining a 64-kilometer (40-mile) wide ORV zone in south Texas along the Rio Grande River to prevent canine rabies from re-emerging in Texas coyotes from Mexican feral dogs. Single cases were confirmed near Laredo in 2001 and 2004, but this ORV zone has been effective in preventing rabies spread. Since its establishment in 2000, the maintenance “barrier” has been annually treated with approximately 700,000 vaccine-laden baits over more than 31,000 km² (12,000 mi²) along the U.S.-Mexico border (Figure 2). Wildlife Services is also an important funding and operational partner with the TDSHS in conducting ORV efforts to contain a unique gray fox variant of rabies in west-central Texas. In 2005, WS contributed over 1.9 million baits and assisted with their distribution over more than 55,000 km² (21,000 mi²) to contain gray fox rabies in Texas. Wildlife Services also provides field expertise, infrastructure, and equipment to help obtain samples to continue to monitor and evaluate the status of the ORV targeting coyotes and gray foxes in Texas.

A pilot ORV study conducted in Flagstaff in 2005 was in response to the re-emergence of rabies in the striped skunk population that originated in big brown bats (*Eptesicus fuscus*). This represented the first operational attempt to field test the performance of Raboral V-RG[®] vaccine (Merial Limited, Athens, Georgia, USA) specifically targeting skunks. In the eastern U.S., where it is common for the raccoon variant of the rabies virus to spill over into skunks, there has been virtually no detectable antibody response related to large scale, multi-year ORV projects targeting raccoons. The significance of skunks infected with raccoon rabies remains unclear, but the apparent inability to orally vaccinate them with the currently licensed oral rabies vaccine and bait could potentially confound progress toward effective raccoon rabies control. A pilot study was also conducted in the vicinity of Chinle, Arizona on the Navajo Nation to field test Raboral V-RG[®] and determine rabies titer levels in feral dogs that may have been exposed to the vaccine. This was the first field trial of its kind specifically targeting feral dogs in the U.S.

Coated sachet (CS) baits were used in both ORV field trials in Arizona. In 2005, WS and cooperators continued to shift from fishmeal polymer (FMP) baits to CS's, with approximately 4 million CS baits distributed. At \$1.00/bait CS's are \$0.25 less expensive than FMP baits, less likely to cause damage from aerial distribution, more palatable to smaller carnivores like skunks, and based on field titer responses from Cornell University perform as well as or better than FMP baits. The shift to CS's is currently viewed as only an interim management step until improved baits can be developed, licensed and produced.

Wildlife Services and cooperators continued contingency actions in Ohio to contain raccoon rabies and restore the “barrier.” Contingency actions were also conducted in Massachusetts in continued response to rabies on Cape Cod, in Chattanooga, Tennessee to bolster the existing ORV zone, and around Montgomery, Alabama to maintain a rabies immune area west of the Alabama River. Contingency actions often include an integration of ORV, trap-vaccinate-release, and increased enhanced rabies surveillance.

Enhanced surveillance is designed to complement public health surveillance to provide greater sensitivity in delineating the leading edge of rabies distribution so that sound ORV decisions can be made to maximize the effective use of resources. Enhanced surveillance includes sampling: animals exhibiting behaviors suggestive of rabies that were not implicated in human or domestic animal exposures, road kills, other animals found dead, animals with wounds or lesions suggestive of rabies, and animals removed near locations where rabies has recently been confirmed. In 2005, WS continued to enhance rabies surveillance in most of the states conducting ORV, as well as emphasizing surveillance in Michigan, Kentucky, Mississippi and Louisiana along the western front of the current AR, GAT, and Alabama portions of the raccoon ORV zones (Figure 2). Additionally, Wyoming collected and submitted 305 animals for rabies testing (no positives). Overall in 2005, WS cooperated to collect and submit 7,623 animals for rabies testing as part of enhanced surveillance efforts in 17 states that otherwise may not have been tested through the public health surveillance system; 241 tested positive for rabies.

In 2005, 21 WS personnel attended Direct Rapid Immunohistochemistry Test (dRIT) training at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories. By year's end, WS had implemented the test in 10 states and 2,738 of the enhanced surveillance animals collected (37%) were tested by WS using the dRIT; 91 tested positive for rabies (Table 1).

Table 1. Wildlife Services enhanced rabies surveillance and post-oral rabies vaccination (ORV) sampling efforts as part of raccoon rabies management programs in the eastern U.S., 2005^a.

State	Enhanced surveillance animals	WS tested by dRIT	Rabid by dRIT	Post-ORV serum samples	Positive rabies antibody response (≥ 0.05 IU)
Alabama	350	115 (32.9%)	0	255	44 (17.3%)
Florida	0			548	96 (17.5%)
Georgia	216	0		130	33 (25.4%)
Kentucky ^b	121	0		n/a ^b	
Louisiana ^b	30	30 (100%)	0	n/a ^b	
Maine	59	10 (16.9%)	0	128	67 (52.3%)
Maryland	0			139	33 (23.7%)
Massachusetts	311	4 (1.3%)	0	478	80 (16.7%)
Michigan ^b	82	22 (26.8%)	0	n/a ^b	
Mississippi ^b	181	0		n/a ^b	
New Hampshire	0			7	2 (28.6%)
New Jersey	0			25	8 (32.0%)
New York	80	0		295	83 (28.1%)
North Carolina	212	107 (50.5%)	43	n/a ^c	
Ohio	3,229	1,845 (57.1%)	12	191	14 (7.3%)
Pennsylvania	719	507 (70.5%)	21	736	113 (15.4%)
Tennessee	1,377	22 (1.6%)	0	437	129 (29.5%)
Vermont	7	0		327	63 (19.3%)
Virginia	95	76 (80.0%)	15	129	48 (37.2%)
West Virginia	249	0		316	83 (26.3%)
Total	7,318	2,738 (37.4%)	91	4,141	896 (21.6%)
Mean \pm Standard Deviation					25 \pm 10%

^a Most states report on 2004 serology in the 2005 report to allow for results to be returned from various labs; Florida, however, reports current year's serology (2005) because their ORV events occur very early in the calendar year.

^b ORV not applied in this state.

^c ORV not applied in North Carolina in 2004.

RabID, a GIS-based surveillance mapping tool developed and implemented at the CDC, continued to undergo phased implementation in eastern states involved in raccoon rabies control. This tool provides nearly real-time access to spatial-temporal rabies distribution data that includes results from enhanced rabies surveillance submissions and dRIT testing. Currently, Alabama, Florida, Georgia, Kentucky, Ohio, Tennessee, Virginia, and West Virginia are routinely submitting data to the RabID system; Michigan, Mississippi, North Carolina and Pennsylvania have also submitted data at times.

In all states conducting ORV bait distribution, WS continues to take the lead on post-ORV monitoring to evaluate program efficacy by collecting blood and tooth samples for determining rabies virus neutralizing antibody (VNA) levels and bait uptake (when appropriate) in raccoons, skunks, coyotes, and foxes. Density indexing is also used to characterize raccoon and skunk populations and to provide post-ORV serum samples for analysis. Most states report on 2004 serology in this 2005 report to allow for results to be returned from laboratory analysis. Florida, Texas, and Arizona report current year's serology (2005) because their ORV events occur early in the calendar year. A mean positive antibody response (VNA ≥ 0.05 IU) of $25 \pm 10\%$ was observed for the sample of 4,141 raccoon serum samples collected post-ORV (Table 1). In 2005, Texas collected serum samples from 115 coyotes and 141 gray foxes to evaluate ORV efficacy targeting those species in south and west-central Texas, respectively; 29 (25%) coyotes and 80 (57%) gray foxes demonstrated positive rabies VNA responses. Arizona, in 2005, collected serum samples from 12 skunks and 40 dogs within the ORV pilot study areas of Flagstaff and Chinle, respectively. Only one skunk (8%) and 5 dogs (13%) had positive rabies VNA responses.

The need for a bait-vaccine combination that produces higher levels of rabies VNA in meso-carnivore species that are reservoirs for rabies remains the highest research priority and requires systematic research. In 2005, external research at Thomas Jefferson University in Philadelphia, Pennsylvania focused on the development of new safe and effective oral rabies vaccines, with canine adenovirus as a prospective vector for expression of the rabies glycoprotein gene. Several pen, laboratory, and field studies were continued or initiated through WS' National Wildlife Research Center (NWRC) in Fort Collins, Colorado. Pen and laboratory studies were conducted at the NWRC and Colorado State University, while field studies were conducted in Alabama, Arizona, Ohio, Pennsylvania, and Texas. Studies involved research on: bait development to better deliver rabies vaccines, such as the currently licensed Raboral V-RG® for raccoons and skunks; ecology of raccoons, gray fox, and striped skunks in rural and urban areas; better use of biomarkers to evaluate vaccine uptake by target and non-target wildlife; evaluating geographic barriers for wildlife dispersal that may affect the spread of rabies; determining long-term efficacy of Raboral V-RG® in raccoons; evaluating the biosafety of Raboral V-RG® in non-target wildlife; determining if infrared thermography can be used as a surveillance tool to detect rabies infected wildlife; and others.

In 2006, WS and cooperators will continue to focus on implementing adequate enhanced rabies surveillance in conjunction with ORV to determine areas at risk of rabies spread and to monitor program success. Adjustment to ORV zones may occur as a result of improved surveillance information. Commitments will continue toward improvements to the existing bait-vaccine and development of new bait-vaccines that perform better and are efficacious in all carnivore reservoirs. Lastly, WS will continue to participate in formal meetings with counterparts from Canada and Mexico on the development of a North American Rabies Management Plan that identified information exchange, enhanced surveillance, rabies control, and research as key needs toward meeting continental goals for rabies management.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM ALABAMA 2005

BACKGROUND

Raccoon (*Procyon lotor*) rabies is thought to have entered Alabama in the late 1970s from Florida. The raccoon variant of the rabies virus 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 10 years, several confirmed raccoon rabies breaches of the Alabama and Coosa Rivers (Figure 1) 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.

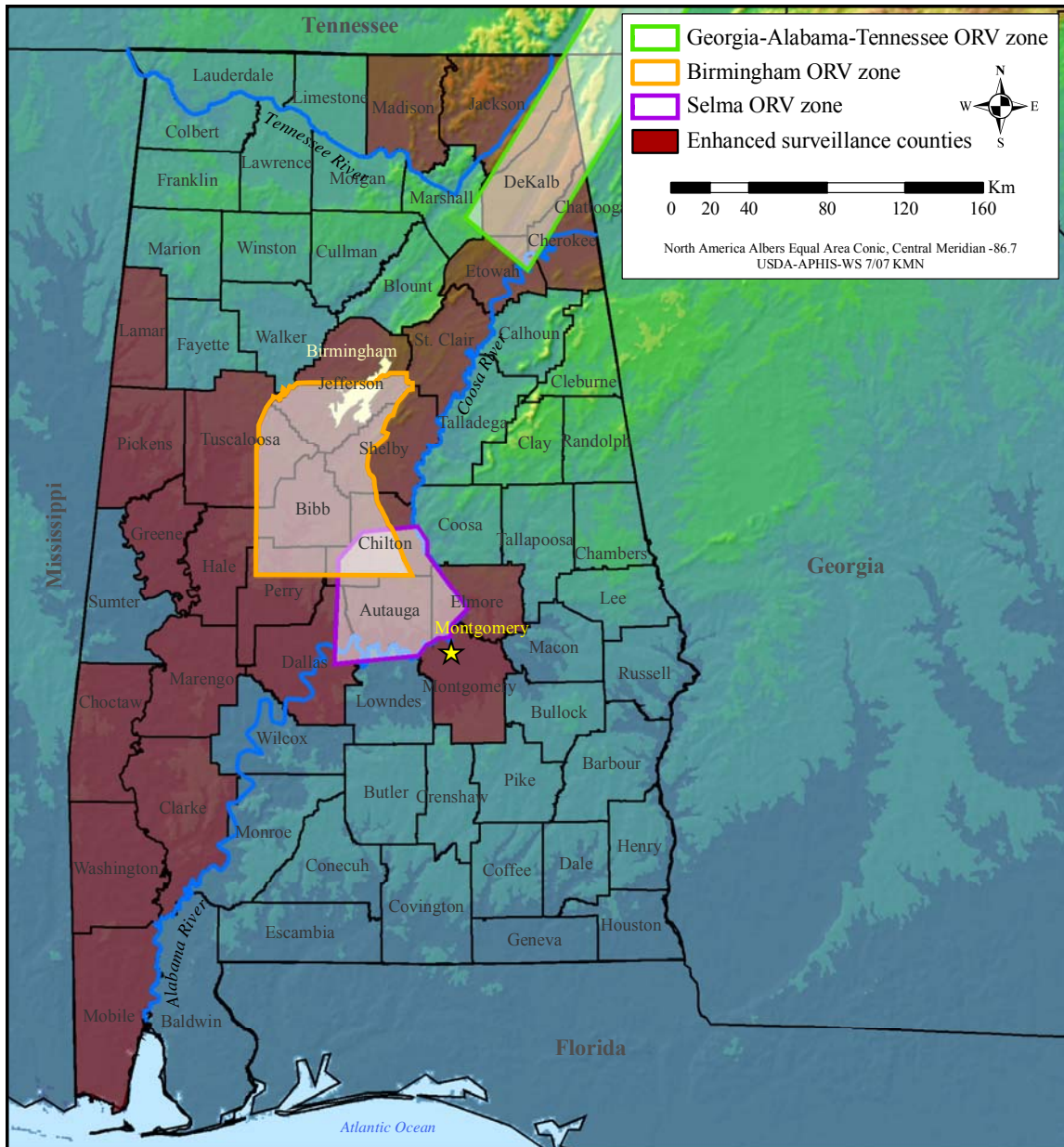


Figure 1. Wildlife Services cooperative rabies management program activities in Alabama, 2005.

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 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 2004, surveillance conducted by WS and the ADPH confirmed 13 raccoon rabies cases in both domestic and wild animals in Autauga, Elmore and Clarke Counties (where it had previously been detected) and Cherokee, DeKalb, and Shelby Counties (where it had never been detected), indicating that raccoon rabies might be on the move westward. As a result, in the fall of 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 counties. Since then, Alabama WS has participated in 5 additional ORV distributions in both northeast Alabama (as part of the Georgia-Alabama-Tennessee [GAT] zone) and central Alabama (Birmingham and Selma zones), all in response to newly confirmed positive cases that indicated raccoon rabies was moving westward.

Recently, 2 new raccoon rabies cases were identified in raccoons by the ADPH in Jefferson County. Both cases were detected in Mountain Brook in October 2005 just outside of Birmingham proper, the population center of Alabama. In addition to initiating a new bait distribution zone encompassing Birmingham and surrounding Bibb, Chilton, Jefferson, Perry, Shelby, and Tuscaloosa Counties in late October 2005, Alabama WS increased monitoring efforts of sick and strange acting animals in Jefferson and Shelby Counties.

ORV PROGRAM 2005

Bait Distribution

For the third consecutive year, WS participated in bait distribution efforts throughout central and northeastern Alabama; 898,746 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 13,260 km² (5,122 mi²) in 2005 (Figure 1). Since its program inception in 2003, WS has distributed 1,585,280 ORV baits in Alabama.

Selma.--The objective of the 2005 Selma ORV zone was to continue to maintain a rabies immune area west of the Alabama River in central Alabama where 3 cases of raccoon rabies had been identified in 2002 and 2003. Wildlife Services distributed baits in central Alabama from 3-5 March 2005 in an area that was 3,521.4 km² (1,360.1 mi²) (Figure 1). Fishmeal polymer (FMP) baits were distributed from the air and by hand (237,520 and 17,280, respectively) in parts of Autauga, Bibb, Chilton, Coosa, Dallas, Elmore, Lowndes, and Montgomery Counties. The ADPH coordinated information outreach to county and local authorities and assisted WS Legislative and Public Affairs personnel with media and public inquiries.

Georgia-Alabama-Tennessee.--The objective of Alabama's 2005 GAT ORV zone was to continue to prevent the westward movement of raccoon rabies from northwest Georgia into Cherokee and DeKalb Counties. No new raccoon rabies cases had been detected in northeast Alabama since the first GAT program was initiated in 2003. Wildlife Services personnel and volunteers from the Centers for Disease Control and Prevention (CDC) distributed baits in Alabama from 22-25 October 2005, in an area that was 3,202.2 km² (1,236.8 mi²) (Figure 1). Fishmeal polymer baits were distributed from the air and by hand (163,961 and 8,130, respectively) in parts of Cherokee, DeKalb, Etowah, Jackson, and Marshall Counties.

Birmingham.--The objective of the 2005 Birmingham ORV zone was to respond to recent raccoon rabies cases detected in Shelby County in 2004 and in Birmingham in October 2005. Raccoon rabies had not been detected in Jefferson or Shelby Counties prior to these occurrences. Wildlife Services personnel, Jefferson County Department of Health environmentalists, and volunteers from the CDC distributed baits from 25-30 October 2005, in an area that was 6,536.3 km² (2,524.6 mi²) (Figure 1). Fishmeal-coated sachet (CS) baits were distributed from the air and FMP baits by hand (325,080 and 146,775, respectively) in parts of Bibb, Chilton, Dallas, Hale, Jefferson, Perry, Shelby, and Tuscaloosa Counties.

Enhanced Surveillance

In 2005, WS continued to enhance rabies surveillance by collecting 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 variant in Alabama. Wildlife Services cooperated with animal control personnel, county health department environmentalists, and wildlife law

enforcement officers to collect 350 animals for rabies testing (Table 1). All of these animals tested negative for rabies. One raccoon from Shelby County and 1 gray fox (*Urocyon cinereoargenteus*) and 1 raccoon from Jefferson County, tested via the public health surveillance system, were confirmed positive for the rabies virus using the direct fluorescent antibody (dFA) test.

Table 1. Animals collected for rabies testing by Wildlife Services along the Alabama-Coosa River system and westward in Alabama, 2005 (no rabies positives).

County	Raccoon	Coyote	Gray fox	Red fox	Bobcat	Opossum	Total
Autauga	2		1				3
Bibb	14		1				15
Cherokee	7						7
Chilton	5	1	1				7
Choctaw ^a	5						5
Clarke ^a	8			1		1	10
Dallas	2		1				3
DeKalb	24						24
Elmore	8		1				9
Etowah	1						1
Greene ^a	4			1			5
Hale	23		1		1		25
Jackson	3						3
Jefferson	74	1	1	1			77
Lamar ^a	1						1
Madison ^a	1						1
Marengo ^a	6	1	1				8
Mobile ^a	22						22
Montgomery			3				3
Perry	3	1					4
Pickens ^a	2						2
Shelby	74	1					75
St. Clair ^a	4						4
Tuscaloosa	19	11		1			31
Washington ^a	5						5
Total	317	16	11	4	1	1	350

^a ORV not applied in this county.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Alabama WS personnel attended dRIT training in April 2005 at the CDC in Atlanta, Georgia and implemented the test on 23 November 2005, at the newly organized lab located at the Agricultural Experiment Station in Chilton County. During 2005, WS collected 350 animals for rabies testing (Table 1) and 115 were tested by WS using the dRIT (33%). Of the dRIT samples, none tested positive, 114 tested negative, and 1 was indeterminate. Ten percent of all negatives and the indeterminate sample were sent to the CDC for confirmation. The CDC (using the dFA test) had 100% agreement with the WS dRIT test results for negative samples. They also confirmed the indeterminate sample as negative. Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid animals in Alabama.

ORV Naïve Monitoring

Wildlife Services refers to areas that have never been treated with ORV as “ORV naïve.”

Birmingham.--In early October 2005, trapping was initiated prior to ORV distribution in the naïve areas of Bibb, Chilton, Jefferson, Perry, Shelby, and Tuscaloosa Counties. Wildlife Services captured 64 target animals: 2 were found dead in traps; and 62 were immobilized, processed and released. Serum samples from 62 raccoons were collected to measure the baseline presence of rabies virus neutralizing antibodies (VNA) in this ORV naïve area. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Post-ORV Monitoring

Selma.--Post-ORV sampling for the 2005 Selma ORV zone was initiated on 4 April 2005. Cage traps were used to capture 158 unique raccoons from Autauga, Elmore, Chilton, and Dallas Counties. One raccoon was found dead in the trap and 157 were immobilized, processed and released.

Georgia-Alabama-Tennessee.--Post-ORV sampling for Alabama’s 2005 GAT ORV zone was initiated on 28 November 2005. Cage traps were used to capture 121 unique raccoons from DeKalb County. All raccoons were immobilized, processed and released.

Birmingham.--Post-ORV sampling for the 2005 Birmingham ORV zone was initiated on 5 December 2005. Cage traps were used to capture 121 unique raccoons from Bibb, Chilton, Jefferson, Shelby, and Tuscaloosa Counties. One raccoon was found dead in the trap, and 120 were immobilized, processed and released.

Raccoon Movements Study

Field work for a telemetry study initiated in January 2004 to monitor raccoon habitat use and movements relative to the Alabama River concluded in December 2005. As many as 120 raccoons were captured and radio-collared from 4 counties as part of this project. Data analyses are currently underway.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 87 opossums (*Didelphis virginiana*), 42 domestic/feral cats (*Felis catus*), 2 black rats (*Rattus rattus*), 2 Eastern box turtles (*Terrapene carolina*), 1 Eastern cottontail (*Sylvilagus floridanus*), 1 gray fox, and 1 Northern mockingbird (*Mimus polyglottos*).

Non-target animals that were captured and euthanized by WS in 2005 included: 167 opossums, 33 domestic/feral cats, 11 coyotes (*Canis latrans*), 4 gray foxes, 2 black rats, 2 nine-banded armadillos (*Dasypus novemcinctus*), 2 red foxes (*Vulpes vulpes*), 1 Eastern cottonmouth (*Agkistrodon piscivorus*), and 1 woodchuck (*Marmota monax*). All animals euthanized by WS in 2005 were done so in accordance with the American Veterinary Medical Association’s Panel on Euthanasia recommendations.

Rabies Laboratory Cooperation

Wildlife Services’ ORV program in Alabama cooperates with the ADPH Bureau of Clinical Laboratories and the CDC.

Alabama Department of Public Health Bureau of Clinical Laboratories.--The ADPH tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). The ADPH confirmed 79 cases of rabies in Alabama in 2005. The number of animals tested for rabies statewide was unknown at the time of printing. For more information about the ADPH please visit: <http://www.adph.org/>

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA.

In 2005, the CDC tested 235 wildlife brainstem samples submitted by Alabama WS. This was a 5.1% decrease from the 247 brainstems submitted by Alabama WS in 2004. Alabama WS also submitted 319 blood serum samples for rabies VNA analysis to the CDC in 2005. This represented a 14.0% decrease from the 371 samples submitted by WS in 2004. The Alabama ORV program anticipates fewer brainstem submissions to the CDC in 2006 (due to implementation of the dRIT), while serum sample submissions will increase because of post-ORV trapping activities in 3 different zones. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Alabama's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

Post-ORV Selma Evaluation.--During sampling in the ORV naïve 2004 Selma zone, 8 of 38 animals (21.1%) demonstrated a positive rabies antibody response (≥ 0.05 IU). Baits were then distributed in April 2004 at 2 densities: 75 baits/km² and 150 baits/km². The double bait density was applied within a 10-mile radius of the last known rabies case at that time, and the standard bait density was applied outside of that radius over the rest of the ORV zone. Serum samples from 128 raccoons were collected 4-5 weeks post-baiting, throughout the entire Selma zone, and 14.1% demonstrated a positive rabies VNA response (Table 2). Tooth samples were also collected from most of these raccoons and sent to Matson's Laboratory LLC (Milltown, Montana, USA) for tetracycline biomarker analysis and aging. Biomarker analysis showed that ORV bait uptake was more prevalent in the double bait density area (Table 2).

Table 2. Serology and tetracycline biomarker results of raccoon biological samples collected during post-bait trapping in the Selma ORV zone in Alabama, 2004.

	75 baits/km ²	150 baits/km ²
Unique raccoon captures	94	34
	Serology	
Testable blood samples	94	34
Positive rabies antibody response (≥ 0.05 IU)	12 (12.8%)	6 (17.6%)
	Tetracycline	
Testable tooth samples	92	31
Presence of tetracycline biomarker	4 (4.3%)	6 (19.4%)

Post-ORV Georgia-Alabama-Tennessee Evaluation.--Serum samples from 127 raccoons were collected 7-12 weeks following the 2004 bait distribution within Alabama's GAT ORV zone. Of these samples, 26 (20.4%) demonstrated a positive rabies VNA response. This was down from a 33.0% positive response following the 2003 ORV bait distribution. In addition, tooth samples were collected from 117 raccoons and sent to Matson's for tetracycline biomarker analysis and aging. Tetracycline biomarker was detected in 41 (35.0%) of the teeth tested. In addition, 11 teeth exhibited more than 1 distinct tetracycline mark, possibly indicating the animal consumed or partially consumed more than 1 bait.

Population Monitoring Evaluation.--Three studies to index relative densities of raccoon populations were conducted in March, September and October 2004, in areas west of enzootic raccoon rabies activity and in ORV

naïve areas. Serum samples from 58 raccoons were collected and analyzed for rabies VNA. Of the 58 samples, 2 (3.4%) demonstrated a positive rabies VNA response.

Age Results.--In 2004, 339 raccoon teeth were aged using premolars of live-captured animals and canines of animals found dead or euthanized. These samples were collected from raccoons during the telemetry study, 3 density studies, enhanced surveillance and post-ORV trapping (Figure 2).

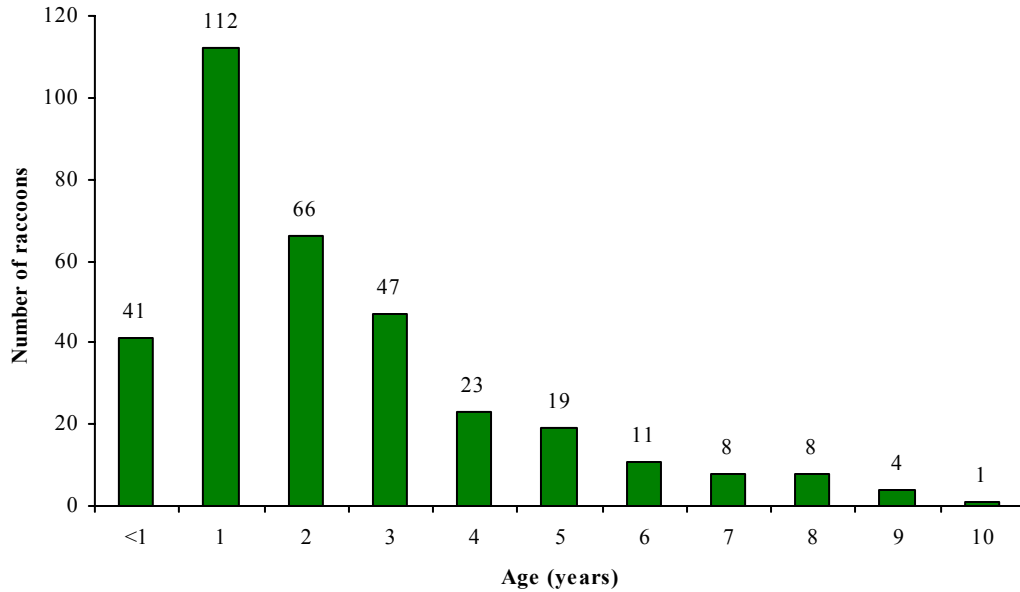


Figure 2. Age results of 339 raccoon tooth samples collected throughout Alabama, 2004.

SUMMARY

The fall of 2005 marked the fifth year of WS cooperative participation in rabies management in Alabama. Work emphasized surveillance of raccoon rabies west and north of the Alabama and Coosa Rivers as well as ORV naïve and post-ORV monitoring and evaluation. Oral rabies vaccination efforts were initiated in Birmingham and its surrounding counties and repeated in northeast and central Alabama in an attempt to stop the westward movement of the raccoon variant 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 and beyond. These ORV zones will be tied to a national planning effort to contain the disease and explore strategies to eliminate the raccoon variant of the rabies virus from North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM ARIZONA 2005

BACKGROUND

The striped skunk (*Mephitis mephitis*) and gray fox (*Urocyon cinereoargenteus*) are the primary reservoirs of terrestrial rabies in Arizona. The South Central skunk variant of the rabies virus typically occurs in the southeastern counties of Arizona. The Arizona gray fox variant generally runs through the eastern counties and into the central part of the state, below the Mogollon Rim. A bat variant of the rabies virus, common in big brown bats (*Eptesicus fuscus*), occurs throughout the state. In 2001, a skunk was infected with a bat variant causing an unprecedented rabies outbreak in Flagstaff (Coconino County). By year's end, this rare spillover had infected 19 rabid skunks and was the first documented event of a bat variant of the rabies virus being transmitted and maintained in skunks. This spillover reoccurred in late 2004 and again in 2005, prompting a trap-vaccinate-release (TVR) campaign by Wildlife Services (WS) in Flagstaff (Figure 1).

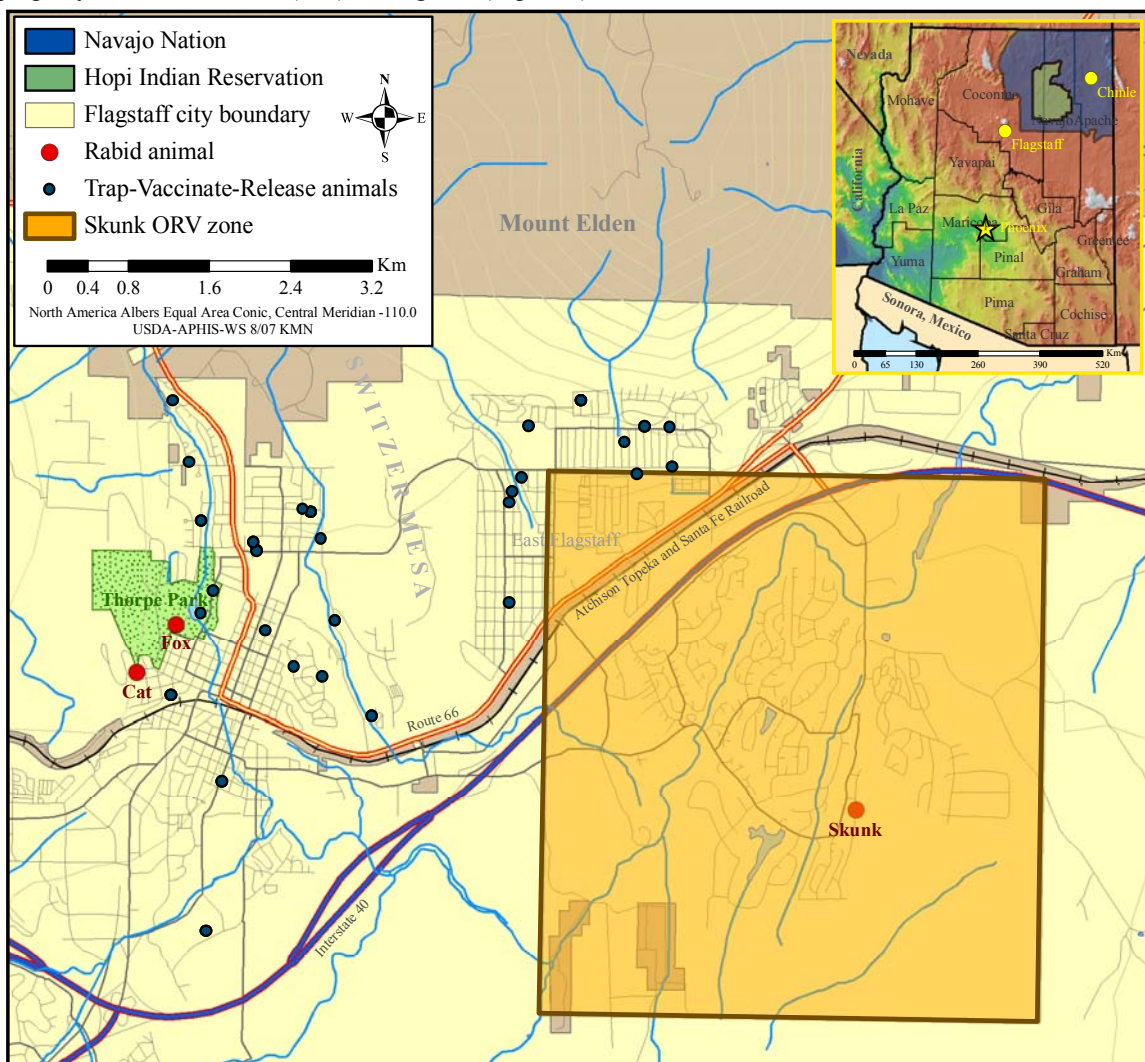


Figure 1. Wildlife Services cooperative rabies management program activities in Arizona, 2005.

In 2005, the Arizona Department of Health Services (ADHS) tested 2,481 animals and confirmed 169 cases of rabies, a 41% increase in positive cases from 2004. The 2005 rabies cases occurred in 11 of the 15 counties in Arizona (Table 1) and included a skunk, gray fox, and domestic cat (*Felis catus*) from Flagstaff that were infected

with the big brown bat variant (Figure 1). For more information on animals tested from Arizona in 2005 by the ADHS please visit: www.azdhs.gov/phs/oids/vector/rabies/stats.htm

Table 1. Animals confirmed positive for the rabies virus by the Arizona Department of Health Services in Arizona, 2005.

County	Bat	Skunk	Fox	Coyote	Other	Total
Cochise	6	5	2			13
Coconino	1	1 ^a	1 ^a		1 (cat) ^a	4
Gila	1		1			2
Graham	1		1			2
Greenlee	2					2
La Paz	1					1
Maricopa	11				1 (bobcat) ^b	12
Pima	48	55	3		1 (raccoon) ^c	107
Pinal	4		1		1 (bobcat) ^b	6
Santa Cruz	3	6	2	1	1 (cat) ^b	13
Yavapai	6		1			7
Total	84	67	12	1	5	169

^a Big brown bat variant of rabies.

^b Arizona gray fox variant rabies.

^c South Central skunk variant rabies.

RABIES MANAGEMENT PROGRAM 2005

Hand Vaccination (TVR)

In a continuing effort to reduce the number of confirmed rabies cases in Arizona, and particularly Flagstaff, WS cooperated with the Centers for Disease Control and Prevention (CDC), the ADHS, and the Coconino County Health Services (CCHS) to trap, vaccinate (using Imrab3®, [Merial Limited, Athens, Georgia, USA]), and release 123 animals in 2005 (Figure 1). These hand vaccinated animals included: 113 striped skunks, 9 raccoons (*Procyon lotor*), and 1 Western hog-nosed skunk (*Conepatus mesoleucus*). All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of oral rabies vaccination (ORV) programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Arizona WS personnel attended dRIT training in November 2005 at the CDC in Atlanta, Georgia and plan to implement the test in 2006.

RABIES-RELATED RESEARCH STUDIES 2005

Rabies control in skunks (via ORV or other means) is not as well studied or documented as it is in raccoons, coyotes (*Canis latrans*), and foxes. Additionally, rabies control in feral/domestic dogs (*Canis familiaris*) is most commonly achieved via hand vaccination by veterinarians or other trained professionals. Prior to 2005, an oral rabies vaccine had never been used in a feral dog population in the U.S. Consequently, WS conducted 5 rabies-related research projects in Arizona in 2005; 4 studies in Flagstaff involving skunks and 1 study on the Navajo Nation in northeastern Arizona involving feral dogs (Figure 1).

Skunk Telemetry Study

The unprecedented 2001 rabies outbreak in Flagstaff (and its re-emergence in 2004 and 2005) involving the spillover and perpetuation of a bat variant of the rabies virus in skunks led to many unanswered questions about skunk biology and ecology. In winter 2003-04, WS and its National Wildlife Research Center, in cooperation with the Northern Arizona University (NAU), began a behavioral research project to better understand striped skunk population dynamics for management and control of rabies outbreaks in Arizona. In 2005, WS continued participating in the study, designed to answer the following questions:

- 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 Switzer Mesa (a mixed ponderosa and grassland environment). The eastern study site covered approximately 5.6 km² and was bound to the west by Switzer mesa, to the north by Mount Elden, and to the south by potential barriers to dispersal (Route 66, the Atchison Topeka and Santa Fe Railroad, and Interstate 40). The western study area covered approximately 5.5 km² and was bound to the west by Thorpe Park, to the east by Switzer Mesa, and to the south by Route 66 and the Atchison Topeka and Santa Fe Railroad (Figure 1).

Methods.--Striped skunks were live-trapped, marked with numbered ear tags, and fit with radio collars to determine home range sizes, den locations, and nocturnal and season movements. Den sites were monitored with automated, infrared 35 mm and digital cameras to document potential inter- and intraspecific contact at den sites.

Results.--This study began in winter 2003-04. Based on radio tracking data collected from January 2004-March 2005, we determined that skunk home range (HR) sizes overlapped. They were similar for males and females to those reported in previous studies (mean minimum convex polygon [MCP] + 146.16 ha [\pm 16.8 SE]). In addition, HRs crossed potential geographic barriers to dispersal.

A significant difference was found in total home range size across sex, but not across age class (sub-adult vs. adult) or season (Mar.-Apr., May-Jul., Aug.-Oct., Nov.-Feb.). A statistical difference was also found in skunk movements (area covered within a night) across age class and season (highest movements from May-Jul. and lowest from Nov.-Feb.), but not across sex. Forty-nine skunks were radio collared, 24 of which factor into these home range calculations, and 13 of those contribute data to multiple seasons.

Cameras also recorded the interaction of dogs, cats, gray foxes, and raccoons with skunks at den sites.

Bait Station Study

Within the urban environment of Flagstaff, WS, with assistance from NAU students, conducted a study to test the efficacy of different sized stations in potentially delivering ORV baits to skunks versus other nocturnal mammals.

Methods.--Different sized stations were constructed using PVC pipe with 4, 6, and 8 inch diameters. Each of the 39 stations was baited with wet, canned cat food. One can of cat food was split into thirds and placed into each of the stations. The stations were placed at 13 locations in sets of 3 (a 4, 6, and 8 inch station at each location). Using digital trail cameras, the stations were monitored for 5 nights during late February and early March 2005.

Results.--Visits by skunks, gray foxes, raccoons, and domestic cats and dogs were recorded via digital images. Skunks entered bait stations of all sizes, but only 1 use of a 4 inch station was recorded. Cats used both 6 and 8 inch stations, but were never recorded in a 4 inch station. Skunks, foxes, and raccoons all used the 6 inch stations, while dogs only entered this diameter station once.

Skunks entered the 6 inch stations 81% of the time, while these stations excluded all dogs, and over 50% of cats, foxes and raccoons that tried to use them. This study demonstrated that 6 inch stations were more effective than 4 or 8 inch stations at allowing skunks access, while limiting non-target access. If however, foxes and raccoons are targets for accessing bait, the data suggests that 8 inch diameter stations would be most effective, but would allow access by non-target cats and small dogs.

Skunk Population Study

With cooperation from an NAU mammalogy class, WS conducted a study to estimate striped skunk population density in East Flagstaff from 4-14 March 2005 (Figure 1).

Methods.--A modified version of the WS National Rabies Management Program's density index to raccoon population abundance and structure protocol was used for this study; 25 Tomahawk #105 live traps were set on a 1.5 km² study area for 10 consecutive days. Traps were moved within the study area every 2-3 days if they did not capture a unique skunk. All skunks captured were ear tagged with a unique number.

Results.--A total of 18 skunks (15 unique individuals and 3 recaptures) were trapped during the study indicating an index to density of 10 skunks/km² in East Flagstaff.

Skunk Oral Rabies Vaccine Study

This study was conducted to field test an oral rabies vaccine and determine rabies titer levels in skunks that may have been exposed to the vaccine and skunks not exposed to the vaccine. This was the first field trial of its kind specifically targeting skunks.

Study Areas.--The Fox Glen Continental area of Flagstaff was chosen as the ORV study area because of the current and historical rabies outbreaks in the skunk population there (Figure 1). The 22.5 km² study site also offered a mix of urban and wild land habitats. A control study site (with no vaccine) was chosen at Munds Park, located 15 miles south of Flagstaff.

Methods.--On 17 April 2005, approximately 50 individuals from WS, the CDC, the ADHS, the CCHS, the City of Flagstaff, and the NAU distributed 1,875 fishmeal coated sachet (CS) baits containing Raboral V-RG® vaccine (Merial Limited) by hand throughout the ORV study area. The control site received no baits/vaccine.

Five weeks post-bait distribution, WS began live-trapping skunks by placing cage traps in areas of suitable skunk habitat (e.g., travel corridors, natural washouts, culverts, etc.) throughout the vaccine and control study areas. Animals trapped at both sites were anesthetized with a 5:1 ketamine:xylazine mixture injected intramuscularly. Blood was collected from each animal and serum samples were sent to the CDC to be analyzed for rabies virus neutralizing antibodies (VNA). Each animal was euthanized and the head sent to the ADHS laboratory to test the brain for the rabies virus using the dFA test. All animals euthanized by WS in 2005 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Results.--Twelve striped skunks were captured from the vaccine study site: 11 had rabies titers of 0.04 International Units (IU), demonstrating no positive rabies antibody response (at ≥ 0.05 IU); and 1 had a titer of 0.05 IU (indicating a positive rabies antibody response). From the control site, 25 skunks, 1 raccoon, and 1 gray fox were captured: 17 skunks, 1 raccoon, and 1 gray fox had rabies titers of 0.04 IU (demonstrating no positive rabies antibody response); 7 skunks had titers ranging from 0.072 to 0.104 IU and 1 skunk had a titer of 0.36 IU (the highest titer level of all animals captured during this study) indicating positive rabies antibody responses. All 39 animals were confirmed negative for rabies using the dFA test.

Feral Dog ORV Bait Study

In April 2005, WS conducted an ORV bait trial on feral free-ranging dogs on the Navajo Nation in conjunction with the CDC and the Navajo Nation Veterinary Services. This study followed an ORV placebo bait study on the Navajo Nation in April 2004. The 2004 study used 3 different baits with placebo vaccine (CS, fishmeal polymer [FMP], and dog food polymer [DFP]) to determine bait acceptance among feral dogs. Coated sachet baits were accepted more often than the other baits. More importantly, the placebo vaccine was taken nearly 4 times as

often in CS than in FMP baits and twice as often in CS than DFP baits. The greater acceptance of placebo vaccine in CS baits during the 2004 study led to the ORV field trial in 2005 using CS baits containing Raboral V-RG® vaccine. The 2005 study was conducted to field test an oral rabies vaccine and determine rabies titer levels in feral dogs that may have been exposed to the vaccine. This was the first field trial of its kind specifically targeting feral dogs in the U.S.

Study Areas.--Sites in and around Chinle, Arizona on the Navajo Nation were chosen as the areas to distribute ORV baits (Figure 1 inset).

Methods.--Groups of 2-4 people, including at least 1 representative from the Navajo Nation, hand baited as many dogs as possible. Each dog was presented a CS bait from a person's hand or a CS bait was tossed in a dog's direction if he was suspicious of eating out-of-hand. Personnel recorded numbers and sex of each dog, and how the dogs reacted to the bait: ignored the bait; took it and discarded it; swallowed it whole; chewed it but spilled the vaccine; or chewed it and received a vaccine dose. In total, 258 CS baits were distributed to 253 dogs (151 males, 98 females, 4 not recorded) with 220 of those dogs potentially receiving a vaccine dose.

Starting 1 month after baiting and continuing for 9 months post-ORV bait distribution, the Navajo Nation Animal Control (NNAC) collected 148 feral dogs during their routine dog control "round-ups" (40 dogs from the baited areas and 108 control dogs from outside the ORV area). All the dogs were bled following euthanasia by the NNAC and serum samples from each dog were sent to the CDC to be analyzed for rabies VNA.

Results.--Serum samples were collected from 148 dogs throughout the Navajo Nation; 108 of those samples (73%) were from control animals outside the ORV area. These samples were analyzed to determine background levels of rabies VNA in dogs on the Navajo Nation. Eight of the 108 control samples (7.4%) had detectable levels of rabies antibody with 4 of the samples having a titer >0.49 IU. Forty samples were taken from dogs rounded-up in the ORV baited area. Five of the 40 samples (12.5%) had detectable levels of rabies antibody with 3 having a titer >0.49 IU.

SUMMARY

The Arizona WS program continues to be unique in that it is currently the only program specifically targeting skunks and feral dogs with ORV. In the coming year, WS anticipates continued ORV bait distribution to suppress rabies in the skunk population of Flagstaff and the feral dog population on the Navajo Nation. Wildlife Services will continue to provide support and respond to requests for assistance with rabies surveillance and management in Arizona. Wildlife Services looks forward to continuing a strong cooperative relationship with state and local agencies, while providing federal leadership in rabies management.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM CALIFORNIA 2005

BACKGROUND

California has 1 terrestrial variant of the rabies virus in striped skunks (*Mephitis mephitis*) and another variant in bats (*Chiroptera* spp.). 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 variants. The skunk variant has been limited to areas north of the Tehachapi mountain range in California (Figure 1). From 1995-2004, the California Department of Health Services (CDHS) reported 3,045 cases of rabies throughout the state, approximately 44% of these were skunks (Dr. B. Sun, CDHS, January 23, 2006, pers. comm.).

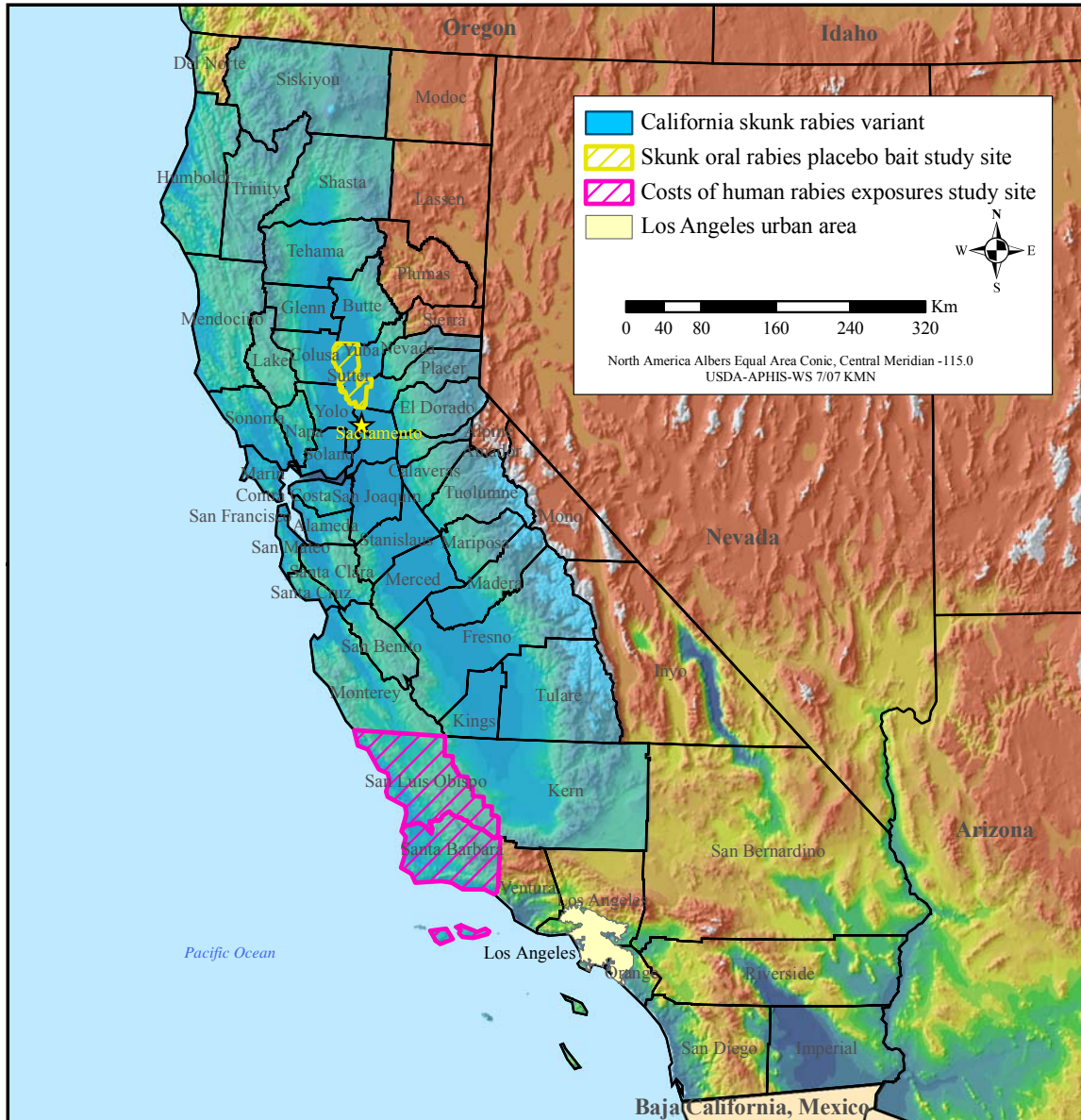


Figure 1. Wildlife Services cooperative rabies management program activities in California, 2005.

RABIES MANAGEMENT PROGRAM 2005

In 2004, Wildlife Services (WS), in conjunction with its National Wildlife Research Center (NWRC) conducted a second round of placebo oral rabies vaccine (ORV) bait research projects. This was part of a larger project that was being conducted in Arizona, Louisiana, Texas, and Wyoming. The goal was 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 being evaluated which may be available for testing in a field setting in the near future. California WS has played an important role in carrying out these bait field trials, in the effort to obtain U.S. Department of Agriculture licensing.

Bait Distribution

There is currently no ORV bait distribution program in California.

Enhanced 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. In 2005, the CDHS confirmed 206 cases of rabies in animals from California. For a full listing of reported animal rabies by county and species in California for 2005 please visit: www.dhs.ca.gov/dcdc/disb/pdf/2005%20Rabies%20Final.pdf

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, California WS is not planning training or implementation of the dRIT.

Other Rabies Management Program Activities

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. Cage traps were placed every 0.5 km along each transect approximately 6 weeks after baits were distributed. Upon capture, animals were euthanized and blood was collected for rabies antibody analysis. The lower jaw bones of 26 striped skunks were removed and sent to the NWRC to be tested for the presence of tetracycline biomarker (Table 1). Several non-target animals were captured and tested for presence of the biomarker, they included: 31 opossums, 20 raccoons, 4 coyotes (*Canis latrans*), 3 California ground squirrels (*Spermophilus beecheyi*), and 1 muskrat (*Ondatra zibethica*) (Table 1). All animals captured by WS in 2004 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Blood serum samples were taken from 31 striped skunks captured in the study site where Artemis Ontario Slim baits were distributed. One sample (3.2%) from this area exhibited a positive rabies antibody response (0.067 IU/ml). In addition, serum samples were taken from 16 striped skunks captured in the study site where Merial Cylindrical baits were distributed. Three samples (18.8%) from this area exhibited a positive rabies antibody response (at 0.095, 0.095, and 0.067 IU).

Table 1. Results and percent positive occurrence (%) of jawbone analysis tested for presence of tetracycline biomarker after consumption of placebo oral rabies vaccine 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%)
Raccoon	6 (50%)	14 (50%)
Coyote	2 (0%)	2 (0%)
California ground squirrel	0	3 (100%)
Muskrat	0	1 (100%)

Evaluation of the Costs of Human Rabies Exposures.--The CDHS was awarded funds from WS to examine the direct and indirect costs of suspected human rabies exposures in California using archival records and telephone interviews for cases between 1998 and 2002. The following results by Shwiff et al. are "In Review" at the Journal of the American Veterinary Medical Association. Clinic, hospital and county public health records in San Luis Obispo (SLO) and Santa Barbara (SB) Counties, California (Figure 1) were examined to determine direct costs for post-exposure prophylaxis (PEP) treatment, and 55 (41%) former patients were contacted to voluntarily provide estimates of their indirect costs associated with receiving PEP. The mean total cost of a suspected human rabies exposure was \$3,688, the direct costs per case were \$2,564 and indirect costs were \$1,124, of that total. Approximately 33% of the total suspected human rabies exposure case expense was attributed to indirect costs (e.g., lost wages, transportation and day-care fees); most of which were not reimbursable to the patient. Additional costs due to public health and animal control personnel responses to rabid animals were collected, including diagnostic testing and wages. Mean annual suspected rabid animal investigations in SLO and SB Counties during the study period were 41.8 and 49.8, and projected costs for public health, animal control and rabies diagnostic activities yielded annual mean expenditures of \$17,723 and \$21,115, respectively.

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 the NWRC are conducting research on baits that could be more easily manipulated and consumed by skunks. The California WS program will continue working with the NWRC and CDHS on the development of baits for the potential use in a skunk ORV program in California.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM FLORIDA 2005

BACKGROUND

In 1947, raccoon (*Procyon lotor*) rabies was first documented in Florida and is now considered enzootic 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. In 1995, Pinellas County Animal Services initiated a county-wide oral rabies vaccination (ORV) program to combat an explosive outbreak of rabies in raccoons. This program continues today and over 600,000 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) have been distributed in the county since 1995 (Figure 1).

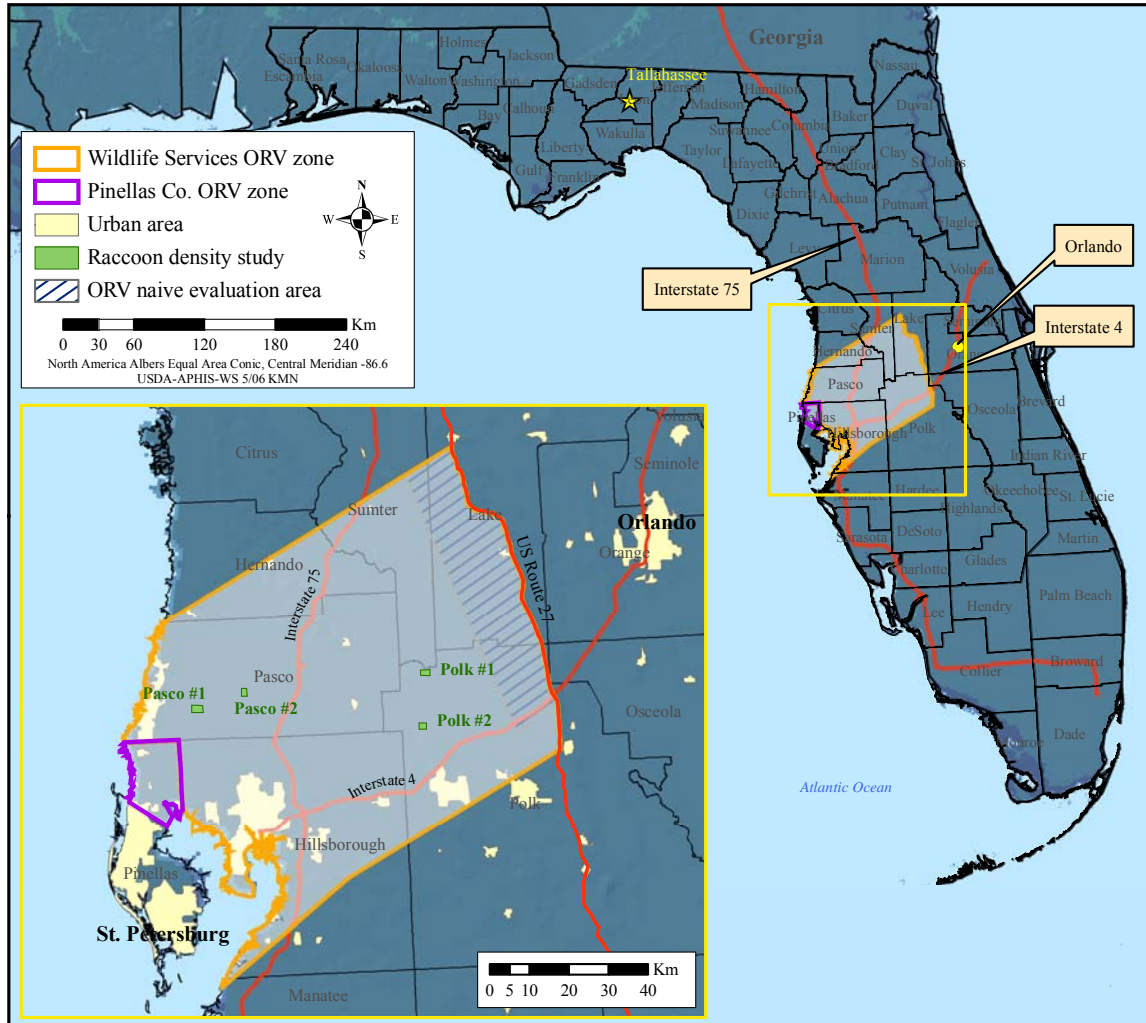


Figure 1. Wildlife Services cooperative rabies management program activities in Florida, 2005.

Wildlife Services (WS) began an ORV program on the Gulf coast in central Florida in 2003. The objective of the Florida WS Cooperative Rabies Management Program was to expand on the success of the Pinellas County ORV Program by establishing a vaccination zone in areas of high human population along the Interstate 4 corridor (Figure 1). The ORV program in Florida constitutes an important southern component in WS' National Rabies Management Program (NRMP).

In 2005, WS worked cooperatively with the Florida Department of Agriculture and Consumer Services (FDACS), Division of Animal Industry; the Florida Department of Health (FDH); 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 2005 ORV bait distribution efforts.

ORV PROGRAM 2005

Bait Distribution

For the third consecutive year in 2005, WS participated in bait distribution efforts throughout central Florida; 652,041 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 7,662.1 km² (2,959.5 mi²). The ORV zone included portions of Hernando, Hillsborough, Lake, Orange, Osceola, Pasco, Pinellas, Polk, and Sumter Counties. During 23 February and 1 March 2005 bait distribution efforts, 332,640 fishmeal polymer (FMP) baits were distributed by air (both helicopter and fixed-wing), while 318,969 FMP baits were distributed by hand (30,240 of those in Pinellas County). Another 432 baits (216 fishmeal-coated sachets [CS] and 216 FMP) were placed in bait stations in Pasco County.

In 2005, aerial bait distribution occurred at a rate of 75 baits/km² east of Interstate 75, and at a rate of 150 baits/km² west of I-75 (Figure 1). Aircraft and flight crews for the 2005 ORV program were provided by the Ontario Ministry of Natural Resources. Ground and aerial baiting support were provided by WS, the FDACS, and county and municipal agencies.

Since its program inception in 2003, WS has distributed 1,805,228 ORV baits in Florida.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Florida WS personnel plan to schedule dRIT training late in 2006 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

Population Monitoring

Wildlife Services conducted 4 raccoon density studies in 2005 using the NRMP standard protocol of 50 cage traps set on a target study area of 3 km² for 10 consecutive nights; 2 each in Polk and Pasco Counties (Figure 1 inset). All studies coincided with post-ORV trapping. Blood samples were collected from 162 unique raccoons (Table 1) and sent to the CDC for rabies virus neutralizing antibody (VNA) testing. One raccoon was euthanized at the landowner's request and 1 relatively old raccoon, with no teeth for aging, was found dead near a trap during these studies. Neither animal was tested for rabies. All remaining raccoons (160) were immobilized, processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Table 1. Index to raccoon densities in Polk and Pasco Counties in Florida, 2005.

	Polk #1	Pasco #1	Polk #2	Pasco #2
Macrohabitat	Forest	Forest	Urban	Urban
Trap nights	500	500	500	500
Unique raccoons	23	42	49	48
Recaptured raccoons	17	38	27	40
Total raccoons	40	80	76	88
Trap success ^a	4.6%	8.4%	9.8%	9.6%
Non-target captures	50	9	9	24
Area (km ²)	3.29	2.72	2.44	4.56
Raccoon density index ^b	7	15	20	11

^a Trap success = (unique raccoons ÷ trap nights) x 100.

^b Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

ORV Naïve Monitoring

Wildlife Services refers to areas that have never been treated with ORV as “ORV naïve.” In January 2005, WS began raccoon trapping in an ORV naïve area that included the land between the eastern edge of the 2004 ORV zone and U.S. Route 27, with the north and south boundaries being extrapolated from the 2004 ORV zone boundaries (Figure 1 inset). Tooth and blood serum samples from 78 raccoons were collected for age analysis and to measure the baseline presence of rabies VNA in this ORV naïve area. All raccoons were immobilized, processed and released.

Post-ORV Monitoring

In April 2005, WS conducted post-ORV trapping and collected 389 raccoon tooth and blood serum samples. One young (approximately 4-8 weeks old) raccoon died under care and 6 raccoons were euthanized because they were acting sick. Two of these raccoons tested negative for rabies; the other 4 were not tested. All remaining raccoons (382) were immobilized, processed and released.

ORV Bait Uptake Study

Florida WS started testing the uptake of FMP and CS baits in late 2005. Tracking stations were designed with specifications from Rick Engeman of WS' National Wildlife Research Center in Fort Collins, Colorado to mimic the distribution of baits by fixed-wing aircraft. Each station was made by tilling up a 1 m² (10.8 ft²) piece of soil to remove dense ground vegetation. One ORV bait was placed in the middle of each sandy plot. Two study zones were established, 1 each on the east and west sides of I-75. Each study zone consisted of 6 sites, each containing 24 stations, totaling 144 stations in each zone. Half of the stations in each zone were baited with FMP baits, while the other half were baited with CS baits. The stations in the zone east of I-75 were monitored for 1 week in October, while the stations west of I-75 were monitored for 1 week in December. The zone east of I-75 was actually baited twice due to disturbance by Hurricane Wilma; all 144 stations received new baits after the hurricane, as FMP baits were eroded and worn while CS baits were devoid of any fishmeal coating. All results were collected after the hurricane. Fishmeal polymer baits were taken more often than CS baits and raccoons took the most bait in both study zones (Table 2).

Table 2. Results of an oral rabies vaccine bait uptake study in Florida, 2005.

Bait type	Stations east of I-75		Stations west of I-75	
	FMP ^a	CS ^a	FMP	CS
Bait stations	72	72	72	72
Baits taken	69 (95.8%)	58 (80.6%)	67 (93.1%)	62 (86.1%)
Baits taken by raccoons	34 (47.2%)	20 (27.8%)	42 (58.3%)	36 (50.0%)

^a FMP=fishmeal polymer; CS=coated sachet.

Opossum Sampling

Opossums (*Didelphis virginiana*) are the most common non-target animal trapped in Florida during ORV program evaluation and they frequently compete with raccoons for ORV baits. Wildlife Services has been sampling a small number of opossums in Florida since 2004 to understand what type of impact they may have on raccoon bait uptake.

Tooth and blood serum samples were collected from 27 opossums during the 2005 raccoon density studies in Florida. Twenty-two testable tooth samples were collected and 18 (81.8%) showed presence of the tetracycline bait biomarker. Three of the 27 opossums (11.1%) demonstrated a positive rabies antibody response (≥ 0.05 IU).

Non-target Captures

In 2005, non-targets were marked with spray paint at the base of the tail, enabling WS personnel to identify the number of unique animals in an area. Non-target animals captured included: 69 opossums, 6 gray foxes (*Urocyon cinereoargenteus*), 5 marsh rabbits (*Sylvilagus palustris*), 5 nine-banded armadillos (*Dasypus novemcinctus*), 2 domestic/feral cats (*Felis catus*), 2 turkey vultures (*Cathartes aura*), 2 turtles (*Testudines* spp.), 1 North American bullfrog (*Rana catesbeiana*), and 1 rat (*Rattus* spp.).

Two feral cats were euthanized during post-ORV sampling at a landowner's request. One opossum was euthanized due to a prolapsed rectum during a density study. Two armadillos and 1 rat were also euthanized at a landowner's request.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Florida cooperates with the FDH Laboratory (FDHL) and the CDC.

Florida Department of Health Laboratory.--The FDHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Animal Control Officers). The FDHL tested 3,787 animals for the rabies virus in 2005 (Table 3), representing a 3.0% increase from the number of samples tested statewide in 2004. Animals were submitted from all 67 counties throughout the state, including the 7 ORV counties and 9 adjacent counties: Charlotte, Citrus, De Soto, Hardee, Highlands, Lee, Manatee, Osceola, and Sarasota. Of the animals tested statewide, 41.2% came from within or adjacent to the ORV zone, representing a 1.6% increase from the number of samples tested within or adjacent to the ORV zone in 2004.

Raccoons, skunks (*Mephitidae* spp.), foxes, coyotes (*Canis latrans*), and bobcats (*Lynx rufus*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 80.5% of the animals tested for rabies in Florida in 2005 are reported by WS as "other." For a full listing of animals tested from Florida in 2005 by the FDHL please visit:

www.doh.state.fl.us/disease_ctrl/epi/rabies/chart.html

Table 3. Animals tested for rabies by the Florida Department of Health Laboratory via the public health surveillance system in Florida, 2005.

	Statewide	Within and adjacent to Florida ORV zone
Raccoons	626	199 (31.8%)
Skunks	13	0
Foxes	93	46 (49.5%)
Coyotes	2	0
Bobcats	4	2 (50.0%)
Other ^a	3,049	1,312 (43.0%)
Total	3,787	1,559 (41.2%)

^a Other animals included: alpaca, bats, bears, boars, cats, coatimundi, cows, deer, dogs, ferrets, gophers, guinea pigs, hamsters, horses, lemur, llamas, mice, mink, mules, opossums, otters, panthers, pigs, prairie dogs, rabbits, rats, rhinos, squirrels, and wolf-dog hybrids.

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA.

One enhanced surveillance brainstem sample from Florida WS was submitted to the CDC for rabies testing in 2005; a gray fox creating a nuisance within the ORV zone and not involved in a human or domestic animal exposure incident. At the request of the homeowner, an Animal Control Officer captured the animal and WS submitted the brainstem to the CDC.

The CDC also analyzed 626 blood serum samples for rabies VNA submitted by Florida WS in 2005. This represented a 47.3% increase from the 425 samples submitted by WS in 2004. The Florida ORV program anticipates similar numbers of submissions to this laboratory in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2005 – EVALUATION

Florida's 2005 ORV bait distribution occurred in February and 2005 program evaluation data (serology, tetracycline, and age results) were available at the time of this report.

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

ORV Naïve Evaluation.--During 2005 ORV naïve trapping, 78 raccoon serum samples were collected and 7 (9.0%) demonstrated a positive rabies VNA response (≥ 0.05 IU). Tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA) and 1 of 68 samples submitted showed the presence of tetracycline biomarker. This raccoon was trapped approximately 1.5 km (<1 mi) from the border of the 2004 ORV zone, potentially explaining the presence of the tetracycline biomarker. Age analysis on 59 teeth indicated a population dominated (55.9%) by yearlings and 2-year-old raccoons.

Post-ORV and Population Monitoring Evaluation.--Serum samples from 548 raccoons were collected 5-13 weeks following the 2005 ORV bait distribution in Florida (Table 3). Of these samples, 17.5% demonstrated a positive rabies VNA response. This was down from a 26.6% positive response following the 2004 ORV bait distribution. In addition, tooth samples were collected from 517 raccoons for tetracycline analysis (also sent to Matson's Laboratory LLC). Of these samples, 28.6% indicated a presence of tetracycline. This was up from 13.8% presence of tetracycline following the 2004 ORV bait distribution.

Table 3. Serology and tetracycline biomarker results of raccoon biological samples collected during post-ORV and population monitoring evaluation in Florida, 2005.

	Post-ORV	Polk #1	Pasco #1	Polk #2	Pasco #2
Unique raccoon captures	389	23	42	49	48
			Serology		
Testable blood samples	387	23	42	48	48
Positive rabies antibody response (≥ 0.05 IU)	45 (11.6%)	8 (34.8%)	19 (33.3%)	8 (16.7%)	16 (33.3%)
			Tetracycline		
Testable tooth samples	365	23	40	48	41
Presence of tetracycline biomarker	109 (29.9%)	7 (30.4%)	15 (37.5%)	3 (6.3%)	14 (34.1%)

Age Results .--In 2005, 510 teeth were collected from raccoons during the 4 density studies and post-ORV trapping (Figure 2). Yearlings and 2-year-old raccoons dominated the age class distribution in Florida.

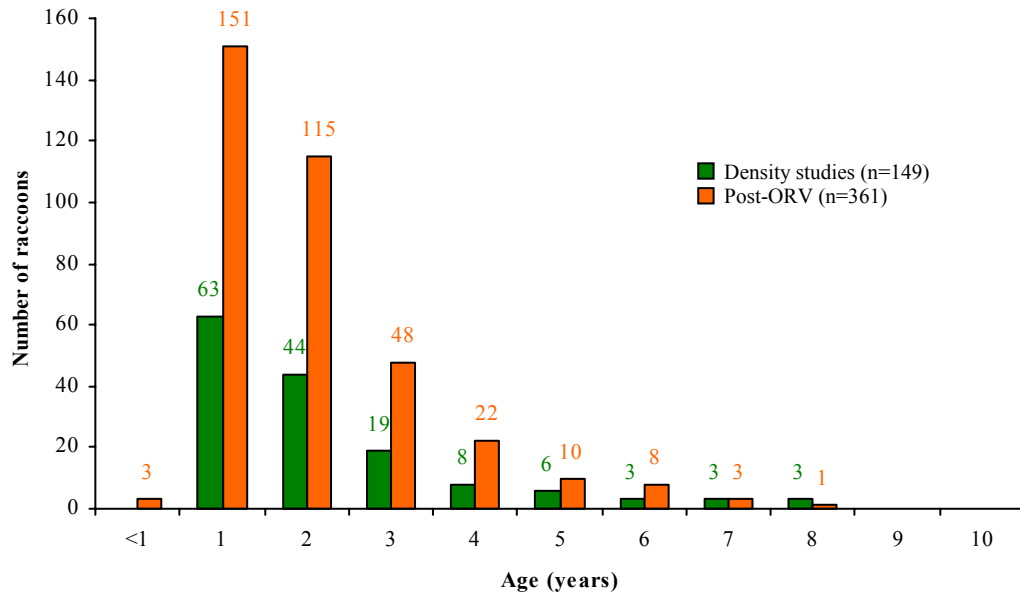


Figure 2. Age class distribution of 510 raccoon tooth samples collected during post-ORV trapping and density studies in Florida, 2005.

SUMMARY

During 2005, WS completed its fourth year of cooperative participation in rabies management in Florida. The focus of activities this year was ORV bait distribution and resuming raccoon density studies in the bait zone area. The ORV zone in Florida this year was the largest to date. Since WS' involvement in the Florida cooperative rabies management program began in 2003, over 1.8 million ORV baits have been distributed.

In 2006, Florida's baiting efforts will continue to be an extension of the successful Pinellas County ORV program. Enhanced surveillance and relative density studies will be increased in the coming year, with efforts to resume more ORV bait uptake studies.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM GEORGIA 2005

BACKGROUND

Raccoon (*Procyon lotor*) rabies was first documented in Florida in 1947. 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 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 2003, forming the Georgia-Alabama-Tennessee (GAT) ORV zone (Figure 1).

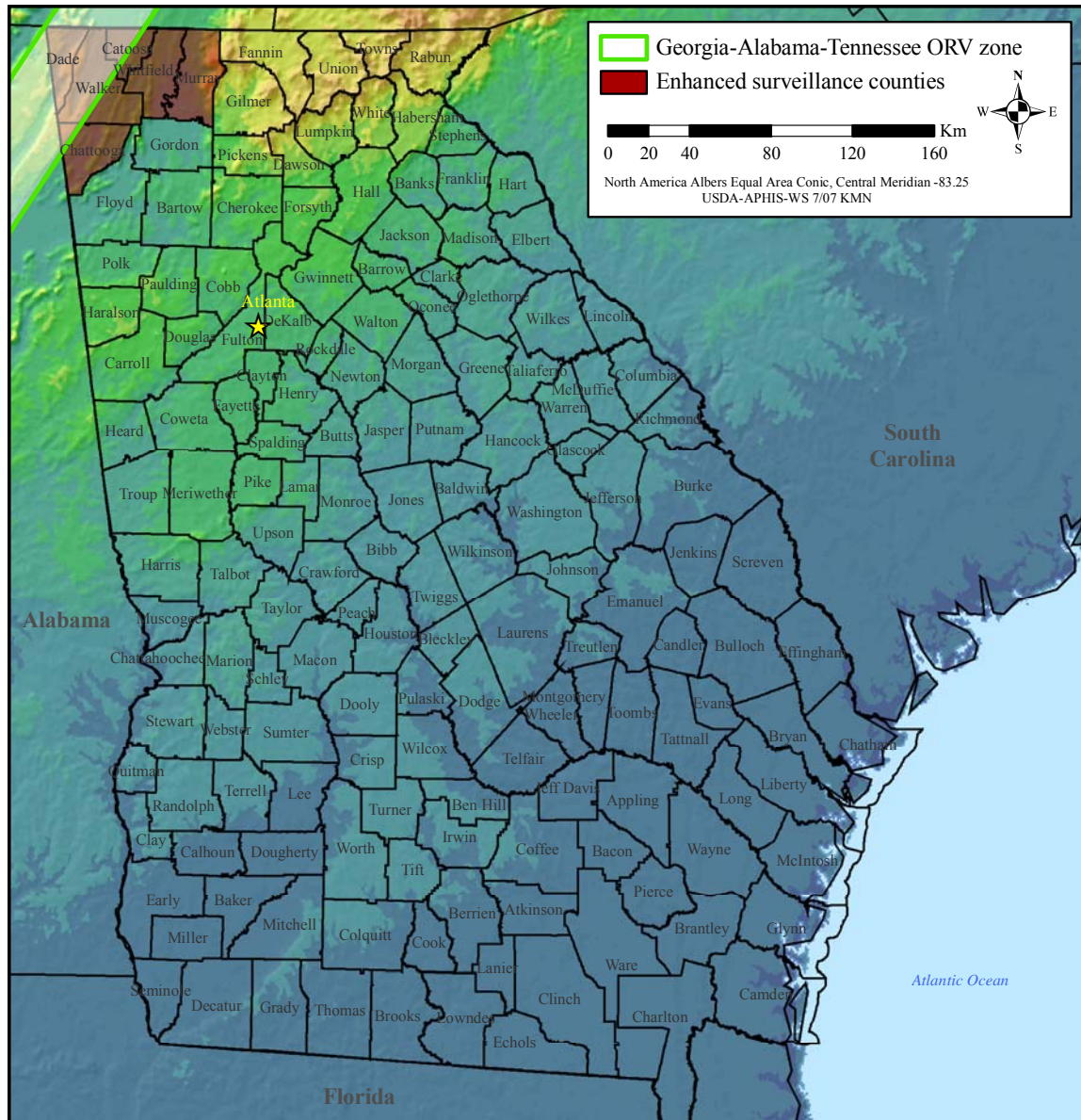


Figure 1. Wildlife Services cooperative rabies management program activities in Georgia, 2005.

Since that time, WS' major cooperators on the Georgia rabies management program have been the: Georgia Department of Human Resources Public Health Division (GDHR); the Georgia Department of Natural Resources; the Georgia Department of Agriculture; and the Centers for Disease Control and Prevention (CDC). In 2005, 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 participated in various aspects of the ORV program including providing public information, assisting with aerial and ground bait distribution, and enhancing rabies surveillance.

ORV PROGRAM 2005

Bait Distribution

For the third consecutive year, WS participated in bait distribution efforts in northwestern Georgia; 88,884 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 1,471.8 km² (568.3 mi²). The ORV zone included portions of Catoosa, Chattooga, and Walker Counties, and all of Dade County (Figure 1). During 22-26 October 2005 bait distribution efforts, 61,884 fishmeal polymer (FMP) baits were distributed by fixed-wing aircraft, while 27,000 FMP baits were distributed by hand.

Since its program inception in 2003, WS has distributed 289,116 ORV baits in Georgia.

Enhanced Surveillance

In 2005, WS continued enhanced rabies surveillance in the northwestern part of the state by collecting 216 samples from road killed, abnormally behaving, and nuisance animals submitted by local animal control agencies in 6 counties (Figure 1). All animals were submitted to the CDC for rabies testing and included the following species: raccoon, striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), bat (*Chiroptera* spp.), coyote (*Canis latrans*), domestic/feral cat (*Felis catus*), mink (*Mustela vison*), and red fox (*Vulpes vulpes*) (Table 1). Four of 216 animals (1.9%) submitted were positive for the rabies virus. Two raccoons and 1 skunk were positive for the raccoon variant of rabies, while 1 bat was positive for a bat variant.

Table 1. Animals collected for rabies testing (positives in parentheses) by Wildlife Services in northwestern Georgia, 2005.

County	Raccoon	Skunk	Gray fox	Bat	Coyote	Cat	Mink	Red fox	Total
Catoosa	70 (1)	13 (1)	2	1					86 (2)
Chattooga	6								6
Dade	15	1	3		1				20
Murray	1								1
Walker	80 (1)	6	5	4 (1)	2	1	1	1	100 (2)
Whitfield	2	1							3
Total	174 (2)	21 (1)	10	5 (1)	3	1	1	1	216 (4)

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Georgia WS personnel attended dRIT training in April 2005 at the CDC in Atlanta, Georgia. If resources are available, Georgia WS hopes to implement the test in 2006.

Post-ORV Monitoring

In December 2005, WS conducted post-ORV trapping in Catoosa, Dade, and Walker Counties. Cage traps were used, over 1,044 trap nights, to capture 137 unique raccoons and collect tooth and blood serum samples from 137 of those raccoons. One raccoon was euthanized and 3 were found dead in traps. All 4 raccoons tested negative for the rabies virus. All remaining raccoons (133) were immobilized, processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 163 opossums (*Didelphis virginiana*), 57 domestic/feral cats, 6 striped skunks, 2 domestic dogs (*Canis familiaris*), and 1 gray squirrel (*Sciurus carolinensis*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Georgia cooperates with the GDHR Public Health Laboratory (PHL) and the CDC.

Georgia Department of Human Resources Public Health Laboratory.--The PHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). The PHL confirmed 251 cases of rabies in Georgia in 2005. The number of animals tested for rabies statewide was unknown at the time of printing, but 58 animals were submitted from the 4 ORV counties (Table 2). The 5 animals that tested positive for rabies within the ORV bait zone were located on the eastern edge of the zone. For more information on historical animal rabies cases in Georgia please visit:

<http://health.state.ga.us/epi/disease/rabies.asp>

Table 2. Submissions to the Georgia Department of Human Resources Public Health Laboratory for rabies testing from counties treated with oral rabies vaccine in Georgia, 2005.

County	Submissions	Rabies Positive
Catoosa	15	2 (1 raccoon, 1 dog) 13.3%
Chattooga	7	1 (skunk) 14.3%
Dade	6	0
Walker	30	2 (1 raccoon, 1 skunk) 6.7%
Total	58	5 (2 raccoons, 2 skunks, 1 dog) 8.6%

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA).

In 2005, the CDC tested 216 wildlife brainstem samples submitted by Georgia WS (Table 1). This was a 3.6% decrease from the 224 brainstems submitted by Georgia WS in 2004. Georgia WS also submitted 137 blood serum samples for rabies VNA analysis to the CDC in 2005. This represented a 5.4% increase from the 130 samples submitted by WS in 2004. The Georgia ORV program anticipates similar numbers of brainstem and serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage:

<http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Georgia's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

Serum samples from 130 raccoons were collected 4-7 weeks following the 2004 ORV bait distribution in Georgia. Of these samples, 33 (25.4%) demonstrated a positive rabies VNA response (≥ 0.05 IU). This was down from a 30.2% positive response following the 2003 ORV bait distribution. In addition, 130 tooth samples were

collected from raccoons but had not been sent to Matson's Laboratory LLC (Milltown, Montana, USA) for tetracycline biomarker analysis and aging at the time of printing.

SUMMARY

During 2005, WS completed its third year of cooperative participation in rabies management in Georgia. Work emphasized ORV bait distribution, enhanced surveillance of raccoon rabies, and post-ORV monitoring and evaluation in northwestern Georgia. Since WS' involvement in the Georgia cooperative rabies management program began in 2003, nearly 300,000 ORV baits have been distributed and the program has continued to receive positive support from both cooperators and the general public.

Future ORV baiting strategies in Georgia will continue to be directed towards halting the spread of raccoon rabies into the western U.S. The Georgia ORV zone will continue to be tied to national and international planning efforts to contain the disease and explore strategies to eliminate the raccoon variant of the rabies virus from North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM KANSAS 2005

BACKGROUND

Kansas has 1 terrestrial variant of the rabies virus in striped skunks (*Mephitis mephitis*) and another variant in bats (*Chiroptera* spp.). The South Central skunk variant is enzootic over nearly all of the state. In 2005, Kansas confirmed 80 cases of rabies in the state; striped skunks accounted for 56 (70.0%) of those cases. Despite a 19.2% decrease from the 99 statewide cases reported in 2004, the need for more information on rabies epidemiology in Kansas remains high. In 2003, the Kansas Wildlife Services (WS) program, Kansas State University College of Veterinary Medicine (KSUCVM) Rabies Lab and the Fort Riley Military Installation (FRMI) began a cooperative effort to collect information on the striped skunk population found on the FRMI in northeast Kansas (Figure 1).

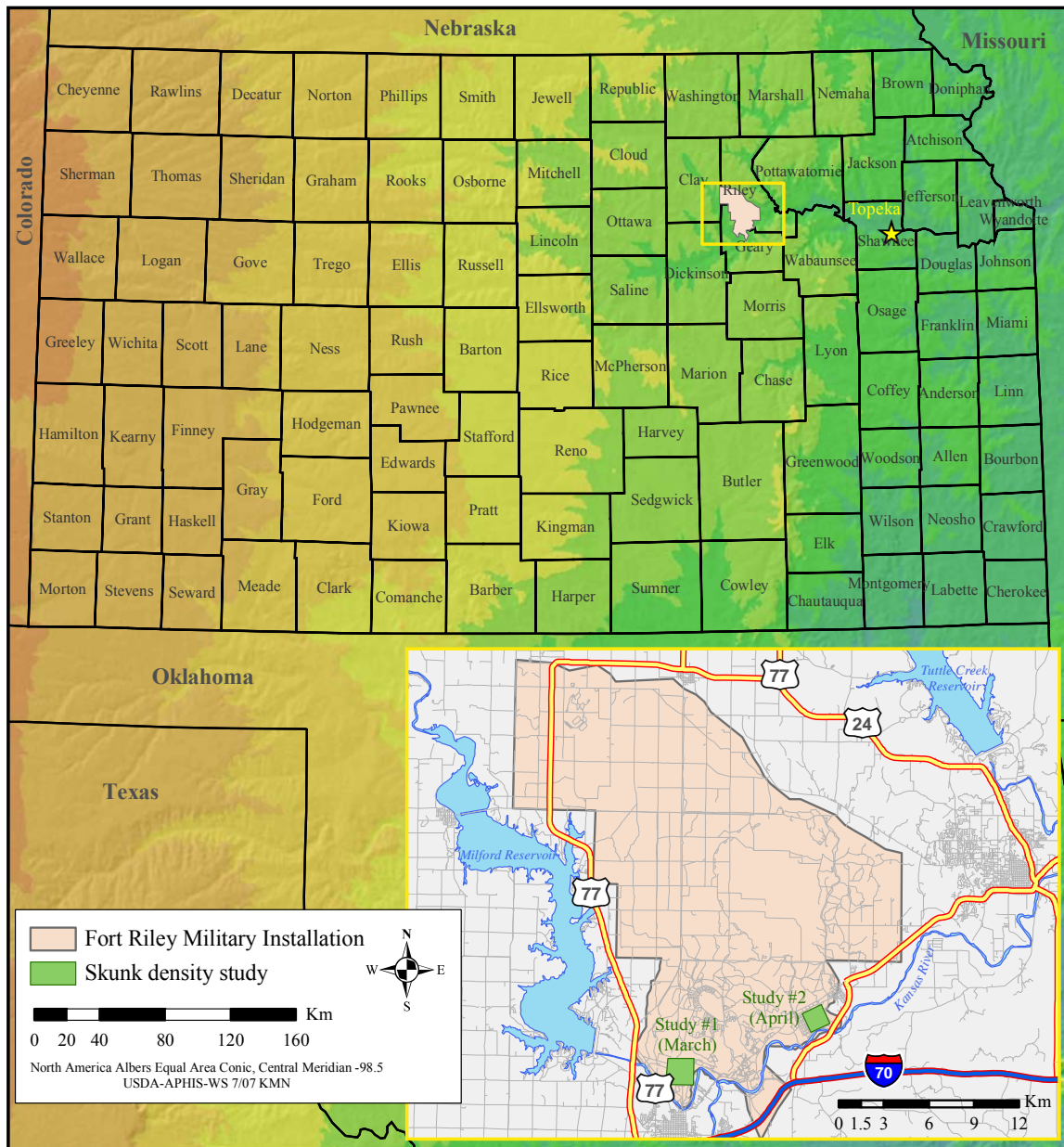


Figure 1. Wildlife Services cooperative rabies management program activities in Kansas, 2005.

Wildlife Services has a full time Wildlife Biologist stationed at the FRMI who regularly removes several skunks each year while responding to routine nuisance animal complaints on the installation. Due to WS' existing presence at the fort, and the nature of the land available to sample both urban and rural animal populations, the FRMI is an ideal location to monitor rabies and conduct density studies of striped skunks and raccoons (*Procyon lotor*).

RABIES MANAGEMENT PROGRAM 2005

Bait Distribution

There is currently no oral rabies vaccination (ORV) bait distribution program in Kansas.

Enhanced Surveillance

As nationwide research continues to find a more effective oral rabies vaccine for use in skunks, the Kansas WS program has focused much of its efforts on enhancing rabies surveillance to better define the distribution and prevalence of the virus on the FRMI. With a population of anywhere between 20,000-30,000 soldiers, families and civilians, the FRMI is considered the ninth largest "city" in the state. Citizens of Fort Riley report all nuisance animal problems 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 indirect rabies surveillance. Due to the unique situation at the FRMI described above, and a reporting system already in place, the WS biologist stationed there has access to most potentially diseased animals. Over the last several years, WS has collected 1-3 rabid striped skunks annually.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, WS is not planning training or implementation of the dRIT because the KSUCVM is meeting enhanced surveillance testing needs.

Population Monitoring

Wildlife Services has conducted several striped skunk density studies in Kansas by modifying the National Rabies Management Program (NRMP) protocol for raccoon density studies. Each study has consisted of 50 cage traps set over a target study area of 3 km² and baited with dry cat food. Traps were not relocated during the 10-day studies (the raccoon protocol calls for traps to be relocated every 2-3 days if they have not captured a unique raccoon).

During 2003-2004, WS conducted 5 skunk density studies (3 in the rural training areas of Fort Riley and 2 in a heavily populated urban area on the FRMI). Indices to skunk density across the 5 studies were similar regardless of habitat type (approximately 1-2 skunks/km²). In 2005, WS conducted 2 skunk density studies on sites with similar suburban habitats located near the Kansas River (Figure 1). While 21 unique striped skunks were captured, 20 unique raccoons were also captured during the 2 studies (Table 1). All skunks and raccoons were euthanized in 2005 at the request of the FRMI. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations. The number of raccoon captures has been consistently high, relative to skunk captures, since studies began in 2003 (139 raccoons vs. 47 skunks). This could be due in part to the NRMP density study protocol, which was originally designed for raccoons. As skunk research and density studies continue, there may be a need for a dedicated skunk density protocol.

Table 1. Index to skunk densities on the Fort Riley Military Installation, Geary and Riley Counties, Kansas, 2005.

	Study #1 (March)	Study #2 (April)
Macrohabitat	Suburban	Suburban
Trap nights	500	500
Unique skunks	8	13
Unique raccoons	2	18
Trap success of skunks ^a	1.6%	2.6%
Non-target captures	16	6
Area (km ²)	3.11	1.94
Skunk density index ^b	2.6	6.7

^a Trap success = (unique skunks ÷ trap nights) x 100.

^b Skunk density index (skunks/km²) = unique skunks ÷ area.

Other Rabies Management Program Activities

There are hundreds of buildings on the FRMI that both humans and resident big brown bats (*Eptesicus fuscus*) occupy. Historically, nuisance bats were excluded and/or relocated from buildings and only bats involved in a human exposure were euthanized for rabies testing. In 2004, in cooperation with a Department of Defense (DOD) biologist, WS initiated a basic monitoring program to determine the prevalence of rabies in the local bat population on the FRMI. In 2005, WS continued to remove a select few bats from various buildings and euthanize them for rabies testing; there have been no positives.

Non-target Captures

Non-target animals captured and euthanized by WS in 2005 included: 22 opossums (*Didelphis virginiana*) and 7 feral cats (*Felis catus*). All animals were euthanized at the request of the DOD for nuisance complaint reasons.

Non-target animals captured and released by WS in 2005 included 1 American badger (*Taxidea taxus*).

Rabies Laboratory Cooperation

The KSUCVM operates the state's public health rabies surveillance laboratory. They test animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by the public) and enhanced surveillance (specimens not involved in an exposure and often submitted by WS).

The KSUCVM Rabies Lab tested 1,177 animals for the rabies virus in 2005 from Kansas (Table 2); the Lab serves as the rabies testing facility for Nebraska as well. The number of samples tested in 2005 represented a 1.2% decrease from the number of samples tested in Kansas in 2004. Animals were submitted from 81 of 105 (77.1%) counties throughout the state, including Geary and Riley Counties (where the FRMI is located).

Skunks, raccoons, foxes (*Canidae* spp.), coyotes (*Canis latrans*), and bobcats (*Lynx rufus*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance in support of ORV. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 84.5% of the animals tested for rabies in Kansas in 2005 are reported by WS as "other." For a full listing of animals tested from Kansas in 2005 by the KSUCVM Rabies Lab please visit: www.vet.ksu.edu/depts/rabies/kansas.htm

Table 2. Animals tested for rabies by the Kansas State University College of Veterinary Medicine Rabies Lab in Kansas, 2005.

	Rabies Negative	Rabies Positive	Total Tested
Skunks	32	56	88 (63.6%)
Raccoons	87	0	87 (0%)
Foxes	0	2	2 (100%)
Coyotes	4	0	4 (0%)
Bobcats	2	0	2 (0%)
Other ^a	972	22	994 (2.2%)
Total	1,098	80	1,177 (6.8%)

^a Other animals included: alpaca, bat, cat, cow, deer, dog, elk, ewe, ferret, goat, groundhog, hamster, horse, llama, mole, monkey, mouse, opossum, pig, prairie dog, rabbit, rat, shrew, squirrel, tiger, wolf, and zebra.

SUMMARY

During 2005, WS completed its third year of cooperative participation in rabies management in Kansas, and specifically on the FRMI. Cooperators at Fort Riley and the KSUCVM continue to support the efforts made by WS to enhance rabies surveillance in skunks and bats. The FRMI is particularly interested in expanding the rabies monitoring effort for bats on the installation. Wildlife Services agrees and hopes to expand this effort in 2006 if funding is available.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM KENTUCKY 2005

BACKGROUND

Kentucky has 1 terrestrial variant of the rabies virus in striped skunks (*Mephitis mephitis*) and another variant in bats (*Chiroptera* spp.). The North Central skunk variant is enzootic over most of the state. In 2002, Wildlife Services (WS) began participating in a cooperative rabies management program in Kentucky as an integral part of the National Rabies Management Program to stop the westward spread of the raccoon (*Procyon lotor*) variant of the rabies virus. In an effort to obtain baseline information on raccoon populations in Kentucky and actively search for raccoon rabies west of the Appalachian Ridge (AR) oral rabies vaccination (ORV) zone, WS began conducting raccoon density studies and enhancing rabies surveillance in the eastern counties bordering Ohio, Virginia, and West Virginia. Since 2002, WS has continued to collect road killed animals to enhance rabies surveillance in eastern Kentucky. To date, no positive cases of raccoon rabies have been documented in the state.

Activities conducted by WS are in cooperation with the Kentucky Department of Fish and Wildlife Resources (KDFWR), the Kentucky Department of Public Health (KDPH), and the Centers for Disease Control and Prevention (CDC).

RABIES MANAGEMENT PROGRAM 2005

Bait Distribution

There is currently no ORV bait distribution program in Kentucky.

Enhanced surveillance

In 2005, WS cooperated with the KDFWR to conduct enhanced surveillance for the raccoon variant of rabies in 18 counties in eastern Kentucky (Figure 1). During these efforts, Kentucky WS collected and submitted 121 animals from 11 counties on road kill survey routes and fur harvest trap lines: 80 raccoons, 21 gray foxes (*Urocyon cinereoargenteus*), 10 coyotes (*Canis latrans*), 8 red foxes (*Vulpes vulpes*), and 2 striped skunks. All samples tested negative for the rabies virus.

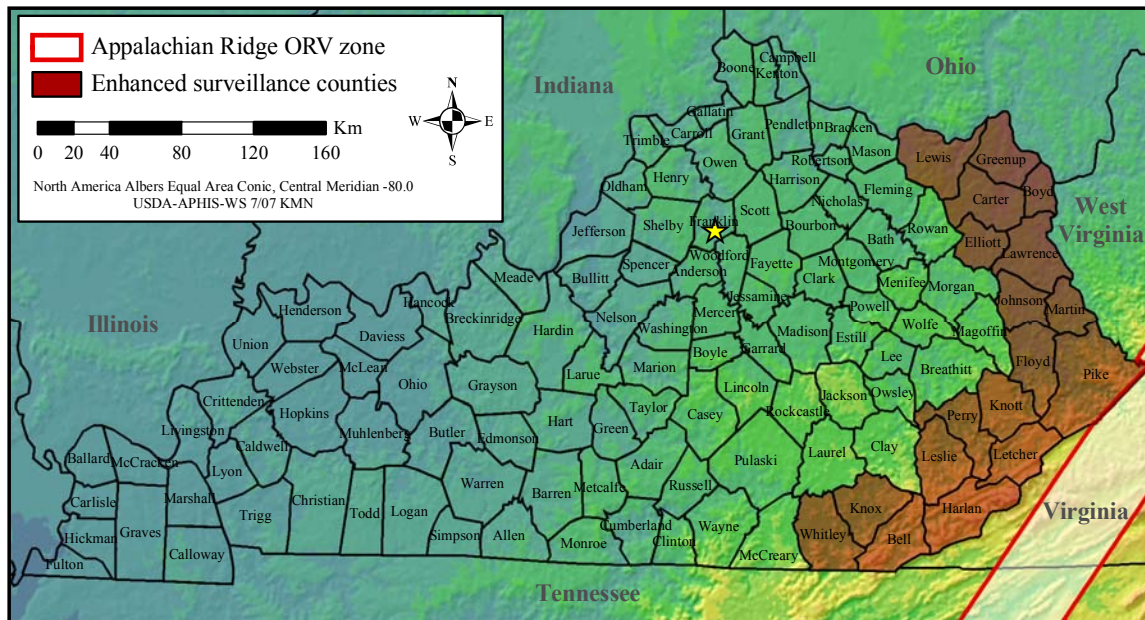


Figure 1. Wildlife Services cooperative rabies management program activities in Kentucky, 2005.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect

wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Wildlife Services personnel are scheduled for dRIT training in February 2006 at the CDC in Atlanta, Georgia. All enhanced surveillance samples collected by Kentucky WS personnel in 2006 will be tested using the dRIT.

Population Monitoring

No raccoon density studies were conducted in Kentucky during 2005.

Rabies Laboratory Cooperation

Wildlife Services' rabies surveillance program in Kentucky cooperates with the KDPH, Division of Laboratory Services (DLS) in Frankfort, the Breathitt Veterinary Center (BVC) at Murray State University in Hopkinsville, and the CDC.

Kentucky Department for Public Health, Division of Laboratory Services and the Breathitt Veterinary Center.--Both the DLS and the BVC are responsible for testing animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure). Positive samples from both labs are then sent to the CDC for rabies variant typing.

The DLS and BVC tested 935 animal brainstem samples for the rabies virus in 2005 (Table 1). This represents an 11.2 % decrease from the number of samples tested in 2004. The 2005 samples were submitted from 114 of 120 counties in Kentucky and from 15 counties within the designated enhanced rabies surveillance zone.

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 84.1% of the animals tested for rabies in Kentucky in 2005 are reported by WS as "other." For more information on rabid animals by county in 2005 please visit: <http://chfs.ky.gov/dph/epi/rabies.htm>

Table 1. Animals tested for rabies by the Kentucky Department for Public Health, Division of Laboratory Services and the Breathitt Veterinary Center at Murray State University in Kentucky, 2005.

	Statewide	Within Wildlife Services' enhanced rabies surveillance zone
Raccoons	99	7 (7.1%)
Skunks	22	0 (0%)
Foxes	21	1 (4.8%)
Coyotes	7	0 (0%)
Other ^a	786	53 (6.7%)
Total	935	61 (6.5%)

^a Other animals included: bats, cats, cattle, chipmunks, deer, dogs, donkeys, gerbils, goats, groundhogs, guinea pigs, hamsters, horses, mink, moles, muskrats, opossums, rabbits, rats, sheep, squirrels, weasels, and zebras.

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The brainstem samples collected by Kentucky WS and submitted to the CDC for rabies testing in 2005 are described above, under *Enhanced Surveillance*. The Kentucky rabies surveillance program anticipates no brainstem submissions to the CDC in 2006 due to implementation of the dRIT. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

SUMMARY

During 2005, WS completed its fourth year of participation in cooperative rabies management efforts in Kentucky. The focus of activities continued to be collection of road killed or suspect rabid animals to enhance rabies surveillance west of the existing AR ORV zone (Figure 1).

In 2006, WS will increase enhanced surveillance for the raccoon variant of rabies in eastern Kentucky by recruiting state and local entities to collect unusual acting and road killed animals. Surveillance efforts will continue to be concentrated in 18 counties bordering Ohio, West Virginia, and Virginia. Additional raccoon density studies will be conducted to compare population characteristics between northeastern and southeastern Kentucky.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM LOUISIANA 2005

BACKGROUND

To date, there have been no reported cases of the raccoon (*Procyon lotor*) variant of rabies in Louisiana, although other variants including bat (*Chiroptera* spp.) and striped skunk (*Mephitis mephitis*) do occur. In an effort to detect possible entry of raccoon rabies into the state, Wildlife Services (WS) reinitiated surveillance of road killed animals in Washington and St. Tammany Parishes in July 2005 (Figure 1).

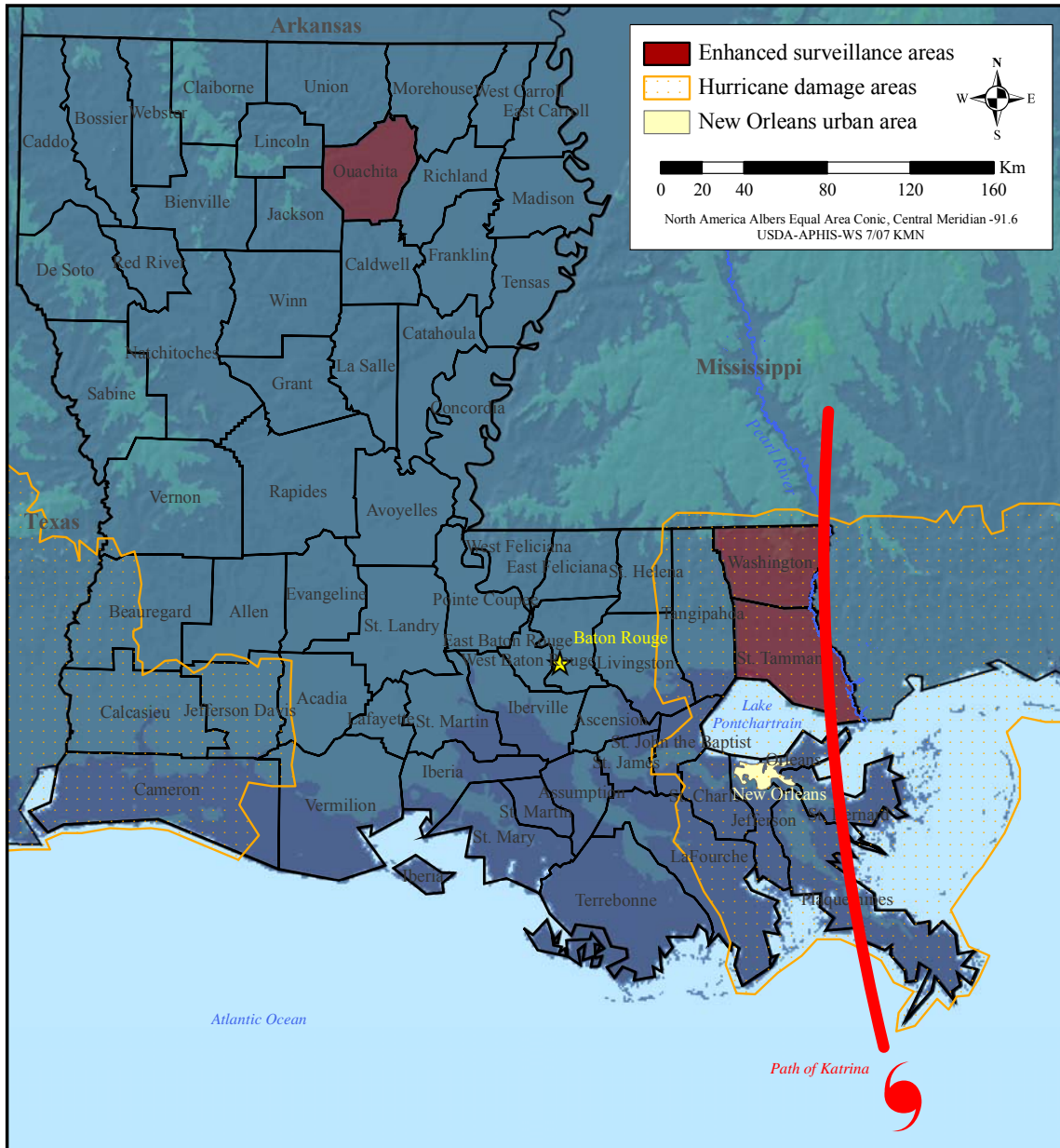


Figure 1. Wildlife Services cooperative rabies management program activities in Louisiana, 2005.

RABIES MANAGEMENT PROGRAM 2005

Bait Distribution

There is currently no oral rabies vaccination (ORV) bait distribution program in Louisiana.

Enhanced Surveillance

From 5 July-25 August 2005, a WS specialist completed road and highway surveys in Washington and St. Tammany Parishes to collect road killed raccoons and other small carnivores for enhanced rabies surveillance. During those weeks, 7 raccoons were collected by WS, while St. Tammany Parish Animal Control collected 1 raccoon and 1 bobcat (*Lynx rufus*). Additional road killed raccoons were observed but were not processed due to advanced deterioration or excessive damage. All 9 animals tested negative for the rabies virus. Due to damage from Hurricane Katrina (Figure 1) all survey activities were suspended on 26 August.

In late summer 2005, WS' Monroe District Office received calls of sick raccoons from the Monroe/West Monroe area in Ouachita Parish (Figure 1). Brainstem samples were collected from 6 abnormally behaving raccoons in Ouachita Parish and all tested negative for rabies. Those animals were then suspected of having canine distemper; brainstem samples were sent to the Animal Health Diagnostic Center at Cornell University in Ithaca, New York. The samples were tested on 18 October 2005 and 5 of 6 (83.3%) were confirmed positive for the canine distemper virus. Wildlife Services also collected 15 brainstems from raccoons that were removed because of nuisance complaints in Ouachita Parish. All 15 animals tested negative for the rabies virus.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

One Louisiana WS employee attended dRIT training in May 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia and implemented the test on 17 November 2005. During 2005, WS collected 30 samples for rabies testing from 3 parishes (21 in Ouachita, 6 in St. Tammany, 3 in Washington) and all tested negative by WS using the dRIT. No samples were sent to the CDC for confirmation in 2005. Louisiana WS will continue to use the dRIT in 2006 and all positives, 10% of all negatives, and all indeterminate samples will be sent to the CDC for confirmation and strain typing. Additionally, Louisiana WS plans to have 2 or 3 more personnel trained in dRIT procedures.

Rabies Laboratory Cooperation

Louisiana regulations require that testing for rabies be conducted when human exposures are involved. Testing for other exposures is not mandatory. The Louisiana Department of Health and Hospitals (LDHH) is responsible for carrying out mandates related to required rabies testing. The LDHH and WS have expressed interest in continued and expanded cooperation on rabies issues; however, the agencies do not jointly conduct any rabies projects at this time.

During 2005, the LDHH tested 882 animals for the rabies virus (Table 1). Three skunks and 4 bats from outside of WS' enhanced rabies surveillance zone tested positive. These rabid animals did not have the raccoon variant of the rabies virus.

Raccoons, skunks, foxes (*Canidae* spp.), and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 94.9% of the animals tested for rabies in Louisiana in 2005 are reported by WS as "other." For more information on historical rabies cases in Louisiana please visit:

http://www.dhh.louisiana.gov/offices/miscdocs/docs-249/recent/LaIDAnnual_Rabies2003.pdf

Table 1. Animals tested for rabies by the Louisiana Department of Health and Hospitals for public health surveillance in Louisiana, 2005.

	Statewide	Within Wildlife Services' enhanced rabies surveillance zone ^a
Raccoons	32	5 (15.6%)
Skunks	9	0 (0%)
Foxes	3	0 (0%)
Coyotes	1	1 (100%)
Other ^b	837	61 (7.3%)
Total	882	67 (7.6%)

^a St. Tammany and Washington Parishes.

^b Other animals included: bats, cats, cattle, deer, dogs, ferrets, goats, gophers, horses, jaguars, minks, mice, opossums, rabbits, rodents (other than mice), squirrels, and wolves.

SUMMARY

In 2005, WS completed its third year of participation in cooperative rabies management efforts in Louisiana by continuing enhanced rabies surveillance work in 2 gulf coast parishes. A rabies specialist was trained to use the dRIT and set up an operational lab in Monroe. Wildlife Services managed to test 9 usable samples from the enhanced surveillance zone despite 2 devastating hurricanes in that area (Figure 1). Valuable knowledge was gained from conducting the dRIT in 2005 and will be incorporated into surveillance efforts in 2006.

Wildlife Services plans for 2006 include: expanding the survey area to include the Louisiana parishes and Mississippi counties on either side of the Pearl River (Figure 1); conducting road and highway surveillance over more consecutive days to reduce the possibility of advanced sample deterioration; conducting night shooting activities on rivers or streams within the surveillance area; conducting trapping activities within the surveillance area; and training 2-3 more individuals in the dRIT procedures. These planned activities should aid in the effort to detect possible entry of the raccoon variant of rabies into Louisiana and southwestern Mississippi.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MAINE 2005

BACKGROUND

Maine's history of the raccoon (*Procyon lotor*) variant of rabies began in 1994 and the number of documented cases has fluctuated from a low of 10 (in 1994) to a high of 248 (in 1998). During the past 5 years, the number of rabies cases has remained fairly steady, ranging from 60 to 85. The distribution of these rabies cases are primarily in the southern counties of Maine. This pattern of few to no cases documented in northern Maine may have several contributing factors: human population dynamics; rabies surveillance efforts; and raccoon population distribution. Approximately 75% of Maine's residents live in the southern half of the state (Figure 1). The human dimension adds both food and shelter aiding raccoon survival and reproductive success (Prange et al. 2003). In addition, people provide an increased potential for human-wildlife interaction resulting in better rabies reporting and surveillance in that area.

In 2000, 2 rabid raccoons were confirmed in Calais, Maine along the United States-Canada border. In the fall of 2000, the raccoon variant of the rabies virus was confirmed for the first time ever in New Brunswick, Canada (St. Stephen, directly across the St. Croix River from Calais, Maine) (Figure 1). In 2001, the New Brunswick Department of Health (NBDH) initiated a Wildlife Rabies Control Program (involving trap-vaccinate-release [TVR] efforts) on the Canada side of the border to contain the spread of raccoon rabies in New Brunswick. In 2002, Maine WS began participating in a cooperative rabies management program to initially determine the distribution and prevalence of raccoon rabies along the Maine-New Brunswick border and into northern Maine. Wildlife Services implemented oral rabies vaccination (ORV) efforts in August 2003 to stop the northward spread of raccoon rabies in Maine and the eastward spread into New Brunswick.

The WS rabies management program in Maine is a cooperative effort among Cornell University (CU), the Maine Department of Health and Human Services (MDH), the Maine Department of Agriculture, the Maine Department of Inland Fisheries and Wildlife, the NBDH, and WS. The Ontario Ministry of Natural Resources (OMNR) has provided aircraft and flight crews for ORV bait distribution since 2003. Numerous private landowners in Maine have provided WS access to their properties for program evaluation (trapping and enhanced rabies surveillance).

ORV PROGRAM 2005

Bait Distribution

For the third consecutive year in 2005, WS participated in ORV bait distribution efforts in northeastern Maine; 45,737 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 747.3 km² (288.5 mi²) (Figure 1). The ORV zone included portions of Penobscot and Washington Counties and averaged 16 km (10 mi) wide and 40 km (25 mi) long.

On 27 August 2005, 45,497 fishmeal polymer (FMP) baits were distributed by fixed-wing aircraft at a rate of 70 baits/km², while 240 FMP baits were distributed by hand in the towns of Danforth and Vanceboro, Maine. Aircraft and flight crews for the 2005 ORV program were provided by the OMNR. Since its program inception in 2003, WS has distributed 419,337 ORV baits in Maine.

Enhanced Surveillance

In 2005, WS conducted enhanced rabies surveillance to help monitor the movement of raccoon rabies in northern Maine. Surveillance methods included road kill surveys and the collection of sick or suspicious acting animals that had no contact with humans or domestic animals. A network of agencies and individuals aware of the cooperative rabies management program has been established to help WS collect and submit animals in and around the ORV zone and from areas of Maine where raccoon rabies has not yet been documented. During 2005, WS provided sample collection logistics and funding to test 59 animals (52 raccoons, 5 striped skunks [*Mephitis mephitis*], 1 red fox [*Vulpes vulpes*], and 1 snowshoe hare [*Lepus americanus*]) from northern Maine. All samples tested negative for the rabies virus.

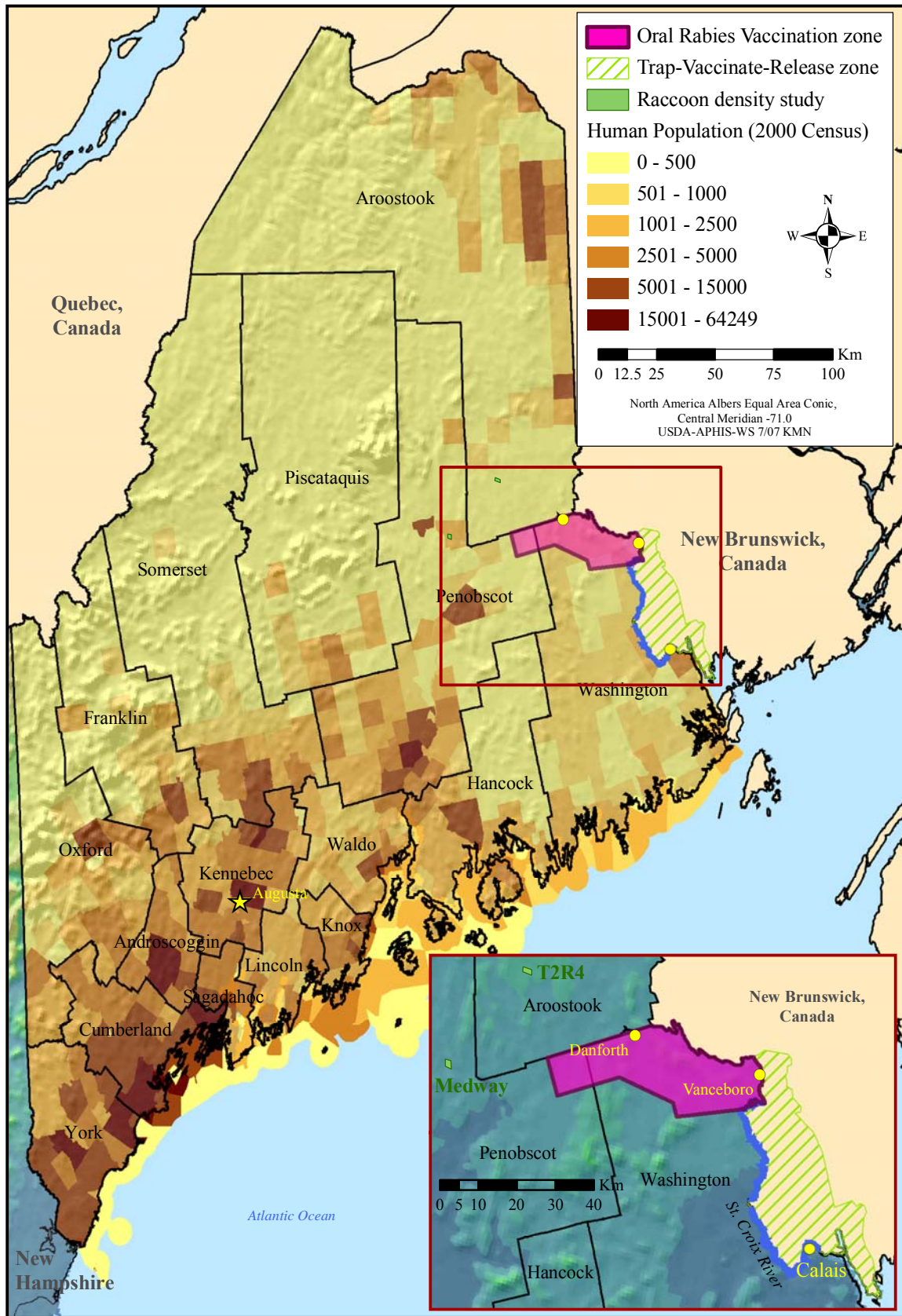


Figure 1. Wildlife Services cooperative rabies management program activities in Maine, 2005.

During enhanced surveillance efforts, 10 raccoons were reportedly displaying symptoms of rabies (e.g., lethargy, paralysis, disorientation, aggressiveness) prior to being euthanized or found dead. After these raccoons tested negative for rabies, they were suspected of having canine distemper virus (CDV). Brainstem samples were sent to the Animal Health Diagnostic Center at CU in Ithaca, New York and all 10 were confirmed positive for the CDV. Wildlife Services will continue to monitor this trend of CDV in northern Maine raccoon populations.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turn around and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Maine personnel attended dRIT training in May 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, GA. Wildlife Services has always submitted enhanced rabies surveillance samples to the MDH Health and Environmental Testing Laboratory (HETL) in Augusta, Maine. In 2005, WS conducted 10 trial tests using the dRIT in parallel to samples tested by the HETL using the dFA test. Wildlife Services dRIT test results had 100% agreement with the HETL's results using the dFA (all 10 samples tested negative).

Population Monitoring

From 2002 to 2004, WS conducted 7 raccoon density studies in northeastern Maine using the National Rabies Management Program (NRMP) standard protocol (50 live traps over a target study area of 3 km² for 10 consecutive nights). During those 7 studies, the index to raccoon density averaged 4 raccoons/km² (with a low of 1 raccoon/km² in Codyville to a high of 6 raccoons/km² in Hodgdon, both in 2002). An NRMP low density protocol (which involves 5 consecutive nights of trapping instead of 10) was established in 2005 to eliminate futile effort in areas where raccoon densities are believed to be ≤ 1 raccoon/km².

In 2005, WS conducted 2 raccoon density studies in Maine: 1 from 18-23 July in Township 2 Range 4 WELS (T2R4) using the low density protocol; and 1 from 2-12 August in Medway using the standard density protocol (Figure 1). Over 250 trap nights, the T2R4 study yielded 1 unique raccoon (an adult male) for a density index of 0.33 raccoons/km². Over 500 trap nights, the Medway study yielded 14 unique raccoons (10 adult males and 4 adult females) for a density index of 4.7 raccoons/km².

All 15 raccoons, as well as 1 skunk, trapped during density studies prior to annual ORV were processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Post-ORV Monitoring

During 26 September and 14 October 2005, WS conducted post-ORV trapping in Penobscot and Washington Counties. Cage traps were used, over 1,000 trap nights, to capture 85 raccoons and 4 skunks and collect tooth and blood serum samples from all of them. All raccoons and skunks were immobilized, processed and released.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 17 snowshoe hares, 9 red squirrels (*Tamiasciurus hudsonicus*), and 3 domestic cats (*Felis catus*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Maine cooperates with the MDH HETL and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC).

Maine Department of Health and Human Services, Health and Environmental Testing Laboratory.--The HETL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or

confirmed exposure) at no cost to the public. The HETL has provided in-kind services to test enhanced rabies surveillance samples (specimens not involved in an exposure and submitted by WS) over the last 4 years. The lab is available 24 hours a day for specimen drop off and results are routinely available the same day the test is conducted. The HETL tested 667 animals statewide in 2005 and confirmed 61 cases of rabies in Maine (Table 1).

Raccoons, skunks, foxes, and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 73.9% of the animals tested for rabies in Maine in 2005 are reported by WS as “other.” For more information on current and historical animal rabies cases in Maine (by year, county, town, and species) please visit:

<http://www.maine.gov/dhhs/etl/rabies/rabies.htm>

Table 1. Animals tested for rabies by the Maine Department of Health and Human Services, Health and Environmental Testing Laboratory in Maine, 2005.

	Number tested	Number rabies positive
Raccoons	117	37 (31.6%)
Skunks	43	21 (48.8%)
Foxes	11	0
Coyotes	3	0
Other ^a	493	3 (0.6%)
Total	667	61 (9.1%)

^a Other animals included: bats; beaver; deer; mouse; chipmunk; fisher; bobcat; mink; muskrat; porcupine; squirrel; weasel; and domestic alpaca, cats, cows, dogs, donkey, ferret, goat, horse, lamb, rabbit, and wolf hybrid.

New York State Department of Health’s Rabies Laboratory at the Wadsworth Center.--The WC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). In 2005, Maine WS submitted 105 blood serum samples (100 raccoons and 5 skunks) for rabies VNA analysis to the WC. This represented an 18% decrease from the 128 samples submitted by WS in 2004. The Maine ORV program anticipates similar numbers of serum sample submissions to the WC in 2006. For more information about the Rabies Laboratory at the WC please visit: <http://www.wadsworth.org/rabies/>

The timeliness of test results from both laboratories enhances rabies management planning and program analysis concurrent with real-time program implementation. Wildlife Services has had an efficient and cooperative relationship with both laboratories since 2003, and they remain critical to the surveillance and monitoring phases of the ORV program in Maine.

ORV PROGRAM 2004 – EVALUATION

Maine’s 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (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; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, during the evaluation phase of the Maine cooperative rabies management program, WS live-trapped 128 unique raccoons within the ORV bait zone (Table 2). Blood and tooth samples were collected from most of these animals and serum samples were sent to the WC, while tooth samples were sent to Matson’s Laboratory LLC (Milltown, Montana, USA).

Table 2. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during the cooperative rabies management program in Maine, 2004.

	Staceyville density study ^a	Hodgdon density study ^a	Post-ORV monitoring	Total
Sample collection timeframe	19-30 Jul.	24 Aug.-3 Sep.	27 Sep.-15 Oct.	2004
Weeks post-ORV	47-48	52-53	3-6	
Last ORV date (and bait type) ^b	24 Aug 03 (CS)	24 Aug 03 (CS)	3 Sep 04 (FMP)	
Unique raccoons	12	11	105	128
	Serology			
Testable blood samples	12	11	105	128
Positive rabies antibody response (≥ 0.05 IU)	2 (16.7%)	3 (27.3%)	62 (59.0%)	67 (52.3%)
	Tetracycline			
Testable tooth samples	12	10	103	125
Presence of tetracycline biomarker	0	0	61 (59.2%)	61 (48.8%)

^a Study conducted prior to annual ORV bait distribution activities.

^b CS=coated sachet; FMP=fishmeal polymer.

Age Results.--In 2004, 125 raccoon teeth were aged using premolars of live-captured animals and canines of animals found dead or euthanized (Figure 2). These samples were collected from raccoons in the Maine ORV zone.

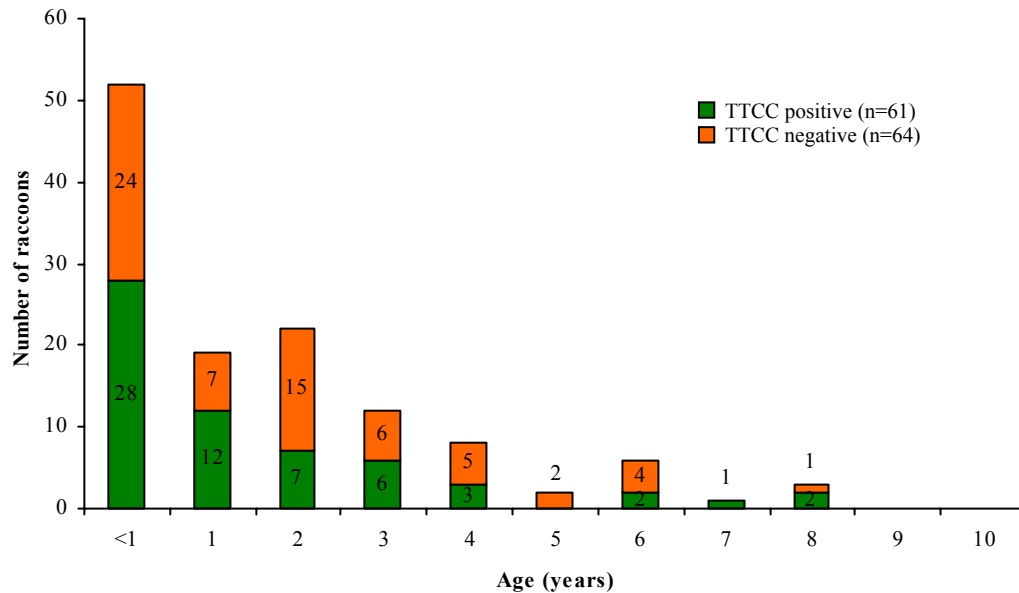


Figure 2. Age class distribution and presence of tetracycline (TTCC) biomarker of 125 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program in Maine, 2004.

SUMMARY

In 2005, WS completed its fourth year of participation in a cooperative rabies management program in northeastern Maine. The ORV zone in Maine has been positioned north and east of the area currently infected with the raccoon variant of the rabies virus. The placement of Maine's ORV zone is a northern continuation of neighboring New Brunswick, Canada's trap-vaccinate-release (TVR) zone. Together, the international effort to stop the northward and eastward spread of rabies covers approximately 100 km (62 mi) of the Maine and New Brunswick border. Since March 2002, after implementing their large scale TVR program, New Brunswick has remained free of raccoon rabies.

In 2006, WS will fully implement the dRIT to continue enhanced rabies surveillance and help raise public awareness of rabies in northeastern Maine. Wildlife Services will also continue coordination with New Brunswick to plan ORV strategies for preventing the spread of raccoon rabies along, and across, the international border and ultimately eliminate terrestrial rabies in Maine.

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WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MARYLAND 2005

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 (AACDH) 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 (Figure 1). This is a cooperative effort between WS and the AACDH. Wildlife Services provides the major source of funds for project implementation.

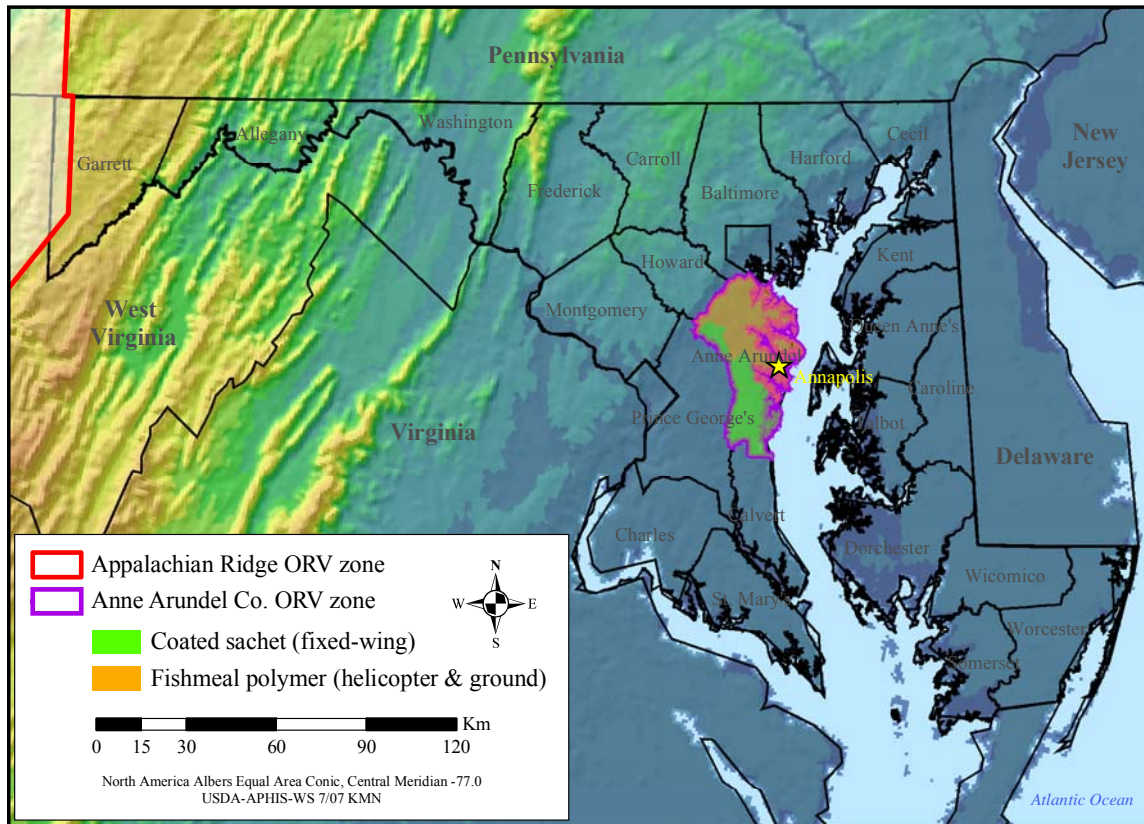


Figure 1. Wildlife Services cooperative rabies management program activities in Maryland, 2005.

In 2003, the Appalachian Ridge (AR) ORV project expanded the eastern boundary from West Virginia into Garrett County, Maryland. To date, WS has distributed 72,432 FMP baits in Garrett County as part of the AR ORV zone that extends from Lake Erie to Tennessee.

ORV PROGRAM 2005

Bait Distribution

For the third consecutive year, WS participated in bait distribution efforts in eastern (Anne Arundel County) and western (Garrett County) Maryland; 94,156 baits were distributed over 1,330 km² (518 mi²) in 2005 (Figure 1).

Anne Arundel County.--The 2005 ORV efforts included all of Anne Arundel County (1,080 km² [421 mi²]), with 81,144 ORV baits (51,120 FMP and 30,024 fishmeal coated sachets [CS]) distributed (Figure 1). The CS baits were all distributed by fixed-wing aircraft on 26 September. From 8-18 August and 15-22 September 39,335 FMP baits were distributed by helicopter. From 9-10 August and 12-23 September ground teams distributed 11,785 FMP baits by hand. The fixed-wing aircraft and pilots were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA) and the helicopter and pilots were provided by the Anne Arundel County Police Department. Baiting efforts and support were provided by WS and the AACDH.

Appalachian Ridge.--The Maryland portion of the AR ORV zone was baited during the greater AR south campaign. From 9-16 August, WS distributed 13,012 FMP baits by fixed-wing aircraft over 250.3 km² (96.6 mi²) in Garrett County. The fixed-wing aircraft and pilots were provided by Dynamic Aviation, while WS provided ground support and served as navigators and flight crew in the plane.

Enhanced Surveillance

Wildlife Services collected blood serum and tooth samples from 15 raccoons that were collected through nuisance wildlife control efforts in Anne Arundel County. A tooth sample was also collected from 1 road killed raccoon in Anne Arundel County. These raccoons were not tested for rabies.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Maryland WS personnel may schedule dRIT training late in 2006 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

Post-ORV Monitoring

On 6 September 2005, WS initiated post-ORV trapping to collect blood and tooth samples to evaluate and monitor program success in Anne Arundel County. Over 840 trap nights, WS captured and released 196 unique raccoons, 1 gray fox (*Urocyon cinereoargenteus*), and 1 red fox (*Vulpes vulpes*). Blood and tooth samples were collected from all of these animals. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 45 opossums (*Didelphis virginiana*), 15 domestic/feral cats (*Felis catus*), 1 Eastern cottontail (*Sylvilagus floridanus*), 1 Eastern box turtle (*Terrapene carolina*), and 1 snapping turtle (*Chelydra serpentina*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Maryland cooperates with the Maryland Department of Health and Mental Hygiene's Laboratories Administration (MDH) and the CDC.

Maryland Department of Health and Mental Hygiene's Laboratories Administration.--The MDH tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). The MDH confirmed 380 cases of rabies in Maryland in 2005. The number of animals tested for rabies statewide was unknown at the time of printing, but 26 and 5 animals were confirmed positive from Anne Arundel and Garrett Counties, respectively. Raccoons represented 63.7% of all animals that tested positive for rabies in Maryland in 2005. For more information on rabies cases by county and species in Maryland (from 2002-2005) please visit: http://edcp.org/vet_med/rabies.html

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). In 2005, the CDC analyzed 212 blood serum samples (including 210 raccoons and 2 foxes) for rabies VNA submitted by Maryland WS. This represented a 52.5% increase from the 139 samples submitted by WS in 2004. The Maryland ORV program anticipates 130-170 sample submissions to this laboratory in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Maryland's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

In 2004, during the evaluation phase of the Maryland cooperative rabies management program, WS live-trapped 139 raccoons within the Anne Arundel County ORV bait zone. Blood and tooth samples were collected from these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Samples were not collected from the AR ORV zone in Garrett County.

Raccoon blood sera are analyzed to detect rabies VNA (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; CS baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

Anne Arundel County.--Serum samples from 139 raccoons were collected 4-6 weeks following the 2004 ORV bait distribution in Anne Arundel County. Of these samples, 33 (23.7%) demonstrated a positive rabies VNA response (≥ 0.05 IU). This was down from a 28.3% positive response following the 2003 ORV bait distribution. In addition, tooth samples were collected from all 139 raccoons for tetracycline analysis. Of these samples, 36 (25.9%) indicated a presence of tetracycline biomarker. This was similar to the presence of tetracycline following the 2003 ORV bait distribution.

Age Results.--In 2004, 184 raccoon teeth were aged using premolars of live-captured animals and canines and premolars of animals found dead or euthanized (Figure 2). Tooth samples (139) were collected by WS during 2004 post-ORV trapping activities in Anne Arundel County, while 45 teeth were collected from raccoons removed by a Nuisance Wildlife Control Officer (NWCO) from the greater Annapolis area. The NWCO removed over 70 raccoons from a backyard outside of Annapolis that was adjacent to a county right-of-way "corridor" (i.e., railroad tracks and bike trail) that ran from Annapolis to Baltimore. The homeowner was apparently dumping bags of dried cat food on her back deck to feed the raccoons. She also had many raccoons living in her attic, as the NWCO reportedly removed 500 pounds of raccoon feces from the attic.

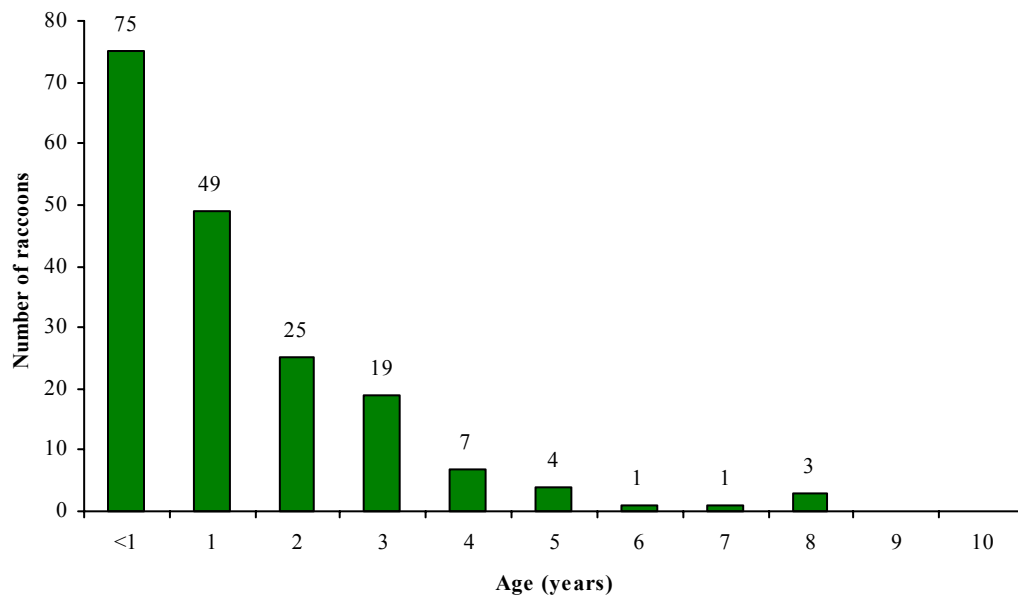


Figure 2. Age class distribution of 184 tooth samples collected by Wildlife Services during the evaluation phase of the cooperative rabies management program in Anne Arundel County, Maryland, 2004.

SUMMARY

The fall of 2005 marked the third year of the eastward expansion of the AR ORV program in Maryland, where WS distributed 13,012 FMP baits in Garrett County. The fall of 2005 also marked the fifth year of WS cooperative participation in the AACDH ORV program. During the 3 years prior to the beginning of the AACDH ORV program (1995-97), an average of 19 rabid animals were reported from the Annapolis Peninsula alone. Since 1998, with the intervention of 310,201 FMP baits, only 13 rabid raccoons have been reported from the Annapolis Peninsula, indicating the success of the Anne Arundel County ORV program.

In 2006, WS plans to continue its cooperative role in ORV bait distribution in Anne Arundel and Garrett Counties, and follow-up post-ORV surveillance trapping to evaluate the success of ORV in Maryland.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MASSACHUSETTS 2005

BACKGROUND

Wildlife Services (WS) continues to support the Cape Cod Oral Rabies Vaccination program (CCORV) in southeastern Massachusetts. This cooperative project among Tufts University (TU), Massachusetts Department of Public Health (MDPH), and the Barnstable County Department of Health and the Environment began in 1994 to reduce the incidence of terrestrial rabies in a 420-712 km² area adjacent to the Cape Cod Canal and to prevent the spread of rabies to Cape Cod, a heavily populated tourist destination south of Boston. Full time assistance from WS began in 2001 and has typically included bait purchase and distribution, membership on the Massachusetts state and Barnstable County Rabies Advisory Committees, surveillance trapping, and ORV-related wildlife research.

In 2004, the raccoon (*Procyon lotor*) variant of rabies was detected on the ocean-side of the canal and the CCORV operational area now includes all of Barnstable County (Figure 1).

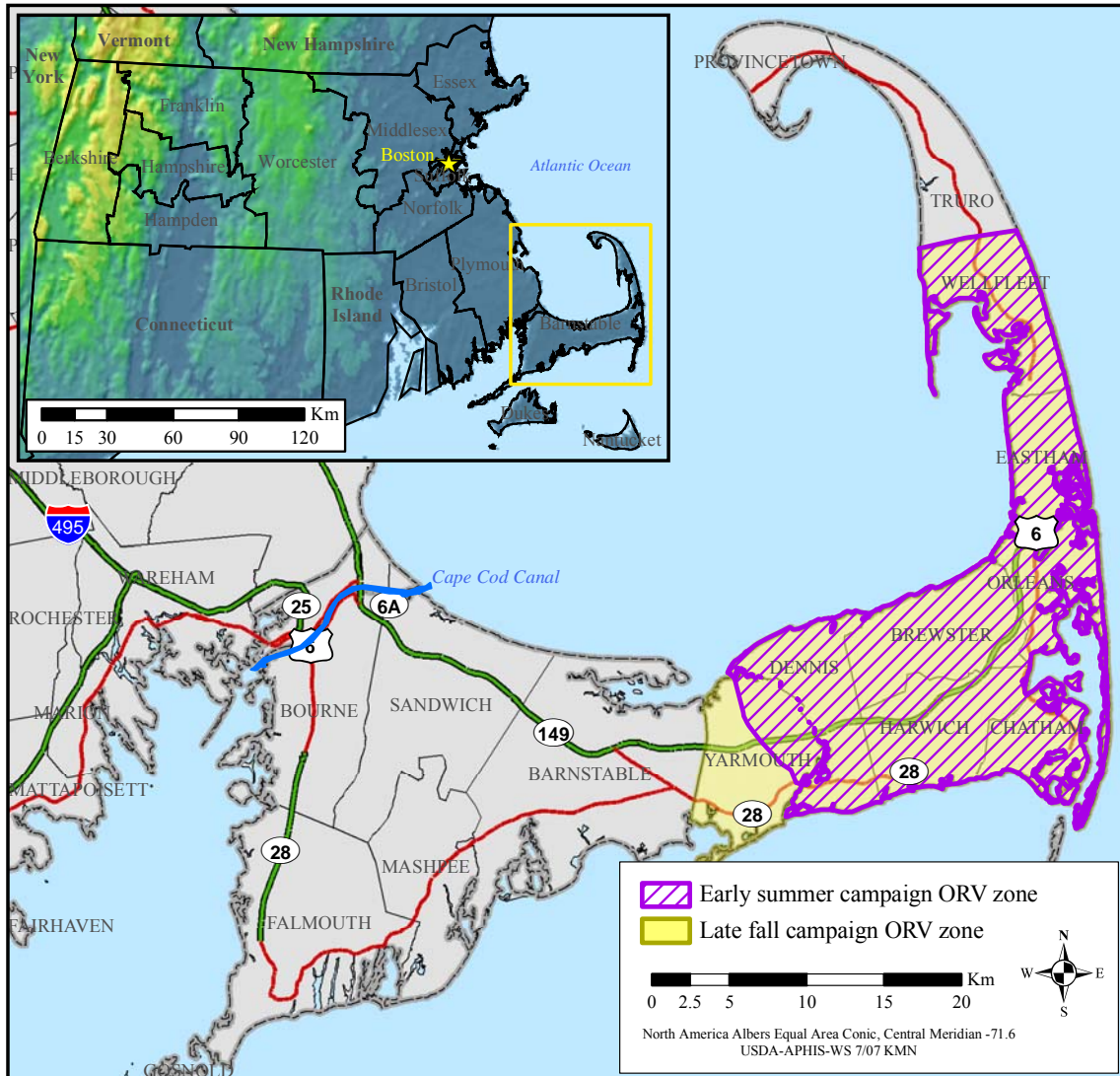


Figure 1. Wildlife Services cooperative rabies management program activities in Massachusetts, 2005.

ORV PROGRAM 2005

Bait distribution

For the fifth consecutive year, WS participated in the CCORV program. During 2 campaigns (early summer and late fall), WS and CCORV cooperators distributed 106,427 ORV baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) over approximately 412 km² (159 mi²) of Cape Cod (Figure 1). Aircraft and pilots for both CCORV campaigns in 2005 were provided by the U.S. Coast Guard, while WS served as flight crew in the helicopters. Community-based volunteers were an integral part of ground operations in 2005, distributing baits in residential areas by vehicle and on foot. All-terrain vehicles (ATVs) were used on the Cape Cod National Seashore to optimize ORV bait distribution and minimize disruption to sensitive beachfront shorebird nesting areas. Since its program inception in 1994, CCORV cooperators and WS have distributed 600,890 baits in Massachusetts.

Early Summer Campaign.--From 13 June-12 July 2005, an area of eastern Barnstable County (364.8 km² [140.9 mi²]) was baited with 49,392 ORV baits: 4,213 fishmeal-coated sachets (CS) via helicopter; 7,373 CS and 37,806 fishmeal polymer (FMP) via ground operations. This area was baited again in the fall 2005 (see *Late Fall Campaign* below).

Late Fall Campaign.--From 24 October-23 November 2005, the *Early Summer Campaign* was repeated and expanded to include 411.6 km² (158.9 mi²) of Barnstable County. This area was baited with 57,035 ORV baits: 5,490 CS via helicopter; 5,043 CS and 46,502 FMP via ground operations.

Enhanced Surveillance

In March 2004, WS and cooperators implemented an enhanced rabies surveillance program that continued through 2005 to track the rabies epizootic on Cape Cod for planning purposes, epidemiological data collection, and reduction of municipal infrastructure-based variation in specimen submissions. Primary activities of the CCORV enhanced surveillance program included the collection, preparation, and transportation of samples to the MDPH Laboratory Institute (LI) for rabies testing. These specimens were collected via public (residential) reports of sick or strange behaving animals to municipal officials, nuisance wildlife trapping, and road kill surveys.

Wildlife Services (with cooperator assistance) submitted 311 specimens (226 raccoons, 85 skunks [*Mephitis mephitis*]) to the MDPH LI as part of an enhanced rabies surveillance program on Cape Cod. However, 53 of those specimens (41 raccoons, 12 skunks) were not tested because the samples were unsuitable. Of the 258 samples tested, 85 (32.9%) tested positive for rabies (Table 1). While assisting municipal officials with enhanced rabies surveillance, WS euthanized 17 raccoons and 6 skunks upon request (they are included in the 311 specimens submitted for rabies testing). All animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Table 1. Prevalence of rabies in raccoon and skunk surveillance specimens tested by the Massachusetts Department of Public Health, Laboratory Institute from various sources on Cape Cod, Massachusetts, 2005.^a

Source	Raccoons submitted	Raccoons suitable for testing	Rabies positive raccoons ^b	Skunks submitted	Skunks suitable for testing	Rabies positive skunks ^b
Complaint-based: residential property	186	160	72 (45.0%)	71	64	6 (9.4%)
Road killed	19	7	2 (28.6%)	8	3	0
Complaint-based: commercial property	11	9	4 (44.4%)	2	2	0
Other ^c	4	3	1 (33.3%)	1	1	0
Unknown	6	6	0	3	3	0
Total	226	185	79 (42.7%)	85	73	6 (8.2%)

^a Does not include specimens submitted directly by municipal governments.

^b Percentage = (# rabies positive ÷ # animals suitable for testing) x 100.

^c Includes forested and recreation areas.

In addition to the raccoons and skunks represented in Table 1, the following animals were submitted for rabies testing from Cape Cod in 2005: 9 red foxes (*Vulpes vulpes*), 8 bats (*Chiroptera* spp.), 4 domestic/feral cats (*Felis catus*), 4 gray squirrels (*Sciurus carolinensis*), 3 opossums (*Didelphis virginiana*), 1 coyote (*Canis latrans*), 1 muskrat (*Ondatra zibethicus*), 1 river otter (*Lutra canadensis*), and 1 short-tailed shrew (*Blarina brevicauda*). The river otter tested positive for rabies, while all others tested negative. Most rabies specimens were handled by WS directly, but some were submitted by municipal officials and others.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Massachusetts WS personnel attended dRIT training in May 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. Test materials were purchased, and one limited test was conducted. However, an adequate space was not available for full-scale implementation of the dRIT during 2005. Efforts are currently underway to locate a new office/warehouse space which will accommodate the dRIT process. During 2005, WS collected 328 animals for rabies testing and 4 were tested by WS using the dRIT (1.2%). All 4 dRIT samples tested negative for rabies. Once full-scale dRIT use is underway, all positives, 10% of all negatives, and all indeterminate samples will be sent to the CDC for confirmation and strain typing.

Post-ORV Monitoring

In 2005, rabies surveillance efforts took precedence over post-ORV monitoring because the rabies epizootic appeared to be moving towards the outer portions of Cape Cod. Consequently, a series of ORV operations were conducted in advance of the active epizootic front, potentially biasing assessments of vaccination and bait uptake rates. Therefore, post-ORV trapping was conducted secondarily to the surveillance effort. During 2005, in 242 trap nights, 40 unique raccoons (exclusive of captures related to surveillance) and 1 unique skunk were captured and released on Cape Cod. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 4 opossums and 1 domestic/feral cat.

Rabies Laboratory Cooperation

Wildlife Services in Massachusetts cooperates with the MDPH LI and the CDC in support of the ORV program on Cape Cod.

Massachusetts Department of Public Health Laboratory Institute.--The LI tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Animal Control and Public Health Officials) and enhanced surveillance (specimens not involved in an exposure and usually submitted by WS from Barnstable and Plymouth Counties or municipal officials statewide). In 2005, the LI received 3,388 specimens for rabies testing, representing a 2.6% decrease from the number of samples received statewide in 2004. Animals were submitted from all 14 counties throughout the state and 329 tested positive for rabies in 2005 (Table 2). Of the animals tested statewide, 609 (18.0%) came from within the current ORV zone (Barnstable County), representing a 4.8% decrease from the number of samples submitted from Barnstable County in 2004. Although the number of raccoons submitted from Barnstable County in 2005 (358) was down when compared to 2004 (470), the percentage of raccoons testing positive in 2005 (36.3%) was up considerably from 2004 (21.9%).

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 72.3% of

the animals submitted for rabies testing in Massachusetts in 2005 are reported by WS as “other.” For a more detailed listing of rabid animals from Massachusetts in 2005 (and prior years dating back to 1992) please visit: <http://www.mass.gov/dph/cdc/epii/rabies/rabies.htm>

Table 2. Animals submitted for rabies testing to the Massachusetts Department of Public Health Laboratory Institute in Massachusetts, 2005.

	Submissions	Rabies Positive
Raccoons	552	207 (37.5%)
Skunks	313	69 (22.0%)
Foxes	68	11 (16.2%)
Coyotes	6	2 (33.3%)
Other ^a	2,449	40 (1.6%)
Total	3,388	329 (9.7%)

^a Other animals included: bats, cats, dogs, otters, woodchucks, and other species not listed.

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA in support of the CCORV program. Massachusetts WS will submit 34 blood serum samples (from 2005) for rabies virus neutralizing antibody (VNA) analysis to the CDC in 2006. Serum sample submissions were down by 92.9% from 2004 due to the extensive trap-vaccinate-release (TVR) effort in 2004, and the relative importance placed on rabies surveillance efforts in 2005. Massachusetts WS anticipates an increase in numbers of serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC’s rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Massachusetts’ 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (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; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, during the evaluation phase of the Massachusetts cooperative rabies management program, WS live-trapped 545 raccoons and 27 skunks within the ORV bait zones, during 2 separate ORV campaigns. Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson’s Laboratory LLC (Milltown, Montana, USA).

Spring 2004 Evaluation.--In March and April 2004, a series of ORV operations were conducted in advance of the active rabies epizootic front, while at the same time, an intensive TVR campaign was occurring. Some of the TVR operations occurred in areas that were previously ORV naïve and some occurred in areas that were being baited at that time or 1-4 weeks prior. These data may potentially bias assessments of vaccination and bait uptake rates. Serum samples from 533 raccoons and 23 skunks were collected from March-August 2004. The CDC received 497 serum samples (478 raccoons and 19 skunks) and 80 raccoons (16.7%) and 3 skunks (15.8%) demonstrated a positive rabies VNA response (≥ 0.05 IU). In addition, tooth samples were collected from 512 raccoons and 12 skunks for tetracycline analysis. Of these samples, 60 raccoons (11.7%) and 5 skunks (41.7%) indicated a presence of tetracycline biomarker.

Fall Post-ORV Evaluation.--Serum samples from 12 raccoons and 2 skunks were collected 2-3 weeks following the October 2004 ORV bait distribution on Cape Cod. Rabies VNA results were pending from the CDC at the time of printing. In addition, tooth samples were collected from 12 raccoons for tetracycline analysis. Of these samples, 1 (8.3%) raccoon indicated a presence of tetracycline biomarker.

Age Results.--In 2004, 481 raccoon teeth were aged using premolars of live-captured animals collected during spring TVR and fall post-ORV trapping activities (Figure 2). Matson's Lab assumes a raccoon birth date of May 1 for aging purposes. Therefore, animals captured in March and April of the following year are 10-11 months old and are reported in Figure 2 as <1 y.o. These animals, however, were not "young of the year" (as is usually assumed with a raccoon <1 y.o.). In addition, 12 skunks were aged and most were 1 or 2 years old.

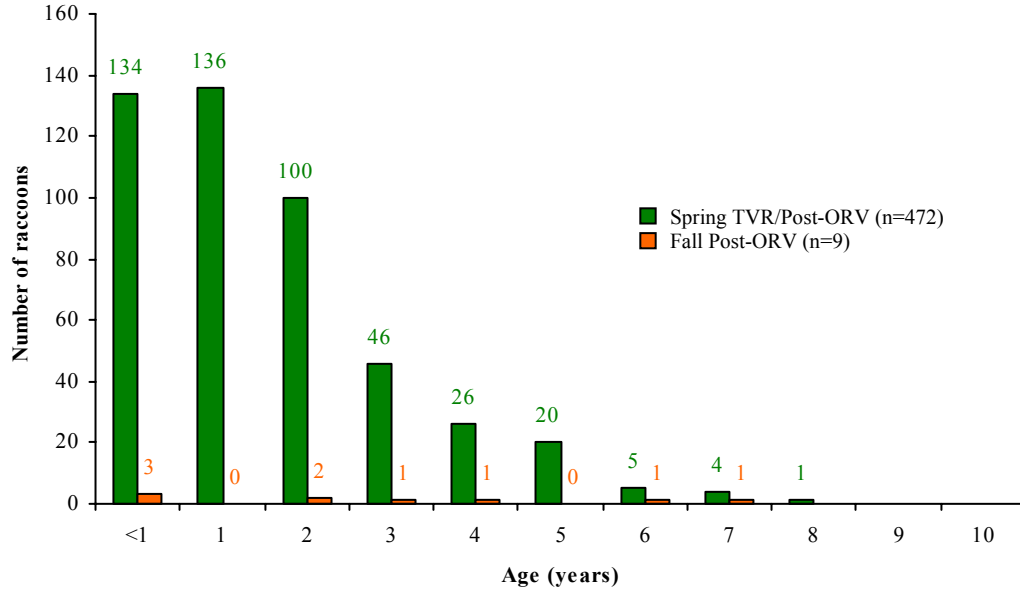


Figure 2. Age class distribution of 481 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program on Cape Cod, Massachusetts, 2004.

ORV PROGRAM 2003 – EVALUATION

Tetracycline Biomarker Results

Tetracycline biomarker results for 2003 post-ORV evaluation efforts (mainland side of canal prior to Cape Cod rabies epizootic) were not available at the time the 2004 Annual Report was printed. Of 47 testable tooth samples, 13 (27.7%) were positive for tetracycline biomarker.

SUMMARY

In 2005, WS completed its fifth year of cooperative participation in rabies management on Cape Cod, Massachusetts. Wildlife Services continued to work with cooperators to develop optimal rabies control strategies (including ORV) to halt the spread of the Cape Cod rabies epizootic. In addition, epizootic front delineation, and enhanced rabies surveillance behind the front to track epizootic intensity, and public information campaigns were priorities of the Cape Cod ORV program in 2005.

In 2006, 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.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MICHIGAN 2005

BACKGROUND

To date, there have been no reported cases of the raccoon (*Procyon lotor*) variant of rabies in Michigan, although other variants (including bat [*Chiroptera* spp.] and striped skunk [*Mephitis mephitis*]) do occur. Given its close proximity to both Ohio and Ontario, Canada however, where raccoon rabies is known to exist, the state of Michigan established a multi-agency rabies working group in 1997. The goals of the group are to: educate the public; provide expertise and recommendations on rabies issues; conduct research; prevent an increase in the disease and risk for existing variants; and prevent the establishment of new variants (raccoon rabies in particular). The Michigan rabies working group developed a contingency plan for the introduction of raccoon rabies, should it occur. The plan was adopted by Wildlife Services' (WS) National Rabies Management Program (NRMP) and has been implemented in areas where raccoon rabies approached or breeched an oral rabies vaccination (ORV) zone, or was confirmed where it was not formerly known to exist. The Michigan rabies working group recently developed an enhanced surveillance system (ESS) to aid in the early detection of raccoon rabies. Through guidance and training from the NRMP, biologists from WS and the Michigan Departments of Natural Resources (MDNR) and Community Health (MDCH) began implementing the ESS in 2005. This marked the first year that raccoon rabies enhanced surveillance activities took place in Michigan.

RABIES MANAGEMENT PROGRAM 2005

Bait Distribution

There is currently no ORV bait distribution program in Michigan.

Enhanced Surveillance

In 2005, a raccoon rabies ESS was initiated for the first time in the state of Michigan. The first phase of the ESS included the collection and testing of road kill raccoons from southeast Michigan, which is considered a higher risk area for the introduction of raccoon rabies due to the proximity to both Ohio and Ontario, Canada, coupled with the high degree of transportation/trucking in that area. In April, 29 raccoon specimens were collected and processed from Ingham, Lenawee, Livingston, Monroe, Shiawassee, Washtenaw, and Wayne Counties (Figure 1). Hair, brain, and tooth samples were collected from each specimen. The MDCH Bureau of Laboratories (BOL) tested the brain samples using direct fluorescent antibody (dFA) testing on complete cross sections of the spinal cord. All samples were negative for the rabies virus. The second phase of the ESS began in late May and involved trapping raccoons on a southeast Michigan landfill that imports the greatest amount of trash from raccoon rabies enzootic areas (Figure 1). A total of 20 raccoons were trapped, euthanized, and sampled. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

One Michigan WS personnel attended dRIT training in May 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia and implemented the test on 31 May 2005. During 2005, WS collected 82 animals for rabies testing and 22 (26.8%) were tested by WS using the dRIT. Of the dRIT samples, none tested positive, 81 tested negative, and 1 was not suitable for testing. Ten percent of all negatives samples were sent to the CDC for confirmation. The CDC (using the dFA test) had 100% agreement with the WS dRIT test results for negative samples. Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid

animals in Michigan. In 2005, the MDNR cooperated in the implementation of the dRIT by providing the use of their Wildlife Disease Biosafety Level 2 (BSL-2) Laboratory.

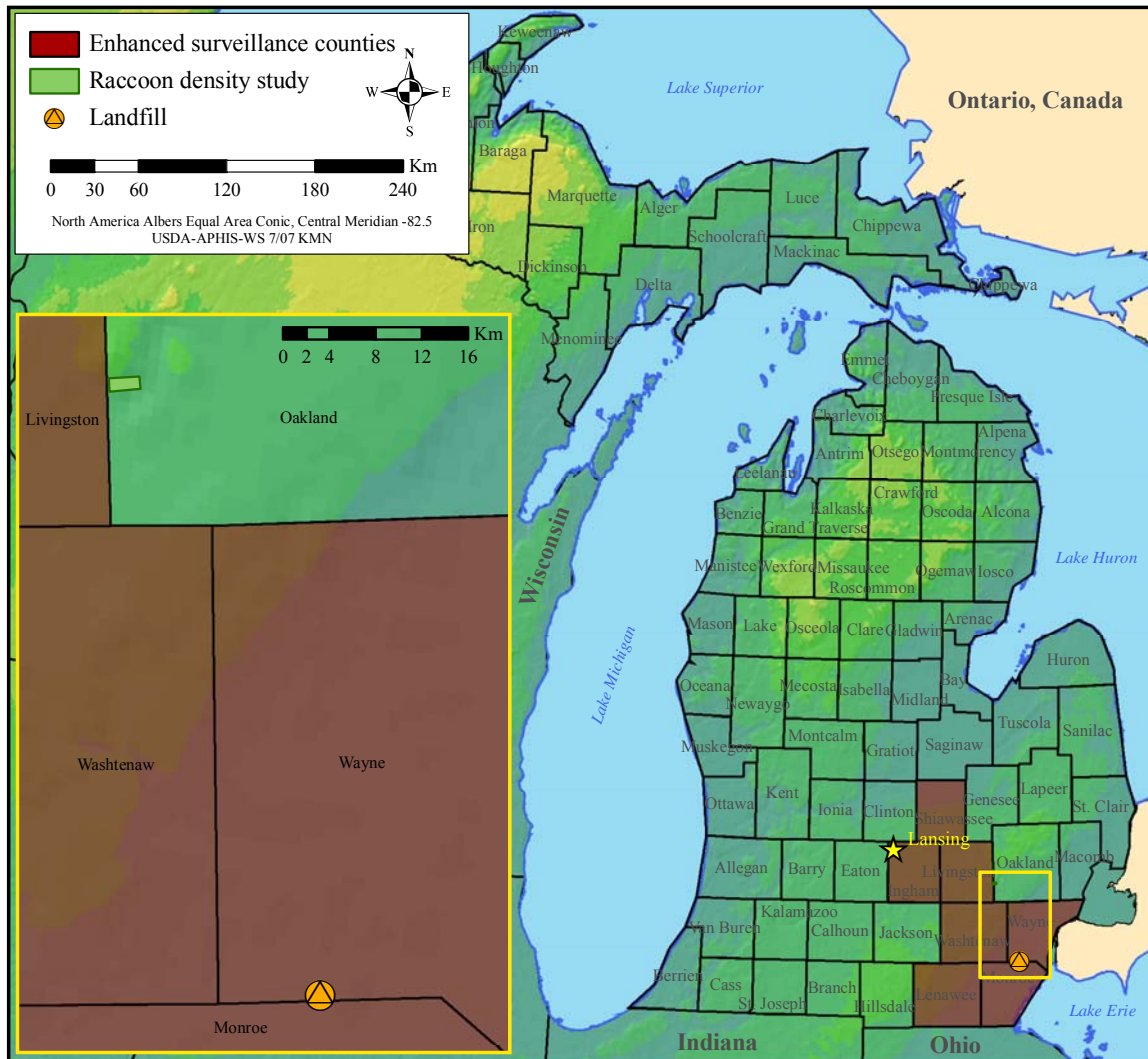


Figure 1. Wildlife Services cooperative rabies management program activities in Michigan, 2005.

Population Monitoring

In September 2005, a raccoon relative density study was conducted at a Metropark in Oakland County, Michigan with cooperation from the MDNR and MDCH (Figure 1). The purpose of the study was to better understand the raccoon population of southeast Michigan, which is considered to be at the highest risk for a raccoon rabies introduction. Trapping and sample collection procedures were conducted following the NRMP protocol for high raccoon density areas (50 cage traps set for 15 consecutive nights over a target study area of 3km²). Raccoons were live-trapped, processed, and released, with the exception of 3 that were humanely euthanized because they were exhibiting abnormal behavior. All 3 raccoons tested negative for rabies using the dRIT. Processing procedures included chemical immobilization, ear tagging, and biological sample collection (blood, tooth, and hair/DNA). A total of 155 unique raccoons were captured and sampled, with 101 recaptures over 750 trap nights. These results indicate a relatively high index to raccoon density (51.7 raccoons/km²) and a higher potential risk to density-dependent diseases such as rabies and canine distemper. This project also provided an opportunity for WS to train biologists from both the MDNR and MDCH in rabies surveillance trapping and sampling, which adds to Michigan’s overall preparedness for a potential response to the introduction of raccoon rabies.

Other Rabies Management Program Activities

Wildlife Services received a request for assistance from a family that had potentially exposed themselves to 2 rabid raccoons. The family had raised 2 raccoons from early juveniles and after releasing the animals back into the wild the family continued to feed the raccoons (by hand and mouth). The raccoons were also allowed to enter and exit the family residence through a pet door. One of the raccoons became sick and died over the winter, and the second animal showed the same signs of illness and died in May. Two family members handled 1 of the raccoons while it was displaying clinical signs and later post-mortem. The family was initially not concerned about exposure to rabies but the husband had recently been diagnosed with Lyme disease after observing numerous ticks on the dead raccoon. The raccoon was presumed to be the source of his Lyme disease. During the case investigation, WS collected the carcass and submitted the head to the BOL for rabies testing; ticks were also collected and sent to an entomologist for identification. The raccoon tested negative for rabies and it was consequently assumed that both animals died from canine distemper. Although some of the ticks were *Ixodes sp.*, none were the host for Lyme disease in Michigan, *I. scapularis*. Wildlife Services followed up by educating the family on rabies and Lyme disease in Michigan, as well as on their habits, lifestyle, and the associated risk of zoonotic diseases and parasites.

Rabies Challenge Study.--Wildlife Services also responded to a request for assistance from the CDC with a critical study being conducted to interpret field serology and subsequently challenge captive raccoons to the rabies virus. The relationship between rabies virus neutralizing antibody (VNA) levels in raccoons and the degree of protection is important for measuring the success of ORV programs in the eastern U.S. The CDC was conducting a research project examining responses of raccoons with varying antibody levels when challenged with live rabies virus. Because Michigan has a raccoon rabies free population and no ORV program exists, the raccoons were expected to have no rabies VNA. Therefore, 15 to 20 adult raccoons from Michigan were requested to serve as the negative controls for the study. The WS program in Michigan trapped 42 raccoons in 77 trap nights and processed and delivered 32 adult raccoons to a WS office in Pennsylvania. Pennsylvania WS was also capturing and transporting raccoons to the CDC for the same project and they assisted by transporting the Michigan raccoons as well.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 21 opossums (*Didelphis virginiana*), 12 woodchucks (*Marmota monax*), 1 American badger (*Taxidea taxus*), and 1 Eastern cottontail (*Sylvilagus floridanus*).

Rabies Laboratory Cooperation

Wildlife Services' rabies management program in Michigan cooperates with the BOL and the CDC.

Michigan Department of Community Health Bureau of Laboratories.--The BOL tests cross-sections of animal cerebellums and brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure) and cross-sections of the brainstems for enhanced surveillance (specimens not involved in an exposure and usually submitted by WS or the MDNR). Specimens are tested at the BOL using the dFA test. The BOL received 2,538 samples for rabies virus testing in 2005, representing a 10.6% increase from the number of samples submitted in 2004. The BOL did not test 751 of these samples because they were either unsatisfactory or were from non-rabies vector species (i.e., small rodents and lagomorphs). An additional 25 samples yielded inconclusive rabies results. Of the 1,762 samples that yielded results, 41 (2.4%) tested positive for the rabies virus (Table 1). None of the 57 samples submitted to the BOL for enhanced surveillance were positive for the rabies virus.

Raccoons, skunks, and foxes (*Canidae spp.*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 90.9% of the animals tested for rabies in Michigan in 2005 (that yielded results) are reported by WS as "other." For more information on current and historical rabies cases in Michigan please visit the Michigan Emerging Disease Issues website at: <http://www.michigan.gov/emergingdiseases/> and click on the "rabies" link on the left side.

Table 1. Animals submitted and tested for rabies by the Michigan Department of Community Health Bureau of Laboratories in Michigan, 2005.

Species	Public Health Surveillance		Enhanced Surveillance	
	Submissions	Rabies Positive	Submissions	Rabies Positive
Raccoons	77	0	41	0
Skunks	18	7 (38.9%)	3	0
Foxes	15	1 (6.7%)	6	0
Other ^a	1,595	33 (2.1%)	7	0
Total	1,705	41 (2.4%)	57	0

^a Other animals included: bats, domestic cats, and sheep.

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA. Michigan WS submitted 173 blood serum samples for rabies VNA analysis to the CDC in 2005. There were no samples submitted in 2004, as WS was not involved in a rabies management program in Michigan at that time. Michigan WS anticipates approximately 100 serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

RABIES MANAGEMENT PROGRAM 2004 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Wildlife Services did not participate in a rabies management program in Michigan prior to 2005, therefore no evaluation results exist for 2004.

SUMMARY

During 2005, WS completed its first year of participation in cooperative rabies management efforts in Michigan. The main focus of activities was to establish an ESS to detect the raccoon variant of the rabies virus in Michigan, should it spread from nearby Ohio and/or Canada. Although the number of samples collected was relatively low in 2005, the program gained valuable knowledge on how to: procure equipment; train personnel; obtain landowner permissions; and determine the most effective strategies for trapping and sampling animals. Michigan now has onsite personnel with the necessary experience and equipment to implement the raccoon rabies contingency plan if needed.

In 2006, WS will begin an educational campaign of local health department staff, human and animal healthcare providers, animal and wildlife control officers, local law enforcement officers, and other personnel from state and federal agencies. The education of these critical stakeholders will increase the efficiency of sample collection throughout the state and thereby enhance surveillance for raccoon rabies in Michigan.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MISSISSIPPI 2005

BACKGROUND

The raccoon (*Procyon lotor*) variant of the rabies virus has not been documented in Mississippi. In 1964, rabies was first detected in bats (*Chiroptera* spp.) 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 confirmed rabid before they came into contact with other animals. Since World War II, 14 cases of human rabies have occurred in the state, the last being in 2005. Most of these cases are suspected to have been canine rabies (Dr. Brigid Elchos, Mississippi Department of Health [MDH], pers. comm.). These cases were located throughout the state. The most recent case was in September 2005; a child who died and had elevated rabies titer levels. A bat was reportedly in his bedroom in April 2005. Unfortunately, the child was cremated so no post-mortem exam to reveal more information about the cause of death could be performed.

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 animals confirmed by the MDH Laboratory decreased. Currently, only the bat variant of rabies is considered enzootic within Mississippi (Riecken 1984). The nearest confirmed case of raccoon rabies to Mississippi has been in Clarke County, Alabama (Figure 1). As a result of the proximity of Clarke County cases, Wildlife Services (WS) in Mississippi began an enhanced rabies surveillance program in 2003 to detect raccoon rabies, should it enter the state.

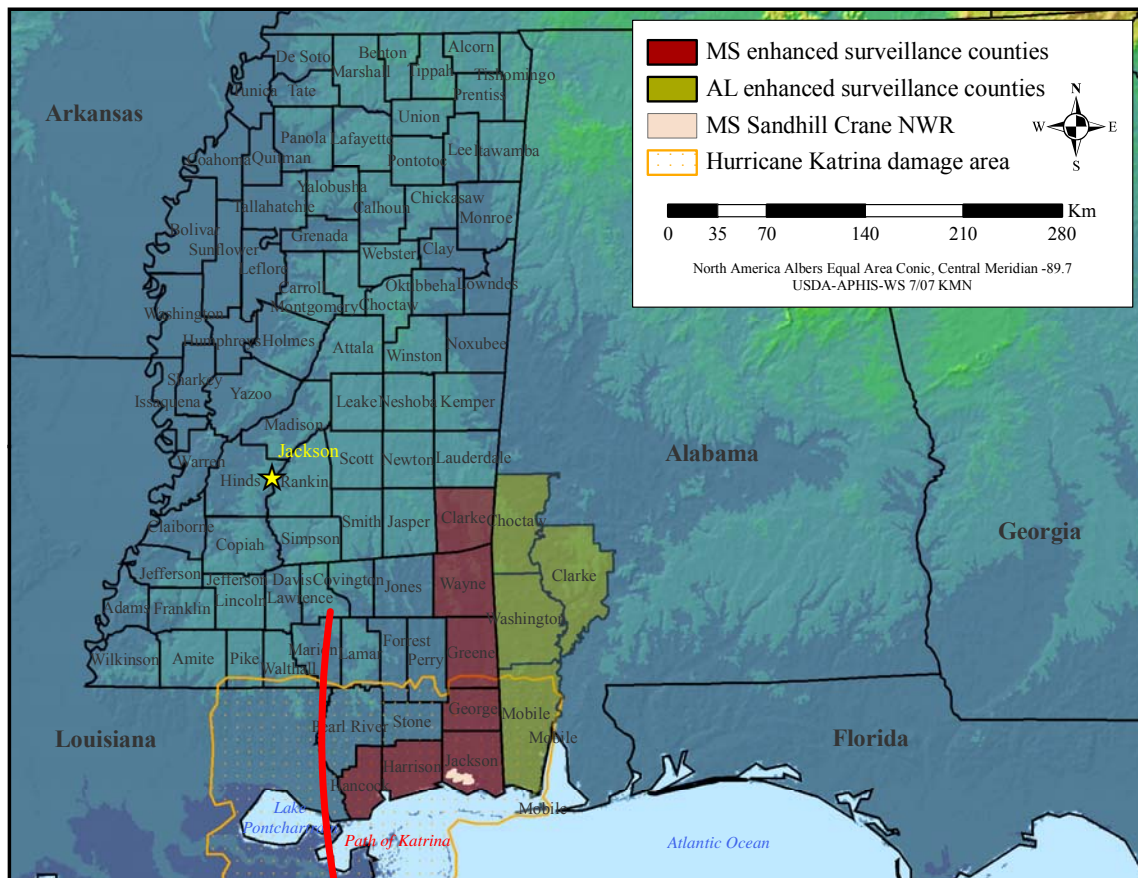


Figure 1. Wildlife Services cooperative rabies management program activities in Mississippi, 2005.

RABIES MANAGEMENT PROGRAM 2005

Bait Distribution

There is currently no ORV bait distribution program in Mississippi.

Enhanced Surveillance

In 2005, WS continued enhanced surveillance of rabies by collecting road killed, suspect rabid, or nuisance raccoons, coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*), and striped skunks (*Mephitis mephitis*) in Clarke, George, Greene, Hancock, Harrison, Jackson, and Wayne Counties of Mississippi (Figure 1). A Mississippi WS technician also conducted enhanced surveillance activities in Choctaw, Clarke, Mobile, and Washington Counties of Alabama in 2005.

Wildlife Services cooperated with wildlife law enforcement officers, city animal control officers, and various county officials to collect 147 animal brainstem samples from Mississippi (species and county information was not recorded on 21 samples) and 34 samples from Alabama in 2005 (Table 1). All 147 samples from Mississippi were submitted to the MDH Public Health Laboratory (PHL) in Jackson for rabies testing; they all tested negative. The 34 samples from Alabama were submitted to the Alabama WS Program for dRIT and also tested negative for rabies.

Table 1. Enhanced surveillance animals collected for rabies testing by Mississippi Wildlife Services in Mississippi and Alabama counties (no rabies positives confirmed), 2005.

County	Raccoon	Red fox	Total
Mississippi			
Clarke	18		18
George	1		1
Greene	3		3
Hancock	48		48
Harrison	39	2	41
Jackson	13	1	14
Wayne	1		1
Total	123	3	126
Alabama			
Choctaw	2		2
Mobile	28		28
Washington	4		4
Total	34		34

Hurricane Katrina (26 August 2005) destroyed WS freezers (used to store samples for rabies testing) in Hancock and Harrison Counties (Figure 1). Despite this and during the aftermath, Mississippi WS was able to work with animal damage control officers from across the United States to coordinate testing of suspect rabid animals along the Gulf Coast.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

One Mississippi WS personnel attended dRIT training in April 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. Wildlife Services plans to implement the dRIT in 2006.

Other Rabies Management Program Activities

In 2005, WS collected brainstem samples from 3 raccoons that were removed from the Mississippi Sandhill Crane Refuge as part of a different project (Figure 1). These are included in the overall sample totals for Mississippi. All of these animals were submitted and tested negative for rabies. No serology or tooth submissions have been done at this time. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Rabies Laboratory Cooperation

The WS cooperative rabies management program in Mississippi currently collaborates with the MDH, PHL. The PHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by veterinarians) and when possible, via enhanced surveillance (specimens not involved in an exposure, usually submitted by WS). On average, the PHL tests over 400 animals for rabies each year (primarily domestic cats [*Felis catus*] and dogs). Numerous bats are also submitted each year and 1 to several bats usually test positive for rabies.

For the past 2 years, WS has assisted the PHL by purchasing various rabies testing supplies (e.g., pipettes, gloves, shipping boxes, etc.). Wildlife Services plans to continue this if resources are available in 2006. Wildlife Services also plans to implement the dRIT in 2006 to relieve some of the rabies testing burden on the PHL, but still anticipates similar numbers of submissions to the lab. For more information about rabies in Mississippi please visit: <http://www.msdh.state.ms.us> and search on "rabies."

SUMMARY

During 2005, WS completed its third year of participation in cooperative rabies management efforts in Mississippi. The focus of activities this year continued to be enhanced rabies surveillance in the southeastern part of the state, and for the first time collecting animals from across the border in southwestern Alabama. In 2006, efforts will continue to focus on enhancing surveillance in these areas to detect the raccoon variant of the rabies virus, should it spread from nearby Alabama.

LITERATURE CITED

Riecken, W.E. Jr. 1984. Review of Rabies in Mississippi. Mississippi Morbidity Report (June). Mississippi Department of Health. Vol 2,11:1-3.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW HAMPSHIRE 2005

BACKGROUND

The first case of raccoon (*Procyon lotor*) rabies confirmed in New Hampshire was a bit of an anomaly. In March 1992, a raccoon entered a local police officer's house in Rumney and began fighting with the family Doberman (Figure 1). 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 (retired State Veterinarian Dr. Clifford McGinnis, New Hampshire Department of Agriculture, Markets and Food [NHDA], personal communication in 2002). The raccoon was confirmed rabid on 6 April with the raccoon variant of rabies. 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 the Rumney area, but the raccoon variant of the rabies virus did enter New Hampshire in the fall of 1992, as an extension of the epizootic in southern New England. Once in New Hampshire, raccoon 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 (in 1999) approximately 60 km (37.5 mi) south of the United States-Canada border (Figure 1).

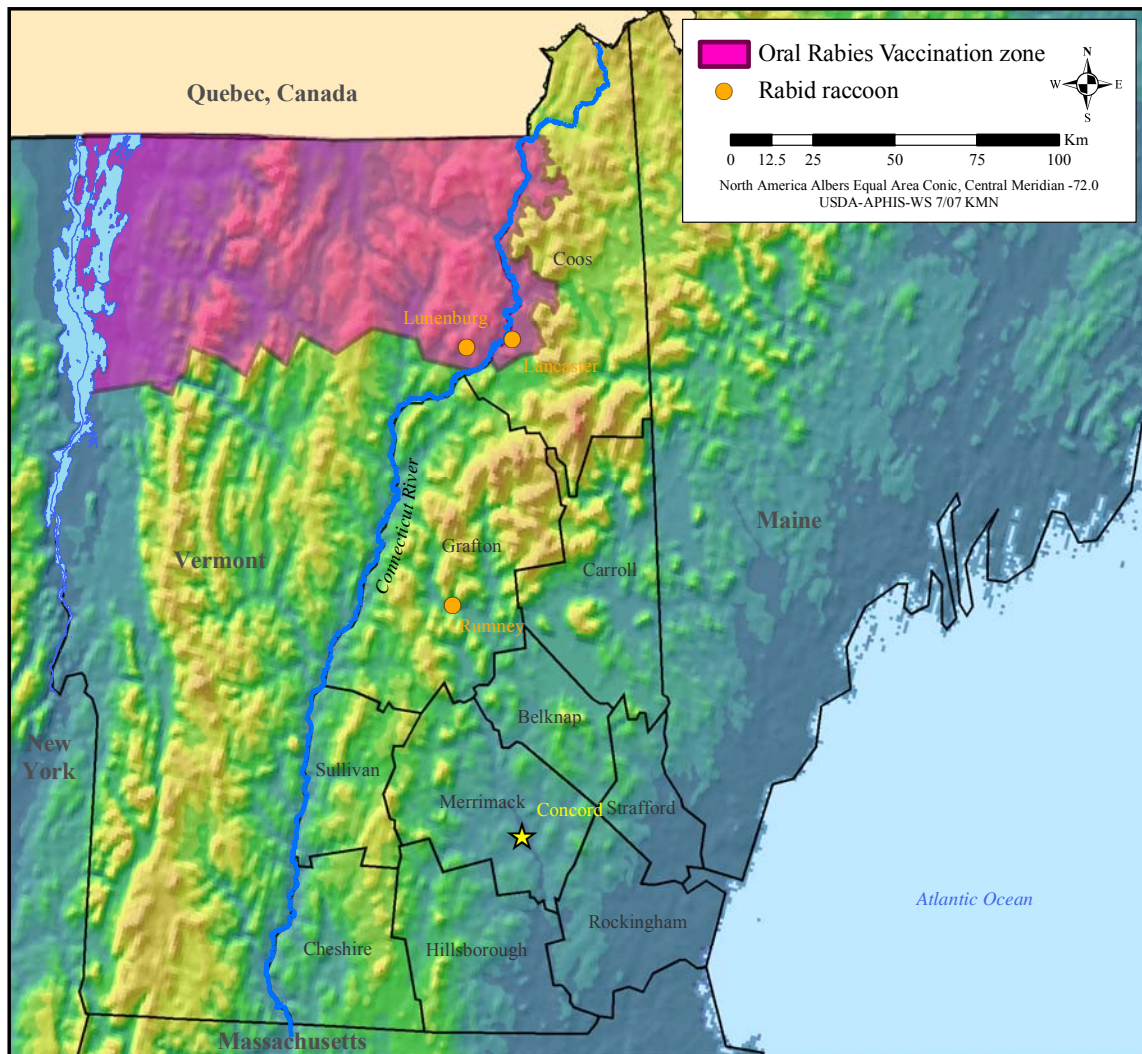


Figure 1. Wildlife Services cooperative rabies management program activities in New Hampshire, 2005.

Just months after the Lancaster, New Hampshire case was documented, a rabid raccoon was confirmed in Lunenburg, Vermont (19 October 1999) directly across the Connecticut River (state border) from Lancaster (Figure 1). This prompted concern over the spread of rabies through the Connecticut River Valley in northern New Hampshire and Vermont into Canada. In July 2001, Wildlife Services (WS) conducted a raccoon density study in northern New Hampshire to better understand the population there and the potential movement of rabies. In August 2002, an oral rabies vaccination (ORV) program was initiated in New Hampshire with the goal to prevent the northward spread of raccoon rabies.

The New Hampshire ORV program has been a cooperative effort between WS, Cornell University (CU), the NHDAG, the New Hampshire Department of Health and Human Services (NHDHHS), and the New Hampshire Department of Fish and Game. Wildlife Services 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: program planning and coordination; organizing ground support for aerial bait distribution; 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 2005

Bait Distribution

For the fourth consecutive year in 2005, WS participated in ORV bait distribution efforts along the upper Connecticut River Valley in northern New Hampshire, coinciding with Vermont aerial bait distribution activities; 28,037 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 543.2 km² (209.7 mi²) of Coos County (Figure 1). During parts of 3 flights on 26 August, 27,897 CS baits were distributed by Twin Otter fixed-wing aircraft over northern New Hampshire, while the village of Colebrook was hand baited with 140 FMP baits on 27 August. Pilots and mechanics for aerial baiting were provided by the Ontario Ministry of Natural Resources, while WS provided navigators, flight crew, and ground support. Since its program inception in 2002, WS has distributed 148,092 ORV baits in New Hampshire.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, New Hampshire WS is not planning training or implementation of the dRIT because the NHDHHS is meeting enhanced surveillance testing needs.

Post-ORV Monitoring

From 24-28 October 2005, Vermont WS conducted post-ORV trapping activities in Coos County, New Hampshire. Over 212 trap nights, blood serum and tooth samples were collected from 7 raccoons to measure rabies virus neutralizing antibody (VNA) response in this ORV zone. All raccoons were immobilized, processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Non-target Captures

In 2005, no non-target species were captured in New Hampshire.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in New Hampshire cooperates with the NHDHHS, Public Health Laboratory (PHL) and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC).

New Hampshire Department of Health and Human Services, Public Health Laboratory.--The PHL routinely tests animal brainstems for rabies via public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Conservation Officers, veterinarians, and the public). When possible, the PHL tests specimens not involved in an exposure to enhance surveillance in towns which have not yet had a confirmed case of rabies. The PHL tested 491 brainstem samples for the rabies virus in 2005 (Table 1). This represents a 3.8% increase from the number of samples tested in 2004. The 2005 samples were submitted from all 10 counties throughout the state and 12 tested positive for rabies.

Raccoons, skunks (*Mephitidae* spp.), foxes (*Canidae* spp.), and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 84.7% of the animals tested for rabies in New Hampshire in 2005 are reported by WS as "other." For more information about rabies in New Hampshire please visit:

<http://www.dhhs.state.nh.us/DHHS/CDCS/rabies.htm>

Table 1. Animals tested for rabies by the New Hampshire Department of Health and Human Services, Public Health Laboratory in New Hampshire, 2005 (rabies positives statewide in parentheses).

	Statewide	Within and adjacent ^a to New Hampshire ORV zone
Raccoons	37 (6)	0
Skunks	25 (4)	0
Foxes	12 (1)	0
Coyotes	1	0
Other ^b	416 (1)	3 (0.7%)
Total	491 (12)	3 (0.6%)

^a Samples were from areas inside or \leq 6 km (10 mi) outside the ORV zone.

^b Other animals included: bats (1 rabid), domestic pets, and woodchucks.

New York State Department of Health's Rabies Laboratory at the Wadsworth Center.--The WC analyzed 7 serum samples for rabies VNA submitted by New Hampshire WS in 2005. This was the same number of samples submitted by WS in 2004. The New Hampshire ORV program anticipates similar numbers of submissions to the WC in 2006. For more information about the Rabies Laboratory at the WC please visit:

<http://www.wadsworth.org/rabies/>

ORV PROGRAM 2004 – EVALUATION

New Hampshire's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serum samples from 7 raccoons were collected 4-5 weeks following the 2004 ORV bait distribution in New Hampshire. Of these samples, 2 (28.5%) demonstrated a positive rabies VNA response. This was the first time post-ORV monitoring had been conducted in New Hampshire. In addition, viable tooth samples were collected from 5 of these raccoons for aging and tetracycline biomarker analysis (by Matson's Lab). None of these samples indicated a presence of tetracycline (CS baits were also distributed in 2004). The age structure of these 5 raccoons was: 2 at age <1 y.o.; 2 at age 1 y.o.; and 1 at age 2 y.o.

SUMMARY

During 2005, WS completed its fifth year of participation in cooperative rabies management efforts in New Hampshire. The focus of activities this year was ORV bait distribution and follow-up post-ORV monitoring (trapping). The New Hampshire ORV program is an important part of a larger northeastern cooperative effort, which in 2005 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 variant of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW JERSEY 2005

BACKGROUND

In the early 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 involving mass vaccination of dogs and 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 (*Chiroptera* spp.) rabies was confirmed in New Jersey. The raccoon (*Procyon lotor*) rabies epizootic spread to New Jersey through Warren and Hunterdon Counties in 1989. 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 an oral rabies vaccine (ORV) in wild raccoons by the State of New Jersey and Thomas Jefferson University, Philadelphia, Pennsylvania. Between 1989 and 2005, 4,938 cases of terrestrial rabies were confirmed. Of these, 3,681 (74.5%) were raccoons.

From 1992-1994, the New Jersey Division of Fish and Wildlife worked cooperatively with the Cape May County Department of Health (CMDH) and the New Jersey Department of Health and Senior Services (NJDHSS) to conduct an experimental ORV program on the rabies-free peninsula of Cape May County (Figure 1). Since 1995, the CMDH has worked independently to distribute ORV baits in Cape May County. In 2004, Wildlife Services (WS) became involved in the ORV program to assist county and state cooperators with project evaluation.

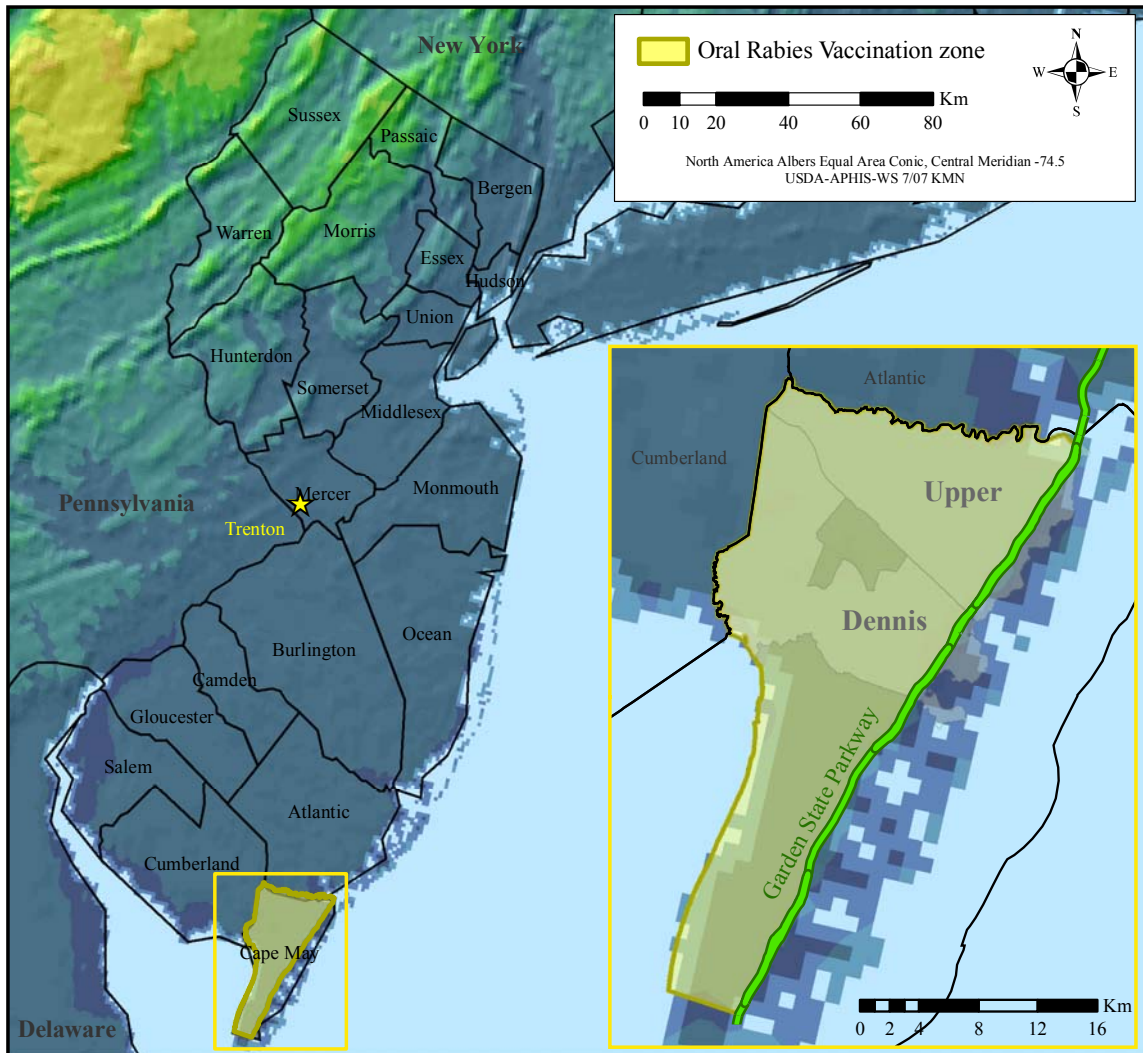


Figure 1. Wildlife Services cooperative rabies management program activities in New Jersey, 2005.

ORV PROGRAM 2005

Bait Distribution

In 2005, the ORV bait zone in Cape May County encompassed 556 km² (215 mi²) west of the Garden State Parkway (Figure 1). From 27 September-7 October, 44,600 fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (Merial Limited, Athens Georgia, USA) were distributed by helicopter provided by the New Jersey Mosquito Commission, while an additional 1,000 FMP baits were distributed by hand. Although baits are distributed at a rate of approximately 64 baits/km², emphasis is placed on Upper and Dennis Townships to prevent the spread of rabies from neighboring Atlantic and Cumberland Counties into Cape May County. Since 1991, approximately 302,500 baits have been distributed in Cape May County.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, New Jersey WS is not planning training or implementation of the dRIT.

Post-ORV Monitoring

No post-ORV monitoring activities were conducted in New Jersey during 2005.

Rabies Laboratory Cooperation

New Jersey WS cooperates with the NJDHSS, Public Health and Environmental Laboratory (PHEL) and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC).

New Jersey Department of Health and Senior Services, Public Health and Environmental Laboratory.--The PHEL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by County Health Officers, veterinarians, and the public). The PHEL tested 2,944 animals for the rabies virus in 2005, representing a 4.0% decrease from the number of samples tested statewide in 2004 (Table 1). Of the animals tested in 2005, 241 were confirmed positive and of those 146 (60.6%) were raccoons. One cow (*Bos taurus*) from Hunterdon County and 1 river otter (*Lutra canadensis*) from Warren County tested positive. There were no positive cases reported from Cape May County in 2005.

Raccoons, skunks (*Mephitidae* spp.), foxes (*Canidae* spp.), and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 83.9% of the animals tested for rabies in New Jersey in 2005 are reported by WS as "other." For more information on rabies in New Jersey please visit:

http://www.state.nj.us/health/cd/f_rabies.htm

Table 1. Animals tested for rabies by the New Jersey Department of Health and Senior Services, Public Health and Environmental Laboratory in New Jersey, 2005.

	Number Tested	Rabies Positive
Raccoons	355	146 (41.1%)
Skunks	92	31 (33.7%)
Foxes	27	6 (22.2%)
Coyotes	1	0
Other ^a	2,469	58 (2.3%)
Total	2,944	241 (8.2%)

^a Other animals included: alpaca, bats, bear, cats, chipmunks, cows, deer, donkey, ferrets, goats, hamsters, horses, mice, moles, muskrats, opossums, otter, rabbits, rats, sheep, squirrels, voles, and woodchucks.

New York State Department of Health's Rabies Laboratory at the Wadsworth Center.--The WC analyzes animal serum samples for rabies virus neutralizing antibodies (VNA) to evaluate the efficacy of ORV. Although WS did not conduct post-ORV monitoring in New Jersey in 2005, 25 serum samples were submitted in 2004. Wildlife Services anticipates serum sample submissions to the WC in 2006.

ORV PROGRAM 2004 – EVALUATION

New Jersey's 2004 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time the 2004 Annual Report was printed; they are presented below.

Serology, Tetracycline Biomarker, and Age Results

In 2004, post-ORV evaluation activities were conducted in New Jersey for the first time in over a decade. Serum samples from 25 raccoons were collected 4-5 weeks following the 2004 ORV bait distribution in Cape May County. Of these samples, 8 (32.0%) demonstrated a positive rabies VNA response (≥ 0.05 IU). In addition, viable tooth samples were collected from 24 of these raccoons for aging and tetracycline biomarker analysis (by Matson's Laboratory LLC [Milltown, Montana, USA]). Seventeen (70.8%) of these samples indicated a presence of tetracycline (Figure 2).

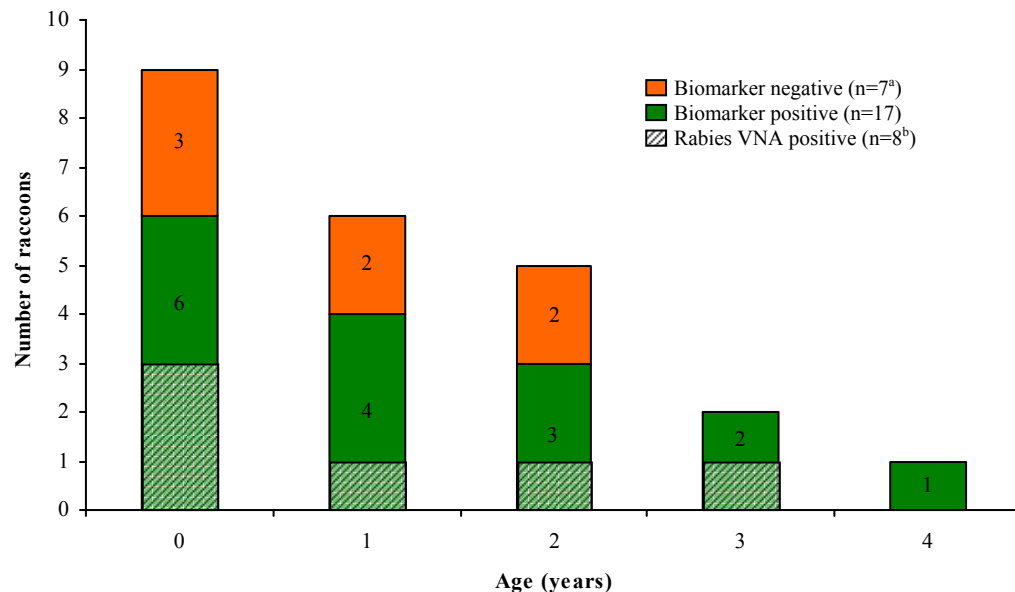


Figure 2. Age class distribution, presence of tetracycline biomarker, and positive rabies virus neutralizing antibody (VNA) response of 24 raccoons collected by Wildlife Services during the cooperative rabies management program in New Jersey, 2004 (^a one tooth sample was positive for tetracycline but was not able to be aged; ^b two raccoons had a positive rabies VNA response, but their teeth were not able to be aged).

SUMMARY

The Cape May County ORV program, although small in scale, maintains its important status as the longest continuously running ORV program in the United States. The CMDH maintains the ORV program due to its proven long term success and continued public support. Wildlife Services plans to resume enhanced rabies surveillance activities and post-ORV evaluation in 2006.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW YORK 2005

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. An outbreak that began in the late 1970s, in the mid-Atlantic states, has been attributed to the 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 aggressively spread throughout the mid-Atlantic and northeastern United States, reaching New York in 1990. The raccoon variant of the rabies virus quickly spread and now is present throughout most of the state. In 1994, the New York State Department of Health (NYSDOH) began experimenting with the use of oral rabies vaccination (ORV) in an enzootic area of the Capital Region and was able to demonstrate a decrease in the number of rabid raccoons. This research led to the use of ORV as a rabies control technique in New York State, where 4 distinct ORV programs exist today.

Champlain Valley.--In 1995, after raccoon rabies made a sudden leap of 70 km from southern Essex County in the Adirondacks to mid-Clinton County, the NYSDOH initiated a point-source control plan involving the use of ORV baits. This was followed by the establishment of a Champlain Valley (CV) ORV zone to prevent further northward spread of raccoon rabies up the Lake Champlain Valley into Quebec, Canada. In 1998, the NYSDOH switched from a biannual spring and fall baiting program to an annual program in August. The CV ORV zone was moved south into the enzootic area of Essex County (Figure 1) following the successful elimination of raccoon rabies in Clinton County (last case of raccoon variant rabies was in September 1997). Wildlife Services (WS) began cooperating in the CV ORV program in 1999 by providing financial and operational support.

St. Lawrence Region.--In 1997, raccoon rabies was documented in St. Lawrence County and the following year an epizootic was identified in the county with 138 confirmed rabies cases in terrestrial wildlife (116 raccoons, 22 striped skunks [*Mephitis mephitis*]). In 1998, a St. Lawrence Region (SLR) ORV program was implemented by Cornell University (CU), the Ontario Ministry of Natural Resources (OMNR), and WS to prevent the northward spread of raccoon rabies in New York and ultimately into Ontario, Canada. Wildlife Services has provided financial and operational support to the SLR ORV program since 1998. In July 1999, the first ever case of raccoon variant rabies was confirmed in Canada, just northwest of Prescott, Ontario. Since that time, the OMNR has implemented rabies control activities that in 2005 included ORV and trap-vaccinate-release (TVR) efforts (Figure 1). Also since that time, the NYSDOH has documented a marked decline in terrestrial wildlife rabies cases in St. Lawrence County. In 2000, there were only 14 cases of rabies associated with the raccoon variant (7 raccoons, 6 skunks, 1 woodchuck [*Marmota monax*]) in St. Lawrence County. Over the next 5 years, 6 cases of raccoon rabies (3 raccoons, 3 skunks) were confirmed in the county, with the last cases coming in June 2004 when 2 skunks were confirmed from Heuvelton within the existing ORV zone (Figure 1).

Long Island.--In August 2004, the NYSDOH confirmed raccoon rabies for the first time in Nassau County (Figure 1). By year's end, 10 rabid raccoons had been confirmed in the county. In response to this outbreak an emergency rabies surveillance and control program was initiated by the NYSDOH Zoonoses Program, WS, and the Nassau County Department of Health. High raccoon densities in conjunction with an urban environment make implementing the Long Island (LI) ORV program challenging. Bait distribution and surveillance trapping efforts are also hindered by high human populations, and in 2005, 35 cases of raccoon rabies (all raccoons) were confirmed in Nassau County.

Western New York.--The OMNR has maintained a TVR zone on the Niagara peninsula of Ontario since 1994 (Figure 1). In 1995, 138 rabid raccoons were confirmed in Niagara County, New York. In response, and in an effort to prevent the westward spread of raccoon rabies into Ontario, the New York State Department of Agriculture and Markets (NYSDAM), Niagara County, and the OMNR funded an ORV program. In 1996, baiting began in Chautauqua County to initially prevent the spread of raccoon rabies into Erie County, Pennsylvania. The NYSDAM and Chautauqua County funded this program. In the following years, the rabies epizootic continued in Erie County, New York (border county between Niagara and Chautauqua). In 2002, the NYSDAM, the OMNR, and WS began baiting Buffalo, New York (Erie County) using helicopters and bait stations. This collective Western New York

(WNY) ORV zone has been tied to larger, national efforts to create an immune barrier from Lake Erie to the Gulf of Mexico.

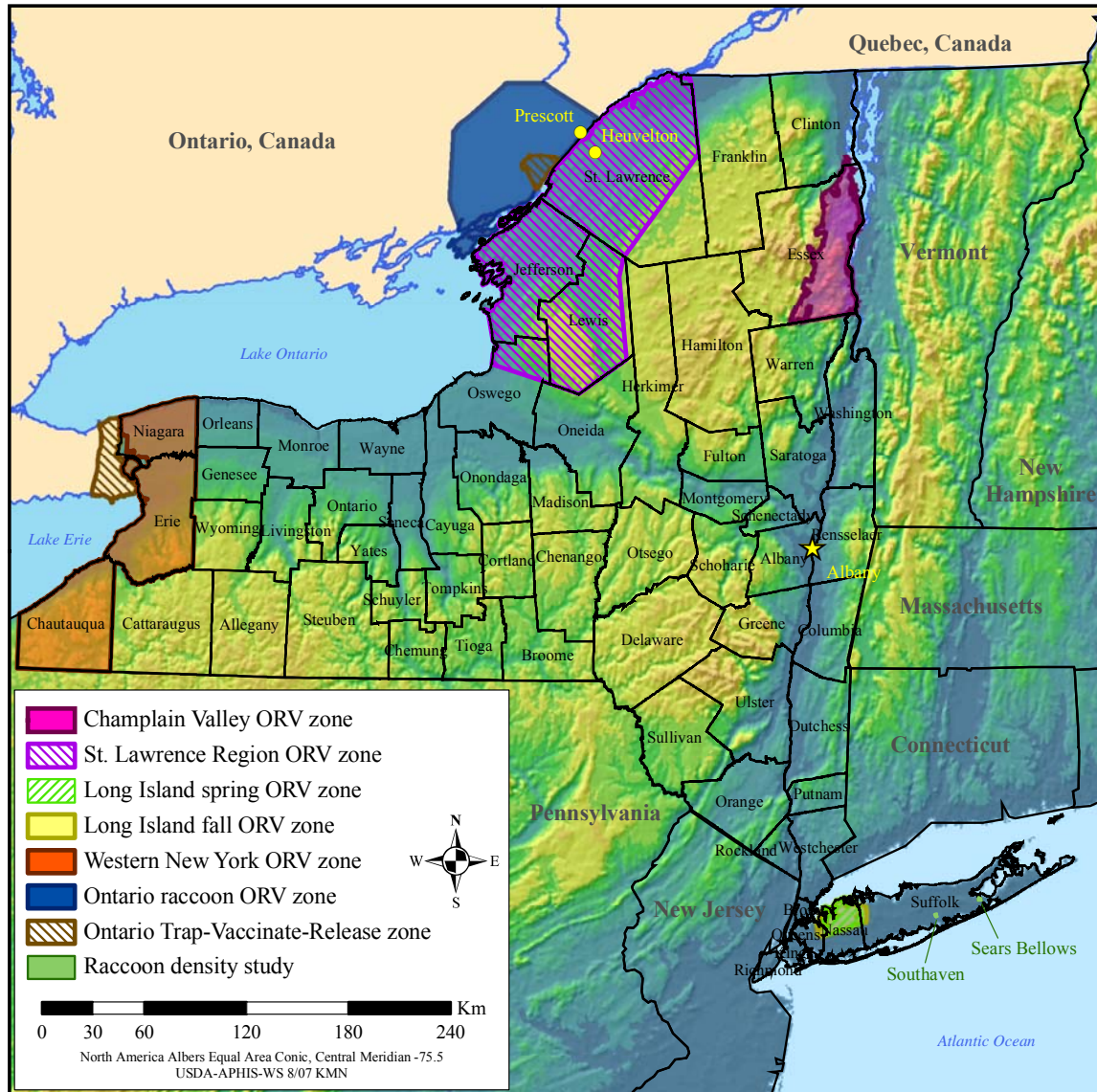


Figure 1. Wildlife Services cooperative rabies management program activities in New York, 2005.

ORV PROGRAM 2005

Bait Distribution

For the eighth consecutive year, WS participated in bait distribution efforts in New York; 1,436,026 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 20,824 km² (8,040 mi²) in 2005 (Figure 1). Wildlife Services has cooperated to distribute 8,942,811 ORV baits in New York since our involvement began in 1998.

Champlain Valley.--From 8-17 August, WS cooperated with the NYSDOH to distribute 130,206 fishmeal polymer (FMP) baits over 1909.5 km² (737.3 mi²) in Essex County. All baits were distributed aerielly via helicopters provided by the New York State Police Aviation Unit (NYSPA).

St. Lawrence Region.--From 22-24 August, WS cooperated with CU to distribute 769,446 ORV baits over 12,471 km² (4815.2 mi²) in Franklin, Jefferson, Lewis, Oneida, Oswego, and St. Lawrence Counties; 751,387 of those baits were fishmeal coated sachets (CS) distributed by fixed wing aircraft provided by the OMNR. Ground bait distribution included 15,599 FMP and 2,460 CS baits.

Long Island.--From 3-13 May and 9-10 June, WS cooperated with the NYSDOH to distribute 67,070 FMP baits over 342.5 km² (132.2 mi²) in Nassau County (Figure 1 *Long Island spring*). Most baits (52,232) were distributed via ground operations by WS, state, county, and local government agencies, and community volunteers, while 14,838 baits were distributed via helicopters provided by the NYSPA. The LI ORV efforts were repeated and expanded in the fall (8-16 and 27-29 September) when 83,230 FMP baits were distributed via NYSPA helicopters over 422.5 km² (163.1 mi²) of Nassau, Queens, and Suffolk Counties (Figure 1 *Long Island fall*).

Western New York.--On 29 August, WS cooperated with CU to distribute 386,074 ORV baits over 6,021 km² (2324.8 mi²) in Cattaraugus, Chautauqua, Erie, Niagara, and Wyoming Counties; 294,907 of those baits were CS distributed by fixed wing aircraft provided by the OMNR, while 63,840 FMP baits were distributed via NYSPA helicopters. Ground bait distribution included 23,058 FMP baits and 4,269 FMP baits were placed in bait stations in the Buffalo area.

Enhanced Surveillance

St. Lawrence Road Kill Survey.--The last rabid raccoon in St. Lawrence County was confirmed in March 2002. In preparation of shifting the ORV zone, WS conducted an extensive road kill survey in 2005 to enhance rabies surveillance and better define the prevalence and distribution of raccoon rabies in the St. Lawrence Region. The survey was conducted from June-August and included major roadways throughout the bait zone in Franklin, Jefferson, and St. Lawrence Counties. Over the course of the 10-week survey 23,733 km (14,741 mi) of roads were driven, resulting in 80 specimens (62 raccoons, 6 red foxes [*Vulpes vulpes*] and 12 skunks) that were submitted to the NYSDOH's Rabies Laboratory at the Wadsworth Center (WC). All samples tested negative for rabies.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, WS is not planning training or implementation of the dRIT because the WC is meeting enhanced surveillance testing needs.

Population Monitoring

Wildlife Services conducted 2 raccoon density studies in 2005 in Suffolk County (Figure 1). The National Rabies Management Program standard protocol (50 traps set on a target study area of 3 km² for 10 consecutive nights) was used and both studies coincided with post-ORV trapping in October. The studies will help determine ORV bait densities for Suffolk County, should raccoon rabies spread and reach the population there.

Both study areas were within forested county parks with campgrounds, near or surrounded by an urban/suburban interface. Sears Bellows County Park (eastern Suffolk County) is a 693-acre park within the Long Island pine barrens, while Southaven County Park (central Suffolk County) is a 1,323-acre pine-oak forested park. The index to density varied from approximately 7 raccoons/km² to over 25 raccoons/km² (Table 1). Blood samples were collected from 98 of 99 unique raccoons and sent to the WC for rabies virus neutralizing antibody (VNA) testing. All 99 raccoons were immobilized, processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 1. Index to raccoon densities in Suffolk County (Long Island), New York, 2005.

	Sears Bellows County Park	Southaven County Park
Macrohabitat	Urban/suburban interface ^a	Urban/suburban interface ^a
Trap nights	500	500
Unique raccoons	24	75
Recaptured raccoons	10	32
Total raccoons	34	107
Trap success ^b	4.8	15.0%
Non-target captures	39	24
Area (km ²)	3.39	2.94
Raccoon density index ^c	7.1	25.5

^a Study was conducted in a forested park within an urban/suburban interface; there are no large tracts of contiguous forest remaining on Long Island, New York.

^b Trap success = (unique raccoons ÷ trap nights) x 100.

^c Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

Post-ORV Monitoring

Champlain Valley.--From 26-30 September 2005, WS assisted the NYSDOH with post-ORV evaluation trapping and collected blood serum and tooth samples as well as other biological data from 111 raccoons in Essex County. All raccoons were immobilized, processed and released.

St. Lawrence Region.--Post-ORV sampling for the SLR ORV zone was initiated on 27 September 2005. Cage traps were used over 670 trap nights to capture 152 unique raccoons in the SLR zone. All raccoons were immobilized, processed and released.

Long Island.--Wildlife Services assisted the NYSDOH with post-spring ORV evaluation trapping (in June 2005) and collected blood serum and tooth samples as well as other biological data from 474 raccoons in Nassau County. All raccoons were immobilized, processed and released. In the fall, WS assisted the NYSDOH with post-fall ORV trapping. In addition to the 99 raccoons captured during density studies, 298 raccoons were immobilized, processed, and released in November 2005. All raccoons captured in the LI ORV zone in 2005 were hand vaccinated with 1 ml of Imrab3® rabies vaccine (Merial Limited).

Western New York.--Wildlife Services did not conduct post-ORV monitoring activities in the WNY ORV zone in 2005.

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, may result in a significantly under-vaccinated subset of the local raccoon population. These under-vaccinated areas may represent corridors through which raccoon rabies could spread, thereby compromising larger ORV efforts; raccoons have been documented crossing major rivers (e.g., New York WS has captured raccoons tagged in Canada by the OMNR).

Since 2001, WS has been involved in a multi-year study to assess aerial ORV baiting efficacy along the St. Lawrence River shoreline (Figure 2). Flight lines have traditionally been flown perpendicular to the shoreline. To avoid a significant loss of baits in the river and striking clustered shoreline houses and residents, ORV baiting machines are turned off as aircraft approach the shoreline. Steep topography, numerous small islands, a highly developed shoreline, and a state highway paralleling the river typify the study area, posing challenges for aerial bait distribution to targeted raccoon habitat.

To address these concerns, rabies VNA in raccoons trapped prior to annual ORV were compared to post-ORV antibody levels in 2001 and 2002; FMP baits were used at a standard aerial baiting density of 75 baits/km² (Table 2). Serology samples collected prior to annual ORV were from areas that had been baited in previous years. In 2003, the river study continued to be baited from aircraft but was supplemented by ground baiting using FMP baits at 75 baits/km². This data was compared to aerial baiting only from previous years (Table 2). In 2004, the study mimicked 2003, but the ground 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. Both sections were aerially baited but supplemented with ground baiting; 1 section at 75 baits/km², the other at 150 baits/km² (Table 2).

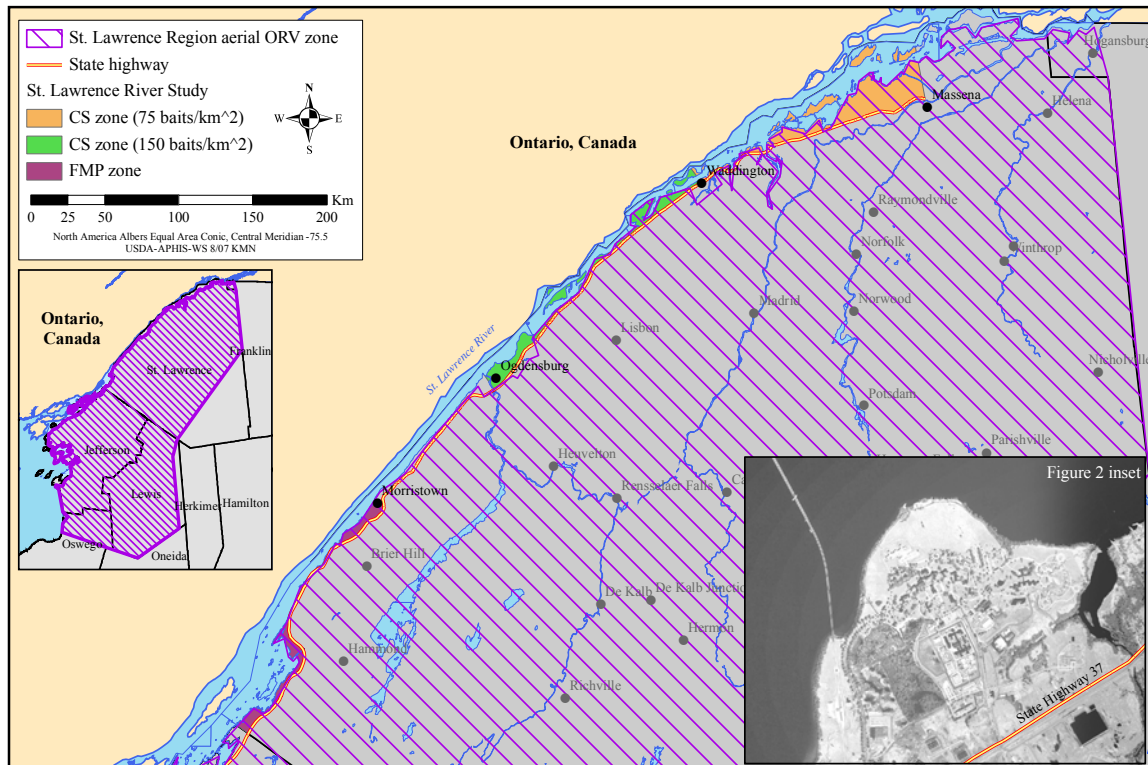


Figure 2. St. Lawrence River study area showing different oral rabies vaccine (ORV) bait types and bait densities, 2001-2004; and typical river shoreline habitat with clustered residential housing (inset).

Information collected during the River Study was used to: identify the percentage of raccoons in the study areas with detectable levels of rabies antibodies, identify the number of animals that consumed baits, and assess the impact of ground baiting to augment aerial bait distribution. As a result of rabies VNA analysis of the various baiting strategies, aerial flight lines were flown parallel to the river in 2005. The results of this study may have broader implications to national ORV programs, as increased human activity is associated with shorelines.

Table 2. Results of raccoon biological samples collected by Wildlife Services during the St. Lawrence River Study in New York, 2001-2004.

	2001 Pre ^a	2001 Post	2002 Pre	2002 Post	2003 Post	2004 Post	2004 Pre	2004 Post	2004 Post
ORV bait type ^b	FMP	FMP	FMP	FMP	FMP	FMP	CS	CS	CS
Bait density/km ²	75	75	75	75	75	150	75	75	150
Bait distribution method	aerial	aerial	aerial	aerial	ground	ground	aerial	ground	ground
Weeks post-ORV	48	4-8	44	4-8	4-8	4-8	32	4-8	4-8
Serology									
Testable blood samples	76	32	58	73	81	80	113	51	48
Positive rabies antibody response (≥ 0.05 IU)	11 (14.5%)	7 (21.9%)	17 (29.3%)	19 (26.0%)	40 (49.4%)	25 (31.3%)	29 (25.7%)	11 (21.6%)	9 (18.8%)
Tetracycline biomarker									
Testable tooth samples	69	33	50	69	81	77	n/a ^c	n/a ^c	n/a ^c
Presence of tetracycline biomarker	21 (30.4%)	10 (30.3%)	19 (38.0%)	23 (33.3%)	42 (51.9%)	53 (68.8%)			

^a Pre means samples were collected prior to that year's bait distribution, but samples were collected in an area that had been previously baited.

^b ORV=oral rabies vaccination; FMP=fishmeal polymer; CS=fishmeal coated sachet.

^c Teeth not tested because coated sachet baits do not contain a tetracycline biomarker.

To further document raccoon fidelity to developed shoreline habitat and monitor raccoon movements while ORV baits were distributed, radio telemetry was used to document the movement patterns of 13 raccoons captured along the River. Intensive dusk to dawn monitoring began 4 weeks prior to and continued 2 weeks after bait distribution activities. Wildlife Services documented approximately 50 locations per raccoon. Home range analysis from this study indicated that 10 of 13 raccoons spent most of their time along the river shoreline, likely precluding them from accessing aerially distributed baits. Data analysis also indicated that average home range size for males and females was equal at 0.7 km² (0.27 mi²) each.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 57 gray squirrels (*Sciurus carolinensis*), 41 opossums (*Didelphis virginiana*), 24 striped skunks, 15 domestic/feral cats (*Felis catus*), 7 porcupines (*Erethizon dorsatum*), 2 Eastern cottontails (*Sylvilagus floridanus*), 2 fishers (*Martes pennanti*), 2 gray foxes (*Urocyon cinereoargenteus*), 1 mink (*Mustela vison*), 1 snowshoe hare (*Lepus americanus*), and 1 woodchuck.

Rabies Laboratory Cooperation

New York WS cooperates with the NYSDOH's Rabies Laboratory at the WC in support of the ORV programs throughout New York. The WC cooperates in rabies surveillance efforts by testing brainstems for the rabies virus. They also collaborate in ORV evaluation efforts by testing wildlife serum for rabies VNA.

Rabies Virus Testing.--The WC tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Animal Control Officers, Conservation Officers, county health departments, veterinarians, and the public) and enhanced surveillance (specimens not involved in an exposure and usually submitted by WS). The WC received 8,318 animals for rabies testing in 2005, representing a 1.7% decrease from the number of samples received statewide in 2004. In 2005, animals were submitted to the WC from 57 of 62 counties throughout the state, including 14 of 15 ORV counties: Cattaraugus, Chautauqua, Erie, Essex, Franklin, Jefferson, Lewis, Nassau, Niagara, Oneida, Oswego, St. Lawrence, Suffolk, and Wyoming. For the most part the New York City Department of Health and Mental Hygiene (NYCDH) examines rabies specimens from the 5 New York City counties: Bronx, Kings, New York, Queens (ORV county), and Richmond. The WC confirmed 564 cases of rabies statewide in 2005; of these, 13.8% were raccoons from counties treated with ORV (Table 3). The WC confirmed an additional rabid bat (*Chiroptera* spp.) from Pennsylvania and the NYCDH confirmed 28 cases of rabies (out of 528 specimens received); none of these data are included in Table 3. The WC and the NYCDH confirmed a total of 592 cases of rabies from New York State in 2005.

Raccoons, skunks, and foxes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 80.9% of the animals submitted to the WC for rabies testing in New York in 2005 are reported by WS as "other." For a detailed listing of current and historical rabies data from New York State please visit:

<http://www.wadsworth.org/rabies/index.htm>

Table 3. Rabies positives/animals submitted for rabies testing to the New York State Department of Health's Rabies Laboratory at the Wadsworth Center in New York, 2005.

	Statewide ^a	Champlain Valley ^b ORV counties	St. Lawrence Region ^b ORV counties	Long Island ^b ORV counties	Western New York ^b ORV counties
Raccoons	334/1127	0/8	15/114	35/294	28/100
Skunks	86/279	0/3	7/35	0/0	4/12
Foxes	24/184	0/0	1/20	0/2	1/11
Other ^d	120/6728	3/69	11/656	3/210	13/877
Total	564/8318	3/80	34/825	38/506	46/1000

^a A small number of submissions (but no positives) were from outside of New York State.

^b Champlain Valley: Essex County; St. Lawrence Region: Franklin, Jefferson, Lewis, Oneida, Oswego, and St. Lawrence Counties; Long Island: Nassau and Suffolk Counties (Queens County is not represented in this table because the New York City Department of Health and Mental Hygiene tests rabies specimens from Queens County); Western New York: Cattaraugus, Chautauqua, Erie, Niagara, and Wyoming Counties.

^d Other animals included: bats, beavers, cats, cows, coyotes, deer, dogs, horses, mules, lagomorphs, rodents, woodchucks, and other domestic and wild animals not listed.

Rabies Virus Neutralizing Antibody Testing.--The WC also analyzed 252 blood serum samples for rabies VNA submitted by New York WS in 2005. This represented a 57.1% decrease from the 587 samples submitted by WS in 2004; no River Study was conducted in 2005. New York WS anticipates approximately 200-300 serum sample submissions to this laboratory in 2006.

ORV PROGRAM 2004 – EVALUATION

New York's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

Wildlife Services did not participate in post-ORV evaluation of the WNY ORV zone in 2004. As the lead agency on the CV and LI ORV zones, the NYSDOH reports those data. Wildlife Services did conduct live-trapping activities to evaluate the success of the SLR ORV zone in 2004. During this evaluation phase, WS live-trapped 321 raccoons within the SLR zone from a density study on Grindstone Island (conducted prior to 2004 annual baiting) and 2 CS zones (baited at 75 and 150 baits/km², respectively) (Table 4). Blood and tooth samples were collected from most of these animals and serum samples were sent to the WC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Tooth samples collected from the SLR zone were not analyzed for tetracycline biomarker presence because FMP baits have not been aerially distributed in this area since 2003.

Table 4. Serology results of raccoon blood samples collected by Wildlife Services during the evaluation phase of the St. Lawrence Region (SLR) oral rabies vaccination (ORV) program in New York, 2004^a.

	Grindstone Island	Coated sachet 75	Coated sachet 150
Bait density/km ²	75	75	150
Bait distribution method	aerial	aerial	aerial
Weeks post-ORV	49	4-8	4-8
Unique raccoons	88	127	106
		Serology	
Testable blood samples	69	127	99
Positive rabies antibody response (≥0.05 IU)	12 (17.4%)	27 (21.3%)	44 (44.4%)

^a Tooth samples were not analyzed for tetracycline biomarker presence because coated sachet baits do not contain tetracycline and fishmeal polymer baits (which do) have not been aerially distributed in the SLR ORV zone since 2003.

Age Results.--In 2004, 567 raccoon teeth were aged using premolars of live-captured animals and canines of animals found dead or euthanized (Figure 3). These samples were collected from raccoons in the SLR ORV zone and the population was dominated by young of the year juveniles (<1 y.o.).

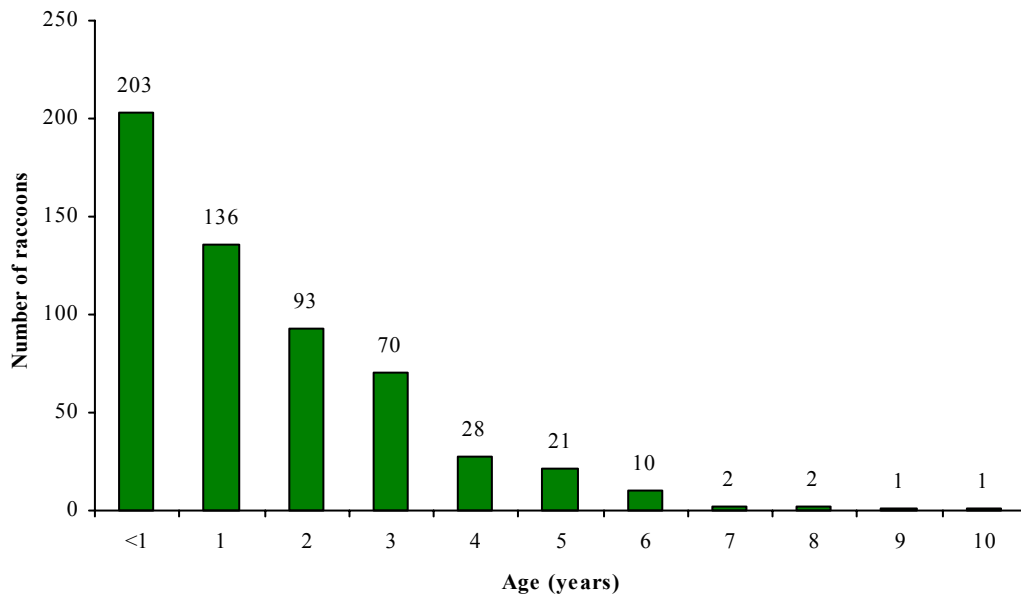


Figure 3. Age results of 567 raccoon tooth samples collected in the St. Lawrence Region of New York, 2004.

SUMMARY

In 2005, New York WS conducted its eighth year of rabies control activities in the SLR ORV zone and assisted the NYSDOH for the seventh year in the CV ORV zone. Wildlife Services also began providing financial support for the first time in the WNY ORV zone and for the second year in the LI ORV zone. Over 1.4 million baits were distributed across the 4 ORV zones to stop the spread of raccoon rabies. While the CV, SLR, and WNY zones are part of a larger northeastern rabies control effort that included Vermont, New Hampshire, Maine and Ontario, Quebec, and New Brunswick, Canada in 2005, the LI ORV program remains critical to limiting raccoon rabies on Long Island.

In 2006, WS will continue to enhance rabies surveillance in the SLR ORV zone, perform raccoon density studies on Long Island, and conduct post-ORV monitoring and evaluation in all 4 zones. Future ORV baiting strategies in New York will continue to be tied to national and international planning efforts to contain the disease and explore strategies to eliminate the raccoon variant of the rabies virus from North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NORTH CAROLINA 2005

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. North Carolina has thus become the meeting point for 3 waves of the raccoon variant of the rabies virus. Presently, 95 of 100 counties have reported cases of raccoon rabies. The remaining 5 counties not reporting cases are in the western portion of the state (Figure 1). They are all in rural areas and do not have active animal control agencies, likely contributing to the fact that they have not reported any cases of raccoon rabies. In 2005, rabies positive cases were reported in Tennessee just west of the North Carolina border along the Nolichucky River basin (Figure 1). These cases, and the increasing number of positives from North Carolina border counties (especially Yancey County), confirmed that the epizootic was breaching the Appalachian Ridge (AR) oral rabies vaccination (ORV) zone along the major river valleys. In an attempt to control this breach, Wildlife Services (WS) decided to extend the AR zone into North Carolina in 2005, along both the Nolichucky and French Broad River basins (Figure 1).

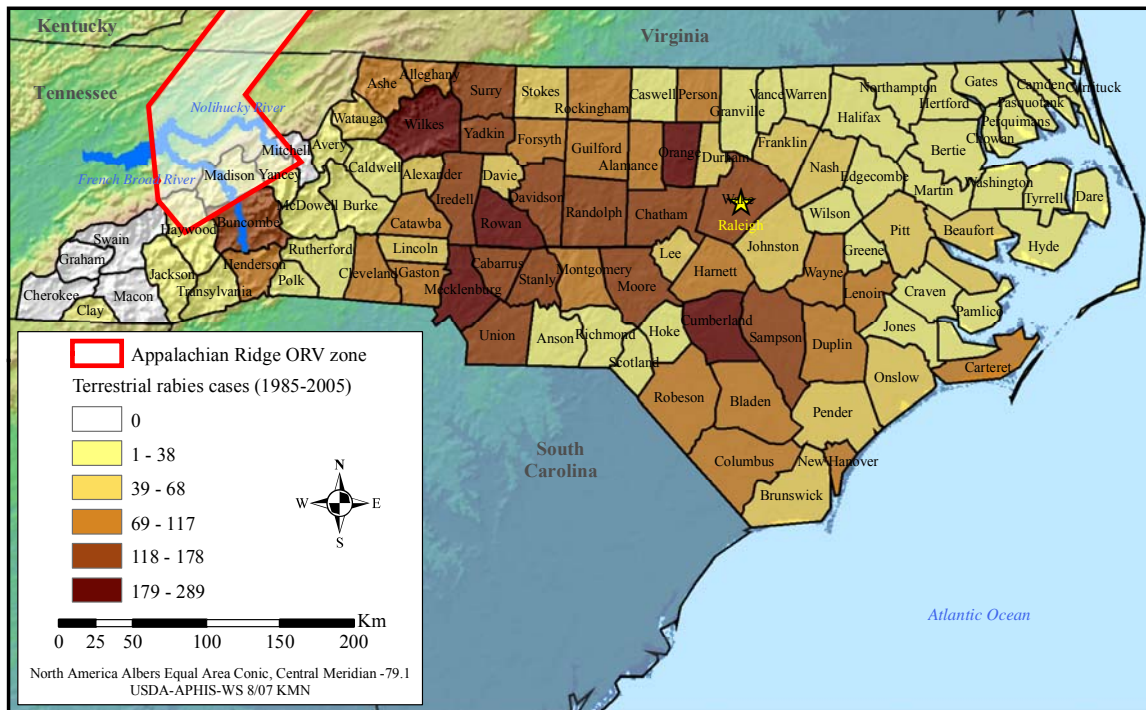


Figure 1. Wildlife Services cooperative rabies management program activities in North Carolina, 2005.

ORV PROGRAM 2005

Bait Distribution

For the first year in 2005, WS participated in bait distribution efforts in North Carolina; 135,857 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 2,475.1 km² (955.7 mi²). The ORV zone included portions of Buncombe, Haywood, Madison, Mitchell, and Yancey Counties. During 8-17 August 2005 bait distribution efforts, 133,698 fishmeal-coated sachets (CS) were distributed by fixed-

wing aircraft (provided by Dynamic Aviation Group Inc. [Bridgewater, Virginia, USA]), while 2,159 fishmeal polymer (FMP) baits were distributed by hand (in urban areas of Madison, Mitchell, and Yancey Counties).

Enhanced Surveillance

North Carolina WS initiated an enhanced rabies surveillance program in 2004 to better document the extent of rabies cases near the western front of the disease (along the North Carolina-Tennessee border). All of the Tennessee border counties are along the AR, thought to pose a potential natural barrier to the westward spread of raccoon rabies. Historically, only 4 of 10 border counties had active animal control agencies and many used regional health departments rather than county level departments. The lack of animal control personnel, coupled with the rural nature of the area, contributed to sporadic rabies surveillance efforts as compared to the rest of the state.

An increase in rabid animals in Yancey County in 2005 (16 animals compared to 1 case of rabies in 2004) prompted the county to add a full time animal control person to their staff. In addition, WS made a half-time position (filled in 2004 to enhance rabies surveillance) a full-time position in 2005. This Wildlife Specialist worked with local authorities to increase the number of animals submitted for rabies testing from 29 in 2004 to 212 in 2005 (Table 1). Species included raccoon, gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and bobcat (*Lynx rufus*). Cooperators were able to freeze carcasses of road killed and suspect rabid animals, while completing a data sheet containing basic biological information about the animal. Wildlife Services personnel prepared the carcasses (head/brainstem removal, etc.) and submitted 103 samples to the Virginia Division of Consolidated Laboratory Services (VDCLS) for rabies testing. All positive samples were confirmed as the raccoon variant of the rabies virus.

Table 1. Results of enhanced surveillance samples tested for rabies by the Virginia Division of Consolidated Laboratory Services and Wildlife Services in North Carolina, 2005.

	Submissions	Rabies Positive
Raccoon	179	66 (36.9%)
Gray fox	13	2 (15.4%)
Striped skunk	10	4 (40.0%)
Coyote	6	0
Red fox	3	0
Bobcat	1	0
Total	212	72 (34.0%)

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

North Carolina WS personnel attended dRIT training in May 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia and implemented the test on 11 October 2005. A laboratory was built in the WS state office in Raleigh and a microscope was donated by the North Carolina Department of Health and Human Services (NCHHS), State Health Laboratory (SHL). During 2005, WS (with cooperator assistance) collected 212 animals for enhanced rabies testing and 107 were tested by WS using the dRIT (50.5%). Of the dRIT samples, 43 tested positive, 61 tested negative, and 3 were indeterminate. All positives, 10% of all negatives, and all indeterminate samples were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples. They also confirmed the 3 indeterminates as negative and typed all positives as raccoon rabies variant. Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid animals in North Carolina.

ORV Naïve Monitoring

Wildlife Services refers to areas that have never been treated with ORV as “ORV naïve.” From 11-15 July 2005, trapping was initiated prior to ORV distribution in the naïve areas of Yancey, Mitchell, and, Madison counties. Blood serum samples from 30 raccoons were collected to measure the baseline presence of rabies virus neutralizing antibody (VNA) response in this ORV naïve area. Tooth samples from 28 of those raccoons were also collected and will be submitted in 2006 for age analysis. All raccoons were immobilized, processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Post-ORV Monitoring

From 6-17 September 2005, WS conducted post-ORV trapping activities in Yancey, Mitchell, Madison and Haywood counties. Blood serum samples from 133 raccoons and 4 striped skunks were collected to measure the presence of rabies VNA response in this ORV zone. Tooth samples from 78 of those raccoons were also collected and will be submitted in 2006 for age analysis. All raccoons but 1 (132) and the 4 skunks were immobilized, processed and released. One raccoon was euthanized because it was exhibiting self-mutilating behavior. Wildlife Services tested it using the dRIT and it was positive for rabies. The CDC confirmed it as raccoon variant. All animals euthanized by WS in 2005 were done so in accordance with the American Veterinary Medical Association’s Panel on Euthanasia recommendations.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 139 opossums (*Didelphis virginiana*), 8 domestic cats (*Felis catus*), 5 striped skunks, 4 Eastern box turtles (*Terrapene carolina*), 3 Eastern woodrats (*Neotoma floridana*), 1 domestic dog (*Canis familiaris*), 1 Eastern cottontail (*Sylvilagus floridanus*), 1 red fox, 1 river otter (*Lutra canadensis*), and 1 woodchuck (*Marmota monax*).

Rabies Laboratory Cooperation

Wildlife Services’ ORV program in North Carolina cooperates with the SHL, the VDCLS, and the CDC.

North Carolina Department of Health and Human Services, State Health Laboratory.--The SHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). The SHL received 3,910 samples for rabies virus testing in 2005 and confirmed 459 positives (Table 2). In recent years, the SHL has conducted rabies virus typing on all non-raccoon terrestrial wildlife samples; they have all been confirmed as raccoon variant.

Raccoons, foxes, skunks, coyotes, and bobcats are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 76.2 % of the animals tested for rabies by the SHL in 2005 are reported by WS as “other.” For a full listing of rabid animals in North Carolina by county and species from 1990 to the present please visit:

<http://www.epi.state.nc.us/epi/rabies/state.html>

The NCHHS has records on rabies cases dating back to 1952. These data show the spread of raccoon rabies across many counties during the 1990’s. These data also demonstrate where the greatest human/wildlife rabies interactions have been occurring for the past 15 years. Unfortunately, the public health surveillance data is currently available at a county level only. The SHL has considered more specific location data but cite time and expense as limiting factors for inputting these type of data. Customer privacy issues were also cited as potential limiting factors when requiring more specific location data for rabies samples. The SHL and WS have considered geo-referencing historical rabies data, but quite often the address of record (from the complainant, etc.) is not necessarily the location of exposure or animal/sample collection.

Table 2. Animals submitted and tested for rabies by the North Carolina Department of Health and Human Services (NCHHS), State Health Laboratory in North Carolina, 2005.

	Submissions	Rabies Positive
Raccoons	653	276 (42.3%)
Foxes	175	68 (38.9%)
Skunks	91	60 (65.9%)
Coyotes	7	1 (14.3%)
Bobcats	4	2 (50.0%)
Other ^a	2,980	51 (1.7%)
Total	3,910	458 (11.7%)

^a Other animals included: bats, bear, beaver, cats, chipmunks, coatimundi, cows, deer, dogs, ferrets, goats, guinea pig, hamsters, horses, humans, llamas, mice, moles, muskrats, opossums, rabbits, rats, sheep, squirrels, weasel, wolf-dog hybrids, wolves, and woodchucks.

Virginia Division of Consolidated Laboratory Services.--The VDCLS is under a regional contract with WS to test animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). Wildlife Services submitted 103 samples to the VDCLS for rabies testing in 2005 (Table 1). The North Carolina ORV program does not anticipate submissions to the VDCLS in 2006 due to implementation of the dRIT. For more information about the VDCLS please visit: <http://dcls.dgs.state.va.us/>

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA. North Carolina WS submitted 167 blood serum samples for rabies VNA analysis to the CDC in 2005. There were no samples submitted in 2004, as WS was not involved in an ORV program in North Carolina at that time. The North Carolina ORV program anticipates similar numbers of serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

An ORV program did not exist in North Carolina prior to 2005, therefore no evaluation results exist for 2004.

SUMMARY

During 2005, WS completed its second year of cooperative participation in rabies management in North Carolina, and its first year conducting ORV bait distribution activities. Other activities in 2005 included enhanced surveillance of raccoon rabies, trapping in an ORV naïve area, and post-ORV monitoring and evaluation in western North Carolina along the Tennessee border. Future ORV baiting strategies in North Carolina will continue to be directed towards halting the spread of raccoon rabies into the western U.S. The North Carolina ORV zone will continue to be tied to national and international planning efforts to contain the disease and explore strategies to eliminate the raccoon variant of the rabies virus from North America.

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WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM OHIO 2005

BACKGROUND

The raccoon (*Procyon lotor*) variant of the rabies virus was first documented in Ohio in 1996 (Mahoning County). Rabies cases continued to escalate and in April 1997 an epizootic of raccoon rabies was identified in northeastern Ohio, with 62 positive cases by year's end. Due to this 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 rabies. The original ORV bait zone included Trumbull, Mahoning, and Columbiana Counties, and encompassed 1,780 km² (688 mi²). With increased surveillance, raccoon rabies cases were confirmed outside the ORV zone. Subsequently, in the fall 1999, the ORV zone more than tripled in size to include Ashtabula, Trumbull, Mahoning, Columbiana, Carroll, and Jefferson Counties, encompassing 6,497 km² (2,509 mi²). By 2004, the ORV zone had nearly doubled again to 11,845 km² (4,573 mi²) and included Ashtabula, Trumbull, Mahoning, Columbiana, Carroll, Jefferson, Harrison, Belmont, Monroe, and Washington Counties. Despite this long-standing ORV zone, in July 2004, a rabid raccoon (with raccoon variant) was confirmed 10.6 km (6.6 mi) west of the zone in Lake County, marking the western-most case of raccoon rabies in Ohio. This case triggered a contingency action response (that included enhanced rabies surveillance via local raccoon depopulation, trap-vaccinate-release, and ORV bait distribution) over 2,471 km² (954 mi²) of Cuyahoga, Geauga, Lake, Portage, and Summit Counties. In 2005, Ohio maintained both the contingency action (CA) and the historic Appalachian Ridge (AR) ORV zones (Figure 1), which are part of a larger zone that stretches from Lake Erie to the Appalachian Mountains of Tennessee and North Carolina.

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

ORV PROGRAM 2005

Bait Distribution

Wildlife Services participated in bait distribution efforts in eastern Ohio for the ninth consecutive year in the AR ORV zone and for the second year in the CA ORV zone; 1,133,042 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 12,506 km² (4,829 mi²) in 2005 (Figure 1). Target bait density for the Ohio ORV zones is 75/km². Since its program inception in 1997, WS has cooperated to distribute 8,294,654 ORV baits in Ohio.

Contingency Action.--In April 2005, the CA ORV zone in Cuyahoga, Geauga, Lake, Portage, and Summit Counties was baited for the second year (initially baited in September 2004). From 25-28 April, 237,600 ORV baits were distributed over 2,829 km² (1,093 mi²): 127,546 fishmeal coated sachet (CS) baits via fixed-wing aircraft; 93,240 fishmeal polymer (FMP) baits via ground operations (hand baiting); and 16,814 FMP baits via helicopter. Fixed-wing aircraft and pilots were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while helicopters and flight crew were provided by the ODNR. Ground and hand baiting support was provided by WS, the ODH, the ODNR, and county/local health departments. The CA ORV zone was baited again in September 2005 as part of the larger AR ORV zone (see *Appalachian Ridge* below).

Appalachian Ridge.--In 2005, the Ohio portion of the AR ORV zone covered 12,506 km² (4,829 mi²) in 16 counties (Figure 1). From 6-15 September, 895,442 ORV baits were distributed: 701,899 CS baits via fixed-wing aircraft; 153,827 FMP baits via hand baiting; and 39,716 FMP baits via helicopter. Fixed-wing aircraft and flight crew were provided by the Ontario Ministry of Natural Resources, while helicopters and flight crew were provided by the ODNR. Ground and hand baiting support was provided by WS, the ODH, the ODNR, the ODA, the Ohio National Guard, and county/local health departments.

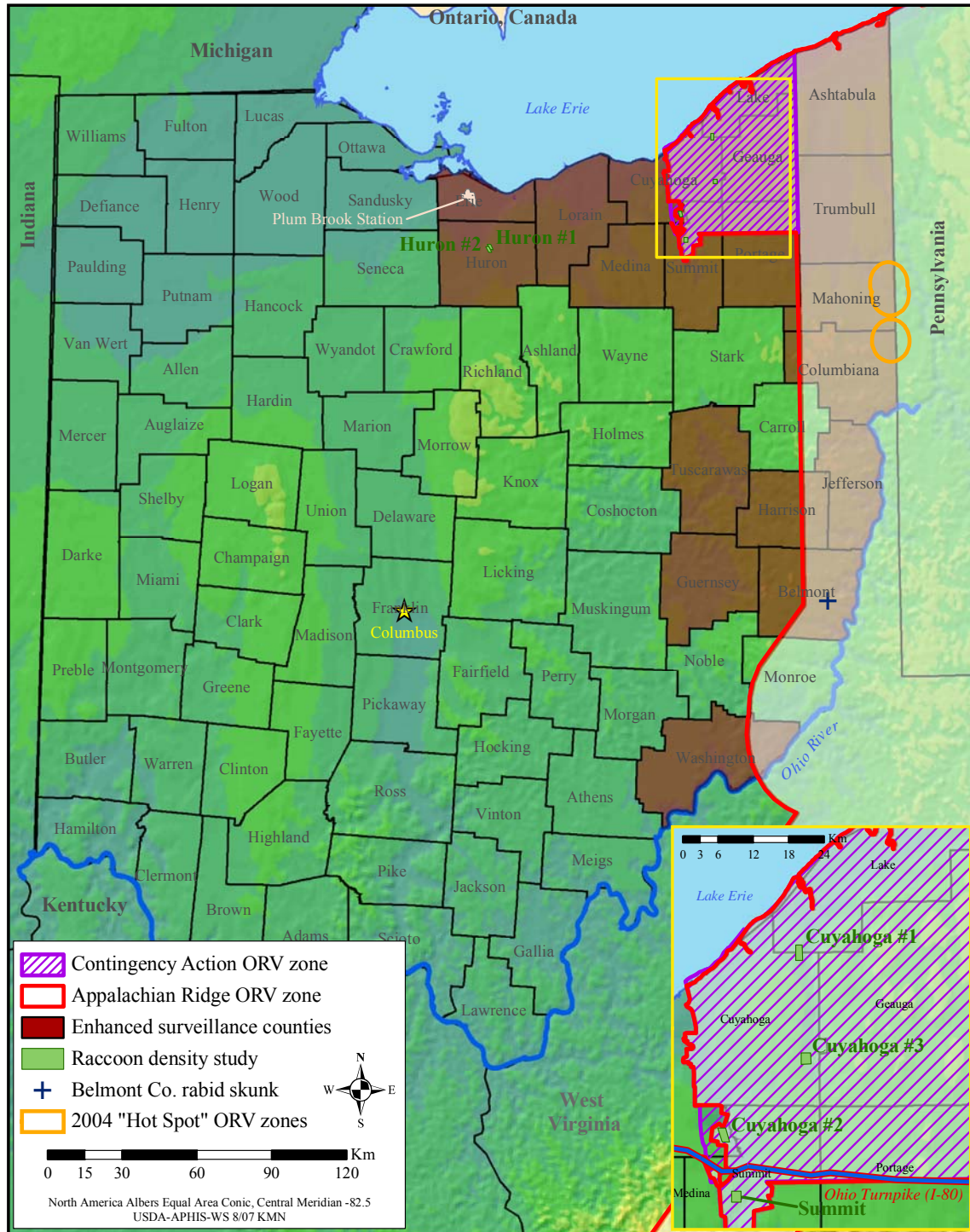


Figure 1. Wildlife Services cooperative rabies management program activities in Ohio, 2005.

Enhanced Surveillance

In 2005, WS enhanced surveillance of raccoon rabies by collecting, submitting, and testing suspect rabid animals from counties in or near the Ohio ORV zones (Figure 1). Wildlife Services collected animals by the following methods: 1) humanely euthanizing (according to the American Veterinary Medical Association’s Panel on Euthanasia recommendations) raccoons that had puncture wounds/bite marks, exhibited disorientation, or

showed signs of illness during trapping activities; 2) conducting road kill surveys and collecting mammals in suitable testing condition; 3) obtaining wildlife reported by Ohio residents as displaying rabies-like symptoms; and 4) obtaining wildlife from nuisance wildlife control officers. Wildlife Services also continued to work with state and local health departments to increase the number of enhanced surveillance samples for rabies testing.

As a result of enhanced surveillance efforts throughout Ohio, WS cooperated to collect and submit 3,229 animals for rabies testing: 2,968 raccoons, 208 striped skunks (*Mephitis mephitis*), 23 domestic/feral cats (*Felis catus*), 11 coyotes (*Canis latrans*), 6 red foxes (*Vulpes vulpes*), 4 mink (*Mustela vison*), 3 woodchucks (*Marmota monax*), 2 domestic/feral dogs (*Canis familiaris*), 2 fox squirrels (*Sciurus niger*), and 2 opossums (*Didelphis virginiana*). Of those samples, 2,807 (86.9%) came from counties in or adjacent to the 2004 CA ORV zone.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Ohio WS personnel attended dRIT training in April and May 2005 at the CDC in Atlanta, Georgia and implemented the test on 9 June 2005. During 2005, WS collected 3,229 samples for rabies testing and 1,845 (57.1%) were tested by WS using the dRIT (Table 1). Of the dRIT samples, 12 tested positive, 1,825 tested negative, and 8 were indeterminate. All positives, 10% of all negatives, and all indeterminate samples were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples. They also confirmed the 8 indeterminates as negative and typed all positives as raccoon rabies variant. Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid animals in Ohio.

Table 1. Animals tested for rabies by Wildlife Services using the Direct Rapid Immunohistochemistry Test (dRIT) in or adjacent to ORV counties in Ohio, 2005 (raccoon rabies variant positives in parentheses).

County	Raccoon	Skunk	Red fox	Coyote	Feral cat	Other ^a	Total
Ashtabula	20						20
Belmont	25						25
Columbiana	32						32
Cuyahoga	1,002 (2)	2	2		6		1,012 (2)
Erie ^a	57						57
Geauga	88 (4)	1				4	93 (4)
Guernsey ^b	1						1
Harrison	6						6
Huron ^b	95						95
Jefferson	6			1			7
Lake	80 (6)	34	2			3	119 (6)
Lorain ^b	20						20
Mahoning	19					1	20
Medina ^b	45	2				1	48
Portage	174	1					175
Summit	80	1		1			82
Trumbull	29	1					30
Tuscarawas ^b	1						1
Washington	2						2
Total	1,782 (12)	42	4	2	6	9	1,845 (12)

^a Other animals included: 3 mink and 1 woodchuck in Geauga Co.; 1 fox squirrel, 1 opossum, and 1 woodchuck in Lake Co.; 1 fox squirrel in Mahoning Co.; and 1 woodchuck in Medina Co.

^b ORV not applied in this county.

Population Monitoring

In 2005, WS conducted 6 raccoon density studies using the National Rabies Management Program (NRMP) protocols; 1 in Summit, 3 in Cuyahoga, (Figure 1 inset) and 2 in Huron Counties. The Summit and Cuyahoga studies provided an index to raccoon densities in urban/suburban environments, representative of habitat found throughout the CA ORV zone. The Huron studies were conducted in ORV naïve areas (never treated with ORV) west of the current zones to provide an index to raccoon densities in agricultural environments, representative of habitat found in western Ohio. During 3 studies, the NRMP standard protocol for indexing raccoon density was used (50 traps set on a target study area of 3 km² for 10 consecutive nights), and the NRMP high density protocol (traps set for 15 consecutive nights) was used during the other 3 studies. During the 6 studies, 571 unique raccoons were captured and blood and tooth samples were collected from most of them (Table 2). Three raccoons were found dead in traps, 60 raccoons were immobilized, processed and released and 508 raccoons were immobilized, processed, euthanized and tested to enhance rabies surveillance. One raccoon from the Cuyahoga #1 study tested positive for rabies (Table 1). All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 2. Index to raccoon densities in Summit, Cuyahoga, and Huron Counties in Ohio, 2005.

	Summit	Cuyahoga #1	Cuyahoga #2	Cuyahoga #3	Huron #1	Huron #2
Time of study	1-11 Jun.	1-16 Jun.	1-16 Aug.	1-16 Aug.	25 Jul.-4 Aug.	25 Jul.-4 Aug.
Weeks post-ORV	5-6	5-7	14-16	14-16	n/a ^a	n/a ^a
Macrohabitat	Urban/suburban	Urban/suburban	Urban/suburban	Urban/suburban	Agriculture	Agriculture
Target trap nights	500	750	750	750	500	500
Trap type	cage trap	cage trap	cage trap	cage trap	foot-hold trap	cage trap
Unique raccoons	85	106	154	131	49	46
Recaptured raccoons	30	0	0	0	0	0
Non-target captures	2	4	2	4	0	17
Area (km ²)	3.02	3.04	3.07	3.15	2.68	2.83
Raccoon density index ^b	28.1	34.9	50.2	41.6	18.3	16.3

^a This study was conducted on an ORV naïve site (never treated with ORV).

^b Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

ORV Naïve Monitoring

Wildlife Services refers to areas that have never been treated with ORV as “ORV naïve.” On 4 April 2005, WS initiated a raccoon live trapping effort in an ORV naïve area of Portage County near the 2004 CA ORV zone. Trapping was conducted 3 weeks prior to 2005 ORV distribution in this area. Samples were collected from 70 raccoons over 660 trap nights. Forty-four raccoons were immobilized, processed and released and 26 raccoons were immobilized, processed, euthanized and tested to enhance rabies surveillance; they all tested negative. The data collected during ORV naïve trapping will help to determine the effectiveness of CS baits that were distributed in the area after trapping occurred.

Post-ORV Monitoring

Post-ORV sampling for the spring baiting of the CA ORV zone was initiated on 23 May 2005 in an area of Portage County that was baited for the first time in 2005. Results from this trapping effort will help determine the efficacy of CS versus FMP baits. Cage traps were used to capture 159 unique raccoons over 904 trap nights. Eleven raccoons were immobilized, processed and released, while 148 raccoons were euthanized and tested to enhance rabies surveillance; they all tested negative (Table 1).

Post-ORV sampling for Ohio’s fall baiting of the AR ORV zone (which included a repeat of the CA ORV zone) was initiated on 17 October 2005. Trapping efforts were concentrated in Lake and Geauga Counties, part of the CA ORV zone. Cage traps were used to capture 83 unique raccoons over 1,354 trap nights: 64 raccoons were immobilized, processed and released, while 19 raccoons were euthanized and tested to enhance rabies surveillance (Table 1).

Other Rabies Management Program Activities

Plum Brook Station Enhanced Surveillance Trapping.--In the summer 2005, WS conducted trapping activities on Plum Brook Station in Sandusky, Ohio (Erie County) (Figure 1) to obtain background information on raccoons in the area by collecting blood and tooth samples. Samples were collected from 122 raccoons over 430 trap nights; 1 raccoon was found dead in a trap and 49 raccoons were euthanized and tested to enhance rabies surveillance. They all tested negative for rabies.

Belmont County Enhanced Surveillance Trapping.--On 10 November 2005, the first case of raccoon variant rabies was confirmed in Belmont County, Ohio (in a striped skunk) (Figure 1). This was also the first ever animal confirmed with raccoon rabies west of the Ohio River, which had presumably served as natural barrier to the spread of raccoon rabies. In response, WS began trapping within a 1.6 km (1 mi) radius of the skunk to help identify additional cases. Wildlife Services also worked with the state and local health departments to enhance rabies surveillance within the county. Trapping efforts yielded 7 raccoons over 263 trap nights. All raccoons were euthanized and tested for rabies (Table 1). Road kill collections and other enhanced surveillance activities produced 19 raccoons from the county. No additional cases of rabies were identified in the area through increased surveillance efforts in 2005.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 47 opossums, 12 Eastern cottontails (*Sylvilagus floridanus*), 8 woodchucks, 6 domestic/feral cats, 1 mink, 1 wood duck (*Aix sponsa*), and 1 wood thrush (*Hylocichla mustelina*).

Non-target animals that were captured and euthanized by WS in 2005 included: 26 opossums, 15 woodchucks, and 2 striped skunks. These animals were all euthanized at the request of property owners or to enhance rabies surveillance.

Rabies Laboratory Cooperation

As part of the ORV program in Ohio, WS cooperates with the ODH Laboratory (ODHL) and the CDC. There were 6,767 animals tested for rabies in Ohio in 2005 (Table 3), and 70 confirmed cases of rabies: 34 raccoons, 31 bats (*Chiroptera* spp.), 2 skunks, 1 coyote, 1 horse (*Equus caballus*), and 1 woodchuck. The horse had North Central skunk rabies variant; all other terrestrial animals had raccoon rabies. Total samples tested by the ODHL, the CDC, and WS increased 37.8% in 2005, as compared to 2004 (n=4,909). Raccoons and skunks from northeast and eastern Ohio accounted for the largest testing increases, 87.2 % and 169.4 % respectively. In 2006, cooperators anticipate an equal or greater number of animals will be tested for rabies given that raccoon rabies cases are still occurring within a 3 county area in northeastern Ohio.

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. This explains why 90.9% of enhanced surveillance samples were from raccoons, skunks, foxes, and coyotes. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 85.9% of public health surveillance samples were from "other" animals (not raccoons, skunks, foxes, and coyotes).

Ohio Department of Health Laboratory.--The ODHL primarily tests animals for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure), although they have historically tested hundreds of enhanced surveillance specimens (animals not involved in an exposure and usually submitted by WS). The ODH Zoonotic Disease Program (ZDP) relies on local health departments to collect and submit animals for rabies testing. Historically, most jurisdictions have been unable to implement enhanced surveillance due to a lack of resources (staff and funding), thereby depending on public health surveillance to monitor rabies in Ohio. Over the last 2 years, WS has provided refrigerators to local health departments (to store animals prior to submission/testing), while ODH has provided reimbursement contracts with 14 northeast counties. These contracts provide local health departments with \$60/animal in compensation for collection, decapitation (usually by a veterinarian), shipment preparation, and staff costs related to animal submission. The ZDP also pays for shipping all animal heads to the ODHL for rabies testing and provides the Laboratory \$189,000/year to support rabies testing. This assistance has led to a more than 2-fold increase in rabies testing in Ohio since 2003 (when 3,223 samples were

tested in the state). For more detailed information on rabies in Ohio over the last decade please visit: <http://www.odh.ohio.gov/odhPrograms/idc/zoodis/rabies/rab1.aspx>

Table 3. Animals tested for rabies via public health and enhanced surveillance systems from within ORV counties in Ohio and statewide, 2005 (rabies testing conducted by the Ohio Department of Health Laboratory, the Centers for Disease Control and Prevention, and Wildlife Services).

Species	Public health surveillance		Enhanced surveillance		Unknown surveillance type	Statewide total ^a
	Statewide	Within ORV counties	Statewide	Within ORV counties		
Raccoons	352	159 (45.2%)	3,246	2,886 (88.9%)	3	3,601
Skunks	31	16 (51.6%)	233	219 (94.0%)	0	264
Foxes	12	7 (58.3%)	12	8 (66.7%)	0	24
Coyotes	1	1 (100.0%)	12	11 (91.7%)	0	13
Other ^b	2,412	544 (22.6%)	349	102 (29.2%)	104	2,865
Total	2,808	727 (25.9%)	3,852	3,226 (83.7%)	107	6,767

^a Includes unknown surveillance type.

^b Other animals included: bats, cats, chipmunks, cows, deer, dogs, ferrets, gerbil, goats, hamsters, horses, llamas/alpaca, mice, mink, moles, muskrats, opossums, pig/hog, rabbits, rats, rodents (unspecified), sheep, squirrels, weasels, woodchucks (groundhogs), wolf-dog hybrids, and other domestic and wild animals (unspecified).

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA).

In 2005, the CDC tested 1,381 wildlife brainstem samples submitted by Ohio WS (including 8 WS dRIT samples that initially yielded “indeterminate” results but were later confirmed negative by the CDC). This was a 28.9% increase from the 1,071 brainstems submitted by Ohio WS in 2004. Ohio WS also submitted 1,010 blood serum samples for rabies VNA analysis to the CDC in 2005. This represented an 18.0% decrease from the 1,192 samples submitted by WS in 2004. The Ohio ORV program anticipates submitting approximately 500 serum samples to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC’s rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Ohio’s 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, WS live-trapped 1,282 raccoons; blood and tooth samples were collected from most of these animals. Serum samples were sent to the CDC, while tooth samples were sent to Matson’s Laboratory LLC (Milltown, Montana, USA). Raccoons were trapped in March and early April 2004 from rabies "hot spot" areas on the border with Pennsylvania (areas that were baited at 75 baits/km² the year before as part of the 2003 AR ORV zone). On 20 April 2004 baits were distributed over these "hot spot" areas at 150 baits/km² (Figure 1). Four weeks later, raccoons were trapped again from these areas to evaluate the efficacy of the double bait density. The positive rabies antibody response declined from 32.4% to 3.4% following the double bait density (Table 4). Late in fall 2003 and again in summer 2004, raccoons were captured from Cuyahoga and Summit Counties (along the Ohio Turnpike in an ORV naïve area [Figure 1 inset]) to gather data in support of reducing the size of the AR ORV zone (at the time scheduled for fall 2004). Immediately following the rabid raccoon confirmed in Lake County, west of the then current AR ORV zone, 956 unique raccoons were trapped in the ORV naïve areas of Cuyahoga, Geauga, and Lake Counties (Table 4). Baits were then distributed over this area (2004 CA ORV zone) at 75 baits/km² and 68 unique

raccoons were trapped 10-11 weeks post-ORV to enhance surveillance and evaluate the efficacy of the CA ORV zone. None of the raccoons trapped post-ORV in the CA zone showed a presence of rabies VNA.

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during ORV program activities in Ohio, 2004.

	Hot spot spring pre ^a	Hot spot spring post-ORV	Turnpike naïve ^b	Contingency action naïve ^b	Contingency action post-ORV
Sample collection timeframe	29 Mar.-9 Apr.	17 May-11 Jun.	27 Nov. 2003-23 Jul. 2004	27 Jul.-12 Aug.	11-22 Oct.
Weeks post-ORV	28-30	4-7	n/a	n/a	10-11
Bait density/km ²	75	150	n/a	n/a	75
Unique raccoons	35	144	79	956	68
Serology					
Testable blood samples	34	89	79	922	68
Positive rabies antibody response (≥0.05 IU)	11 (32.4%)	3 (3.4%)	7 (8.9%)	72 (7.8%)	0
Tetracycline biomarker					
Testable tooth samples	33	128	n/a ^c	n/a ^c	n/a ^d
Presence of tetracycline biomarker	11 (33.3%)	77 (60.2%)			

^a Pre means samples were collected prior to that year's bait distribution, but samples were collected in an area that had been previously baited.

^b Naïve means samples were collected in an ORV naïve area (never before treated with ORV).

^c Teeth were not analyzed for tetracycline biomarker because baits had never been distributed in this area.

^d Teeth were not analyzed for tetracycline biomarker because coated sachet baits were distributed; they do not contain tetracycline.

Age Results.--In 2004, 1,136 raccoon teeth were aged using premolars of live-captured animals and canines of animals found dead or euthanized (Figure 2). These samples were collected from raccoons during the spring ("hot spot") and fall (Turnpike and contingency action) trapping activities. Spring season age results are typical, with the population dominated by adult animals (≥1 y.o.). The fall season results are also expected with the population dominated by young of the year juveniles (<1 y.o.). Six raccoons >10 y.o. were captured: 1 at 11 y.o.; 2 at 12 y.o.; 2 at 13 y.o.; and 1 at 15 y.o.

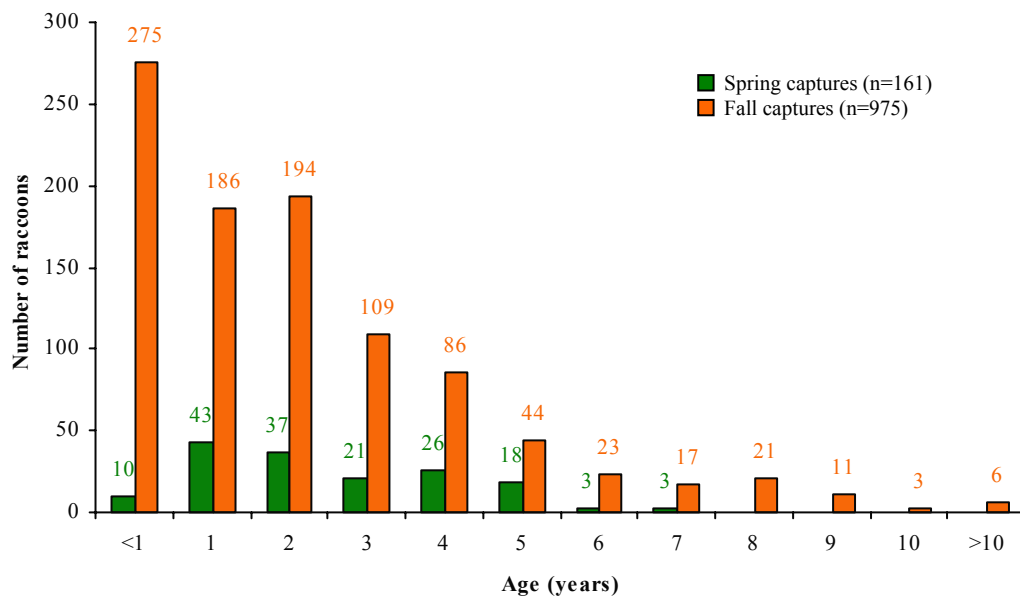


Figure 2. Age distribution of 1,136 raccoon teeth collected by Wildlife Services during oral rabies vaccination program activities in Ohio, 2004.

SUMMARY

In 2005, WS completed its ninth year of cooperative participation in the Ohio ORV program. Over 1.1 million baits were distributed over the AR and CA ORV zones. The focus in 2005 was on enhancing rabies surveillance, particularly in the CA zone, and implementing the dRIT to reduce the burden on public health laboratories and improve turnaround time of test results during a rabies outbreak. Wildlife Services cooperated to collect and submit 3,229 animals for rabies testing, while testing 1,845 of those animals using the dRIT. Six raccoons density studies were conducted in 2005 (4 in urban/suburban environments near Cleveland and 2 in agricultural environments indicative of western Ohio). Trapping was conducted in an ORV naïve area 3 weeks prior to bait distribution and then trapped again post-ORV to determine the effectiveness of CS baits. Post-ORV trapping activities in 2005 focused on counties within the CA zone and yielded 242 raccoons. An additional 122 raccoons were trapped at Plum Brook Station in Sandusky, Ohio (west of the current ORV zones) to obtain background information; and 7 more raccoons were trapped in Belmont County in response to the first case of raccoon variant rabies in the county.

In 2006, WS will continue to: enhance rabies surveillance in the AR and CA zones focusing on Belmont and nearby counties and areas near major urban population centers (Cleveland and other Cuyahoga County cities); participate in ORV bait distribution; perform density studies; and conduct post-ORV monitoring and evaluation in both zones. The Ohio ORV zones continue to be an integral part of a larger Appalachian effort that in 2005 included Maryland, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. Future ORV baiting strategies in Ohio will continue to be tied to national planning efforts to prevent the westward spread of raccoon rabies and explore strategies to eliminate this variant from the U.S.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM PENNSYLVANIA 2005

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 have been confirmed positive for rabies annually. The first oral rabies vaccine (ORV) baits were distributed in Pennsylvania during the fall of 2001; 138,602 baits were hand distributed across 1,875 km² within 2 counties in the northwest corner of the state. This baiting effort was tied to the Appalachian Ridge (AR) ORV zone, with the goal of strengthening the existing ORV zone in eastern Ohio and expanding it eastward to reduce the area where raccoon rabies occurs. In 2002 and 2003, Pennsylvania expanded its baiting program to cover 25,189 km² in 18 western counties bordering Maryland, Ohio, and West Virginia. The program became an integral part of national efforts to create an ORV zone from Lake Erie to the Gulf of Mexico to prevent the westward spread of raccoon rabies. In 2004, Wildlife Services (WS) distributed baits across a similar (although slightly smaller) area of western Pennsylvania and also in previously ORV naïve areas of Cambria, Indiana, Somerset, and Westmoreland Counties. The naïve area was baited in April 2004 as a spring bait efficacy study coupled with a raccoon density study. In 2005, the spring bait study (SBS) area was treated again, a live rabies challenge study was conducted (within the SBS area), and Pennsylvania's portion of the AR zone was baited (Figure 1). The Pennsylvania Department of Agriculture (PDA) provided the state leadership for the baiting effort, while WS provided wildlife management leadership and contributed significant funding. This cooperative initiative should create a vaccinated area of sufficient scope and allow for the exploration of methods to eliminate raccoon rabies from Pennsylvania.

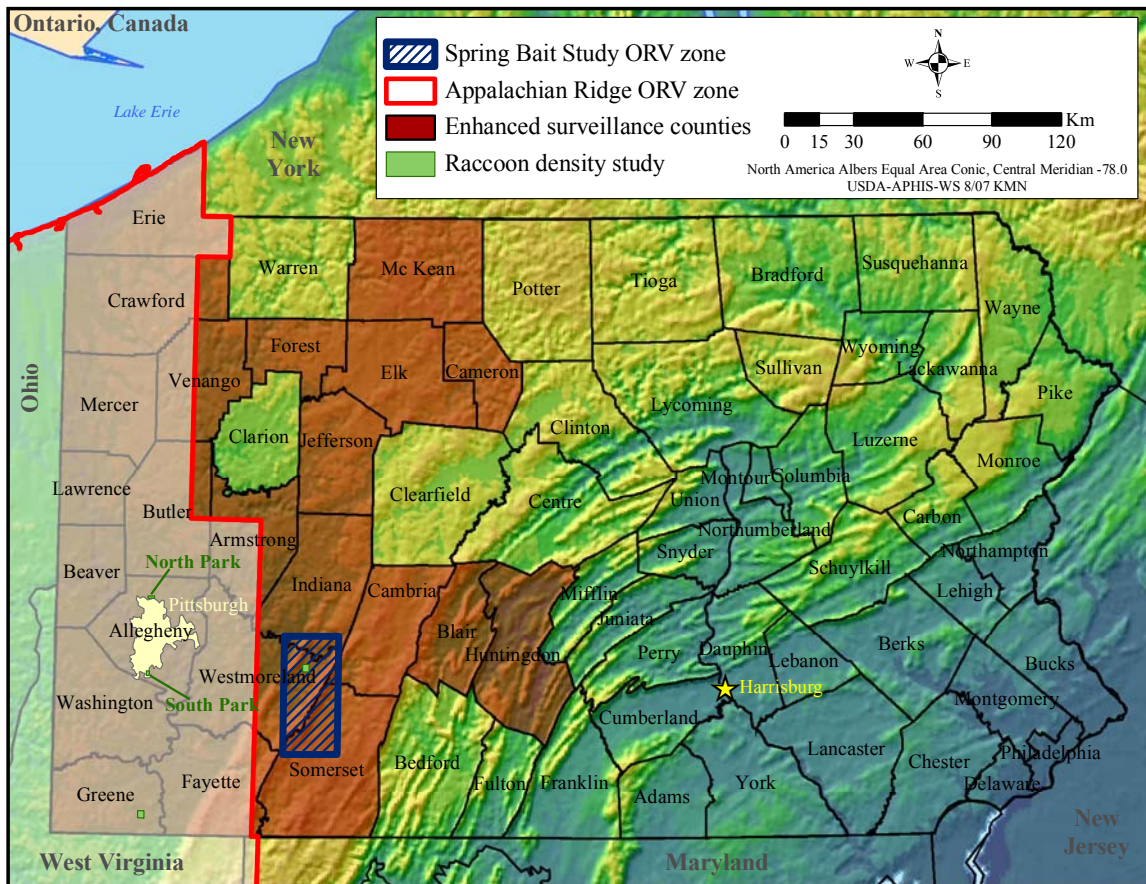


Figure 1. Cooperative rabies management program activities in Pennsylvania, 2005.

ORV PROGRAM 2005

Bait Distribution

For the fifth consecutive year in 2005, WS participated in bait distribution efforts throughout western Pennsylvania; 1,392,506 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 21,802 km² (8,418 mi²). Since its program inception in 2001, WS has distributed 6,577,488 ORV baits in Pennsylvania.

During ground (hand) bait operations, assistance was provided to WS by: the PDA, the Pennsylvania Department of Health (PDH), the Erie County Department of Health, and the Allegheny County Health Department (ACHD). During aerial baiting, aircraft and pilots were provided by the Ontario Ministry of Natural Resources, while WS personnel served as navigators and flight crew in the planes. Ground support for the flights was offered by: the Ohio Department of Health, the Ohio National Guard, the Pennsylvania Game Commission, the PDA, the PDH, and WS employees from Pennsylvania, Maryland, Ohio, and West Virginia.

Spring Bait Study.--In April 2005, the SBS ORV zone covered 1,204 km² (465 mi²) and included portions of Cambria, Indiana, Somerset, and Westmoreland Counties (Figure 1). From 18-29 April, 2,242 fishmeal polymer (FMP) baits were distributed by hand, while 47,144 fishmeal-coated sachet (CS) and 29,266 FMP baits were distributed by fixed-wing aircraft from 25-28 April.

Appalachian Ridge.--In 2005, the Pennsylvania portion of the AR ORV zone covered 20,598 km² (7,953 mi²) and included portions of 15 counties in the western part of the state (Figure 1). From 8-26 August, 204,444 FMP baits (199,254 by hand; 5,190 by boat) were distributed from the ground in areas too populated to bait by air. Aerial bait distribution was conducted from 6-15 September via fixed-wing aircraft; 1,038,400 FMP and 71,010 CS baits were distributed.

Enhanced Surveillance

In 2005, WS enhanced surveillance of raccoon rabies by collecting, submitting, and testing suspect rabid animals from counties in or near the Pennsylvania ORV zones. Wildlife Services collected animals by the following methods: 1) humanely euthanizing (according to the American Veterinary Medical Association's Panel on Euthanasia recommendations) raccoons that had puncture wounds/bite marks, exhibited disorientation, or showed signs of illness during trapping activities; 2) conducting road kill surveys and collecting mammals in suitable testing condition; 3) obtaining wildlife reported by Pennsylvania residents as displaying rabies-like symptoms; and 4) obtaining wildlife from nuisance wildlife control officers. Wildlife Services also continued to work with state and local health departments to increase the number of enhanced surveillance samples for rabies testing.

As a result of enhanced surveillance efforts in western and central Pennsylvania, WS cooperated to collect and submit 719 animals for rabies testing (Table 1). Of those samples, 44 animals (6.1%) tested positive for the raccoon variant of the rabies virus.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Pennsylvania WS personnel attended dRIT training in April 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia and implemented the test on 22 June 2005. During 2005, WS collected 719 samples for rabies testing and 507 were tested by WS using the dRIT (70.5%). Of the dRIT samples, 21 tested positive, 480 tested negative, and 6 were indeterminate. All positives, 10% of all negatives, and all indeterminate samples were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples. They also confirmed the 6 indeterminates as negative and typed all positives as raccoon rabies variant. Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid animals in Pennsylvania.

Table 1. Animals submitted for rabies testing by Wildlife Services (rabies positives in parentheses) in or adjacent to ORV counties in Pennsylvania, 2005.

County	Raccoon	Skunk	Coyote	Gray fox	Red fox	Bobcat	Other ^a	Total
Allegheny	48 (7)		6		1		2	57 (7)
Armstrong	10				1			11
Beaver	31							31
Blair ^b	2							2
Butler	16 (2)	3						19 (2)
Cambria	10 (2)	2 (1)		1	1		2	16 (3)
Cameron ^b							1	1
Crawford	10	1			1			12
Elk ^b	3							3
Erie	28	2						30
Fayette	36	1		2	1	1	6	47
Forest ^b	1							1
Greene	10							10
Huntingdon ^b	2	2						4
Indiana	20 (1)	1			3		3	27 (1)
Jefferson ^b	1							1
Lawrence	42	2		1			1	46
McKean ^b	1	5	1	1	2		1	11
Mercer	18	1			1		1	21
Somerset	49 (8)	5 (1)	3	2	3		1	63 (9)
Unknown ^{b,c}	3							3
Venango	3							3
Washington	54 (3)	2	3		4		8	71 (3)
Westmoreland	205 (18)	8 (1)		3	2		11	229 (19)
Total	603 (41)	35 (3)	13	10	20	1	37	719 (44)

^a Other animals included: black bear, cat, dog, mink, white-tailed deer, woodchuck, and unknown animals (species not recorded).

^b ORV not applied in this county.

^c County name not recorded, but was not from ORV zone.

Population Monitoring

In 2005, WS conducted 4 raccoon density studies using the National Rabies Management Program (NRMP) protocols; 2 in Allegheny, 1 in Greene, and 1 in Westmoreland Counties (Figure 1). The NRMP standard protocol (50 cage traps set on a target study area of 3 km² for 10 consecutive nights) was used during 2 of the studies. The Westmoreland study used the NRMP high density protocol (traps set for 15 consecutive nights). The Westmoreland and Greene studies were inadvertently conducted on approximately 9 km² study areas rather than 3 km². The 2 Allegheny County studies were conducted in wooded metro parks (with playground areas, picnic pavilions, bike trails, and ball fields) on the periphery of Pittsburgh, while the Greene and Westmoreland studies took place on forested and agricultural sites, respectively. All 4 study areas had been treated with ORV the previous year. Blood and tooth samples were collected from most of the 442 unique raccoons captured during the 4 studies (Table 2). All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 2. Index to raccoon densities in Westmoreland, Greene, and Allegheny Counties, Pennsylvania, 2005.

	Westmoreland Co.	Greene Co.	Allegheny Co. (North Park)	Allegheny Co. (South Park)
Time of study	1-16 Jun.	13-23 Jul.	20-30 July	2-12 August
Weeks post-ORV	35-37	40-41	47-48	49-50
Macrohabitat	Agriculture	Forested	Urban/suburban	Urban/suburban
Target trap nights	750	500	500	500
Unique raccoons	71	70	163	138
Recaptured raccoons	21	14	75	18
Area (km ²)	9.08	8.89	3.03	2.99
Raccoon density index ^a	7.8	7.9	53.8	46.2

^a Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

Post-ORV Monitoring

Spring Bait Study (Post-2004 ORV).--Post-ORV sampling within the SBS ORV zone was initiated on 11 April 2005, prior to 2005 ORV distribution but approximately 49 weeks post-2004 bait distribution. Cage traps were used over 286 trap nights to capture 46 unique raccoons from Indiana, Somerset, and Westmoreland Counties. Forty raccoons were immobilized, processed and released, while 5 were immobilized, processed and euthanized due to abnormal behavior and condition. Another raccoon was found dead in a trap. One of the euthanized raccoons and the one found dead both tested positive for rabies.

Rabies Challenge Study.--Wildlife Services responded to a request for assistance from the CDC with a critical study being conducted to interpret field serology and subsequently challenge captive raccoons to the rabies virus. The relationship between rabies virus neutralizing antibody (VNA) levels in raccoons and the degree of protection is important for measuring the success of ORV programs in the eastern U.S. The CDC was conducting a research project examining responses of raccoons with varying antibody levels when challenged with live rabies virus. Wildlife Services collected raccoons from within the SBS zone during post-2005 ORV, but avoided the edges because the areas surrounding this zone had not been previously baited. Because Pennsylvania had baited the SBS zone for 2 years (2004-2005), the raccoons were expected to have varying levels of rabies VNA. Sampling for this challenge study was initiated on 17 June 2005. Over the next 4 weeks, Pennsylvania WS trapped 360 unique raccoons and recaptured another 15 raccoons in 1,421 trap nights. Of these, 30 adult raccoons were immobilized, processed and delivered to the CDC in Atlanta, Georgia. Pennsylvania WS also transported 32 adult raccoons that had been collected by Michigan WS (at the CDC's request) to serve as negative controls for the study (no ORV program exists in Michigan). Of the raccoons not transported to the CDC, 247 were immobilized, processed and released; 59 were euthanized as part of a separate Cooperative Service Agreement (within the study area); 13 were euthanized due to abnormal behavior; 10 died in captivity while waiting for serology results related to the challenge study; and 1 was found dead in a trap.

Appalachian Ridge.--Post-ORV sampling for Pennsylvania's AR ORV zone was initiated on 16 September 2005 in areas that were hand baited approximately 5 weeks prior. Cage traps were used over 710 trap nights to capture 51 unique raccoons from Beaver, Crawford, Erie, Fayette, Greene, Indiana, Mercer, Somerset, and Washington Counties. All raccoons were immobilized, processed and released except for 1 raccoon captured in Erie County. This raccoon was euthanized by WS due to rabies-like behavior (chewing on its front foot while in the trap); it tested negative for rabies.

Non-target Captures

Wildlife Services' non-target captures were down in Pennsylvania nearly 60% from 2004, while the number of unique raccoons captured remained relatively constant. Non-target animals captured and released by WS in 2005 included: 93 opossums (*Didelphis virginiana*), 18 domestic/feral cats (*Felis catus*), 16 woodchucks (*Marmota monax*), 7 Eastern cottontails (*Sylvilagus floridanus*), 6 striped skunks (*Mephitis mephitis*), 2 Norway rats (*Rattus norvegicus*), 2 red foxes (*Vulpes vulpes*), 2 red squirrels (*Tamiasciurus hudsonicus*), 1 American robin (*Turdus migratorius*), 1 English house sparrow (*Passer domesticus*), 1 gray catbird (*Dumetella carolinensis*), 1 muskrat (*Ondatra zibethicus*), 1 ring-necked pheasant (*Phasianus colchicus*), and 1 wild turkey (*Meleagris gallopavo*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Pennsylvania cooperates with the PDH Bureau of Laboratories (PDHBL), the PDA Veterinary Laboratory (PDAVL), the ACHD, and the CDC. Wildlife Services has had an efficient and cooperative relationship with all 4 laboratories since 2001, and they remain critical to the surveillance and monitoring phases of the ORV program in Pennsylvania.

Pennsylvania Department of Health Bureau of Laboratories.--The PDHBL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed human exposure, usually submitted by Wildlife Conservation Officers and the public). The PDHBL tested 3,570 animals for the rabies virus in 2005, representing a 2% decrease from the number of samples tested in 2004 (Table 3). Animals were submitted from all 67 counties throughout the state, including the 17 ORV counties: Allegheny, Armstrong, Beaver, Butler, Cambria, Crawford, Erie, Fayette, Greene, Indiana, Lawrence, Mercer, Somerset, Venango, Warren, Washington, and Westmoreland. Of the animals tested statewide by the PDHBL, 15.0% came from a county treated with ORV.

Raccoons, skunks, and foxes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 92.2% of the animals tested for rabies by the PDHBL in 2005 are reported by WS as "other." For more general information on rabies from the PDH please visit: <http://www.dsf.health.state.pa.us/health/cwp/view.asp?A=171&Q=230513>

Table 3. Animals tested for rabies by the Pennsylvania Department of Health Bureau of Laboratories via the public health surveillance system in Pennsylvania, 2005.

	Statewide	Within ORV counties
Raccoons	207	80 (38.6%)
Skunks	41	13 (31.7%)
Foxes	29	4 (13.8%)
Other ^a	3,293	440 (13.4%)
Total	3,570	537 (15.0%)

^a Other animals included: bats, cats, dogs, woodchucks, and other unspecified animals.

Pennsylvania Department of Agriculture Veterinary Laboratory.--The PDAVL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed domestic animal exposure, usually submitted by Wildlife Conservation Officers, veterinarians, and the public). The PDAVL also tested enhanced surveillance specimens (animals not involved in an exposure) at the request of WS until 22 June 2005 when WS began using the dRIT. The PDAVL tested 1,784 animals for the rabies virus in 2005, representing a 2% decrease from the number of samples tested in 2004 (Table 4). Animals were submitted from all 67 counties throughout the state, including the 17 ORV counties. Of the animals tested statewide by the PDAVL, 21.6% came from a county treated with ORV. For more general information on rabies from the PDA please visit: <http://www.agriculture.state.pa.us/agriculture/cwp/view.asp?q=127956>

Allegheny County Health Department.--The ACHD tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed human or domestic animal exposure) within Allegheny County (and sometimes nearby counties). The ACHD tested 413 animals for the rabies virus in 2005: 47 raccoons, 5 foxes, 2 skunks, and 359 other animals (bats [*Chiroptera* spp.], domestic/feral cats, domestic/feral dogs, woodchucks, and other unspecified animals). This was a 26% decrease from the number of samples tested in 2004. Animals were submitted to the ACHD from 6 counties in western Pennsylvania: Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland. For more general information on rabies from the ACHD please visit: <http://www.achd.net/factsheet/rabies.htm>

Table 4. Animals tested for rabies by the Pennsylvania Department of Agriculture Veterinary Laboratory via the public health and enhanced surveillance systems in Pennsylvania, 2005.

Species	Public health surveillance		Enhanced surveillance	
	Statewide	Within ORV counties	Statewide	Within ORV counties
Raccoons	537	97 (18.1%)	144	143 (99.3%)
Skunks	117	11 (9.4%)	6	6 (100%)
Foxes	66	5 (7.6%)	4	4(100%)
Other ^a	902	111 (12.3%)	8	8 (100%)
Total	1,622	224 (13.8%)	162	161 (99.4%)

^a Other animals included: bats, cats, dogs, woodchucks, and other unspecified animals.

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA. Pennsylvania WS submitted 607 blood serum samples for rabies VNA analysis to the CDC in 2005. This represents a 30.5% decrease from the 873 samples submitted by WS in 2004. The Pennsylvania ORV program anticipates similar numbers of serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology, and prevention and control) on a national level please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, WS live-trapped 911 raccoons (Table 5); blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA).

Table 5. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during the cooperative rabies management program in Pennsylvania, 2004.

	Spring bait study (ORV naïve ^a)	Spring hot spot and research evaluation	Summer density studies (post-2003 ORV)	Fall AR ^b evaluation
Sample collection timeframe	23 Mar.-16 Apr.	17 May-16 Jul.	1 Jun.-23 Jul.	1 Sep.-5 Nov.
Weeks post-ORV	n/a	4-13	37-44	5-7
ORV bait type	n/a	FMP ^b	FMP	FMP
Unique raccoons	131	215	181	384
Serology				
Testable blood samples	127	218	140	378
Positive rabies antibody response (≥0.05 IU)	18 (14.2%)	35 (16.1%)	31 (22.1%)	47 (12.4%)
Tetracycline biomarker				
Testable tooth samples	128	215	139	376
Presence of tetracycline biomarker	15 (11.7%)	82 (38.1%)	14 (10.1%)	91 (24.2%)

^a Naïve means samples were collected in an ORV naïve area (never before treated with ORV).

^b AR=Appalachian Ridge; FMP=fishmeal polymer.

Age Results.--In 2004, 787 raccoon teeth were aged using premolars of live-captured animals and canines of animals found dead or euthanized (Figure 2). These samples were collected from raccoons during the spring bait study, the spring hot spot and research evaluation, and the fall AR ORV evaluation.

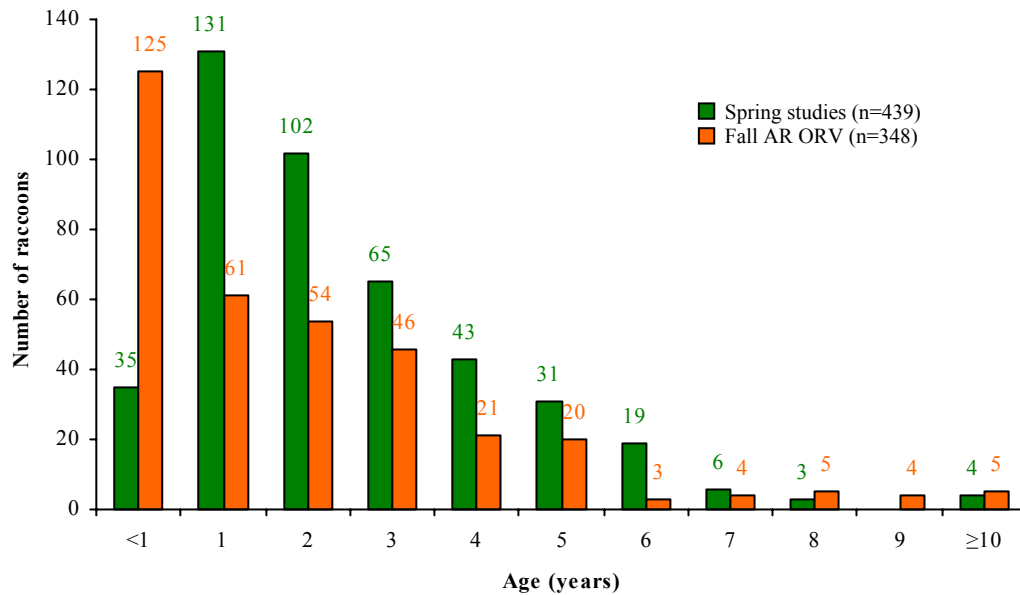


Figure 2. Age class distribution of 787 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program in Pennsylvania, 2004.

SUMMARY

During 2005, WS completed its fifth year of cooperative participation in the Pennsylvania ORV program, distributing 1,392,506 ORV baits. Baits were distributed by boat, hand, and from aircraft, across 17 counties encompassing 21,802 km². Over 6.5 million ORV baits have been distributed in Pennsylvania since baiting began in 2001. Pennsylvania's baiting effort is part of a larger AR ORV zone, which in 2005 included Maryland, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

In 2006, the Pennsylvania ORV program will continue to distribute baits in the western part of the state, but the exact area is undetermined. Even greater emphasis will be placed on enhanced rabies surveillance. The Pennsylvania ORV program is integral to national planning efforts to contain raccoon rabies and explore strategies to eliminate this unique variant of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM TENNESSEE 2005

BACKGROUND

In 2002, an oral rabies vaccination (ORV) program was initiated in Tennessee as part of Wildlife Services (WS) National Rabies Management Program (NRMP) to stop the westward spread of the raccoon (*Procyon lotor*) variant of rabies. Raccoon rabies had not been found in Tennessee at that point, but was reported across the border in nearby North Carolina. In an effort to stay ahead of the disease front, WS extended the Appalachian Ridge (AR) ORV zone (which began at Lake Erie) into northeastern Tennessee. In June 2003, the rabies front, which had stalled in North Carolina, crossed into Tennessee and 4 cases of raccoon rabies were confirmed in Carter County, while 1 case was confirmed in Johnson County. There were no cases found in this area during 2004 despite increased surveillance. In 2005, 6 cases were confirmed in wildlife in the area, including positives in Washington and Unicoi Counties where raccoon rabies had not been previously documented.

In November 2003, WS established the Georgia-Alabama-Tennessee (GAT) ORV zone where the Georgia and Alabama borders meet southern Tennessee. At the time, raccoon rabies was in northwestern Georgia and moving westward. The Alabama-Coosa River system to the south and the Appalachian Mountains to the north were serving as potential natural barriers to the westward spread of raccoon rabies. The GAT zone was established to help fill a gap between these potential barriers and to prevent the spread of raccoon rabies into the Tennessee Valley and subsequently the interior of the United States. In January 2004, raccoon rabies entered southeastern Tennessee from Georgia and reached the GAT ORV zone. In response to the first positive case of raccoon rabies inside the GAT zone, WS began baiting the city of Chattanooga and surrounding areas of Hamilton County in the spring, while baiting these areas again in the fall as part of the larger GAT ORV effort. During 2004, 14 cases of raccoon rabies were documented in wildlife in Hamilton County. During 2005, only 1 animal (a raccoon) was confirmed with raccoon rabies in Hamilton County and the virus was not detected in any surrounding counties. On 10 October 2005, a sick-acting red fox (*Vulpes vulpes*) was collected in Knox County as part of WS enhanced surveillance. This fox became the first positive case of the raccoon variant of rabies in the Knoxville area, almost halfway between the AR and the GAT ORV zones (Figure 1).

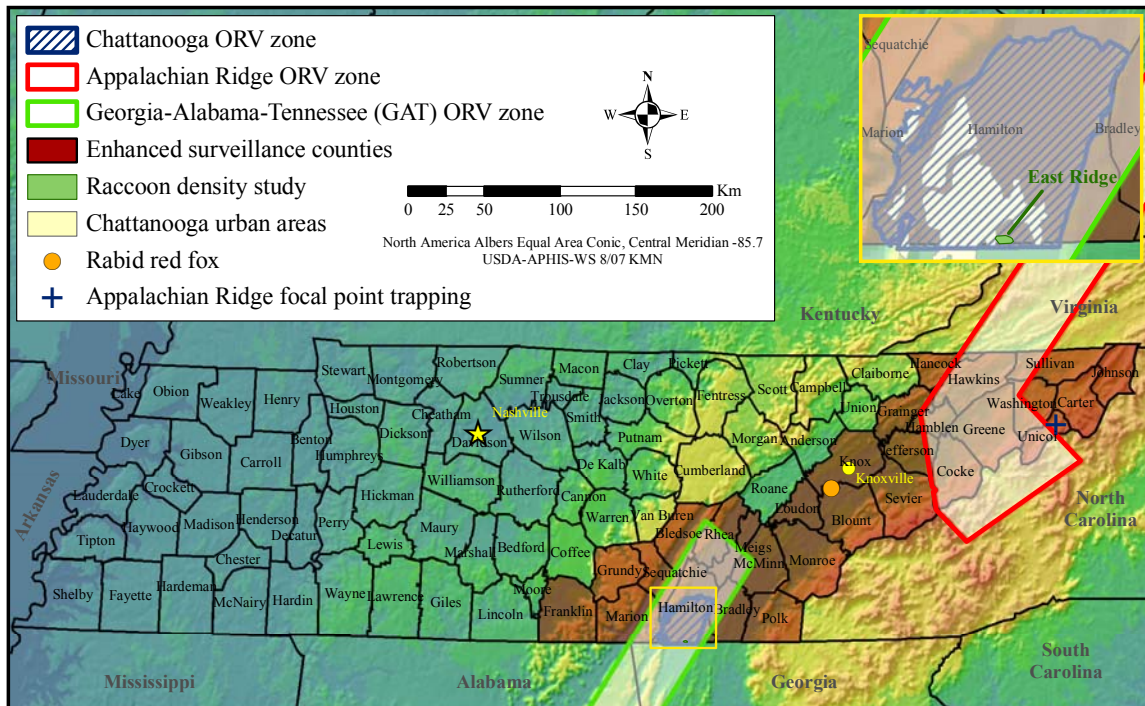


Figure 1. Wildlife Services cooperative rabies management program activities in Tennessee, 2005.

In Tennessee, the AR and GAT ORV programs are being conducted by WS, in cooperation with the Tennessee Department of Health (TDH), Tennessee Department of Agriculture, Tennessee Wildlife Resources Agency (TWRA), Chattanooga/Hamilton County Department of Health, and the Centers for Disease Control and Prevention (CDC). Numerous individual landowners and many federal, state, and local agencies provided WS access to private and government owned properties for ORV program trapping and monitoring. Many other agencies and numerous animal control departments, nuisance wildlife control operators, and wildlife rehabilitators assisted WS by collecting suspicious acting and road killed animals for rabies testing in the surveillance zone.

ORV PROGRAM 2005

Bait Distribution

For the fourth consecutive year, WS participated in bait distribution efforts in northeastern Tennessee (AR ORV zone) and for the third year in southeastern Tennessee (GAT ORV zone); 555,282 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 8,893 km² (3,434 mi²) (Figure 1). Since its program inception in 2002, WS has distributed 1,478,758 ORV baits in Tennessee. Aircraft and pilots for both Tennessee ORV programs in 2005 were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS provided ground support and served as navigators and flight crew in the planes.

Chattanooga.--In April 2005, the city of Chattanooga and surrounding areas in Hamilton County were baited for the second consecutive spring. The Chattanooga ORV zone was 763 km² (295 mi²) in size and 59,760 FMP baits were distributed by hand from 24-27 April. The Chattanooga ORV zone was baited again in October 2005 as part of the larger GAT ORV zone (see *Georgia-Alabama-Tennessee* below).

Appalachian Ridge.--In 2005, the Tennessee portion of the AR ORV zone was doubled in area and covered 5,668 km² (2,188 mi²) in 10 counties. From 9-16 August, 238,958 fishmeal-coated sachet baits (CS) were distributed by fixed-wing aircraft, while 29,880 fishmeal polymer baits (FMP) baits were distributed by hand from 17-18 August.

Georgia-Alabama-Tennessee.--In October 2005, the Tennessee portion of the GAT ORV zone covered 3,226 km² (1,245 mi²) in 8 counties. From 19-20 October, 110,160 FMP baits were distributed by hand, while 116,524 FMP baits were distributed by fixed-wing aircraft from 22-25 October.

Enhanced Surveillance

In 2005, WS continued enhanced surveillance for the raccoon variant 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, and coyotes (*Canis latrans*) that exhibited strange behavior, were found dead in unusual places, or were fresh road killed animals. The enhanced surveillance area included 28 counties, creating a surveillance corridor along the borders with Virginia, North Carolina, Georgia and Alabama (Figure 1). During these efforts, 1,377 animals were collected and submitted for rabies testing: 1,005 raccoons, 288 striped skunks, 42 gray foxes, 16 red foxes, 23 coyotes, 1 feral cat (*Felis catus*), 1 opossum (*Didelphis virginiana*), and 1 woodchuck (*Marmota monax*). Seven of these animals tested positive for the rabies virus: 4 with the raccoon variant (1 Carter Co. raccoon, 1 Unicoi Co. raccoon, 1 Knox Co. red fox, 1 Hamilton Co. skunk); and 3 with the North Central skunk variant (2 Cocke Co. skunks and 1 Greene Co. skunk).

Direct Rapid Immunohistochemistry Testing (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the accepted standard test used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to reduce turnaround time of results and the burden on rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state or federal laboratories.

Tennessee WS personnel attended dRIT training in May 2005 at the CDC in Atlanta, Georgia. A Biosafety Level 2 (BSL-2) laboratory at the College of Veterinary Medicine at the University of Tennessee was secured and

fitted to conduct this test. During 2005, WS tested 22 animals (19 raccoons and 3 skunks) using the dRIT; they all tested negative for rabies. Ten percent of the negatives were sent to the CDC for confirmation. Using the dFA test, the CDC had 100% agreement with the WS dRIT results. Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid animals in Tennessee.

Population Monitoring

In December 2005, WS conducted a raccoon density study using the NRMP standard protocol of 50 cage traps set on a target study area of 3 km² for 10 consecutive nights. The study area was a mixture of suburban, commercial, and wooded recreational areas in East Ridge, Tennessee (Chattanooga ORV zone) at an elevation of 210 meters (Figure 1 inset). The density study was conducted in conjunction with post-ORV trapping and 59 unique raccoons were captured yielding an index to raccoon density of 19.3 raccoons/km². One striped skunk and 1 bobcat (*Lynx rufus*) were also captured during the raccoon density study. Both animals were immobilized and processed. The skunk was euthanized at the landowner's request and the bobcat was released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Post-ORV Monitoring

Chattanooga.--Post-ORV sampling for the Chattanooga ORV zone was initiated on 23 May 2005. Cage traps were used to capture 138 unique raccoons from Hamilton County; 134 raccoons were immobilized, processed and released. Four raccoons were immobilized, processed and euthanized due to obvious illness or severe injuries; they all tested negative for rabies.

Appalachian Ridge.--Post-ORV sampling for Tennessee's 2005 AR ORV zone was initiated on 6 September 2005. Cage traps were used to capture 160 unique raccoons from Cocke, Greene, Hamblen, Hawkins, Unicoi, and Sullivan Counties; 159 raccoons were immobilized, processed and released. One raccoon was immobilized, processed and euthanized due to severe injuries; it tested negative for rabies. Two striped skunks were captured during post-ORV sampling as well. One was immobilized, processed and euthanized at the landowner's request. The second was released without processing.

Georgia-Alabama-Tennessee.--Post-ORV sampling for Tennessee's 2005 GAT ORV zone was initiated on 28 November 2005. Cage traps were used to capture 131 unique raccoons from Hamilton, Marion, and Meigs Counties; 125 raccoons were immobilized, processed and released. Six raccoons were euthanized due to obvious illness; they tested negative for rabies.

Other Rabies Management Program Activities

Appalachian Ridge Focal Point Trapping.--In late July 2005, a man in Unicoi County was bitten by a raccoon as he released it from a live trap. The raccoon was reportedly ear tagged with a "WV" and a number, potentially indicating that the animal had been previously trapped by WS in West Virginia. Wildlife Services personnel from Tennessee conducted intensive trapping from 3-5 August in the area of Unicoi County where the animal was released (Figure 1), approximately 250 km south of the West Virginia state border. Six raccoons were captured, euthanized, and submitted for rabies testing. None of these animals were ear tagged and all samples tested negative for the rabies virus.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 299 opossums, 31 feral cats, 4 snapping turtles (*Chelydra serpentina*), 2 Eastern box turtles (*Terrapene carolina*), 2 gray squirrels (*Sciurus carolinensis*), 1 bobcat, 1 Eastern cottontail (*Sylvilagus floridanus*), 1 fox squirrel (*Sciurus niger*), 1 Norway rat (*Rattus norvegicus*), and 1 striped skunk.

Non-target animals that were captured and euthanized by WS in 2005 included: 2 striped skunks. In addition, 1 Northern flicker (*Colaptes auratus*) was captured and died in the trap.

Rabies Laboratory Cooperation

The ORV program in Tennessee cooperates with the TDH laboratories in Jackson, Nashville, and Knoxville and the CDC.

Tennessee Department of Health Laboratories. --Each of the TDH labs is responsible for testing animal brainstems for rabies within their designated region. Positive samples are sent to the Nashville Branch Laboratory for rabies variant typing. The Knoxville Branch Laboratory (KBL) is responsible for the East Tennessee region which includes 26 of the 28 designated enhanced surveillance counties. The KBL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure) and enhanced surveillance (specimens not involved in an exposure) at the request of WS.

The KBL tested 1,032 brainstem samples for the rabies virus in 2005 (Table 1). This represents an 8.6% decrease from the number of samples tested in 2004. The 2005 samples were submitted from 34 counties in the East Tennessee region and from 26 counties within the designated enhanced rabies surveillance zone.

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 78.6% of the animals tested for rabies in the East Tennessee region in 2005 are reported by WS as “other.” For general information on rabies in Tennessee please visit: <http://www.state.tn.us/health/>

Table 1. Animal tested for rabies by the Tennessee Department of Health, Knoxville Branch Laboratory in the East Tennessee region, 2005.

	East Tennessee region	Within Wildlife Services' enhanced rabies surveillance zone
Raccoons	177	168 (94.9%)
Skunks	26	26 (100%)
Foxes	17	17 (100%)
Coyotes	1	1 (100%)
Other ^a	811	732 (90.3%)
Total	1,032	944

^a Other animals included: bats, bears, cats, cattle, chipmunks, deer, dog, ferrets, gerbils, goats, hamsters, horses, moles, opossums, rabbits, rats, squirrels, voles, and woodchucks (groundhogs).

The KBL currently handles the disposal of medical waste created during WS ORV surveillance, monitoring and evaluation projects. During 2005 the KBL also provided positive and negative rabies controls for the implementation of the dRIT by WS.

The TDH is working to create a real-time online disease tracking system for the entire state. This system would allow laboratory personnel to input test results immediately for a variety of diseases. It would allow health professionals to quickly identify disease trends and help in identifying possible breaches in the ORV zones should they occur. In addition, the KBL hopes to begin rabies variant typing in 2006, further increasing the abilities of the TDH and WS to respond quickly to potential breaches in the ORV zones.

Centers for Disease Control and Prevention. --The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). Tennessee WS submitted 497 blood serum samples for rabies VNA analysis to the CDC in 2005. This represents a 13.7% increase from the 437 samples submitted by WS in 2004. The Tennessee ORV program anticipates similar numbers of serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Tennessee's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (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; CS baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, during the evaluation phase of the Tennessee cooperative rabies management program, WS live-trapped 437 unique raccoons within the ORV bait zones (Table 2). Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA).

Table 2. Results of raccoon samples collected by Wildlife Services during the cooperative rabies management program in Tennessee, 2004.

	GAT ^a focal point evaluation	Chattanooga evaluation	AR ^a evaluation	GAT evaluation	Total
Sample collection timeframe	10-18 Feb. & 29 Mar.-2 Apr.	10-27 May	8-29 Sep.	6-16 Dec.	2004
Weeks post-ORV	12-13 & 19	4-6	3-6	4-5	
Unique raccoons	39	129	131	138	437
Serology					
Testable blood samples	39	129	131	138	437
Positive rabies antibody response (≥ 0.05 IU)	9 (23.1%)	51 (39.5%)	21 (16.0%)	48 (34.8%)	129 (29.5%)
Tetracycline					
Testable tooth samples	31	109	121	120	381
Presence of tetracycline biomarker	2 (6.5%)	16 (14.7%)	50 (41.3%)	43 (35.8%)	111 (29.1%)

^a GAT=Georgia-Alabama-Tennessee; AR=Appalachian Ridge.

Age Results.--In 2004, 381 raccoon teeth were aged using premolars of live-captured animals (Figure 2). These samples were collected from raccoons in the AR and GAT ORV zones (including the focal point trapping and Chattanooga ORV zone).

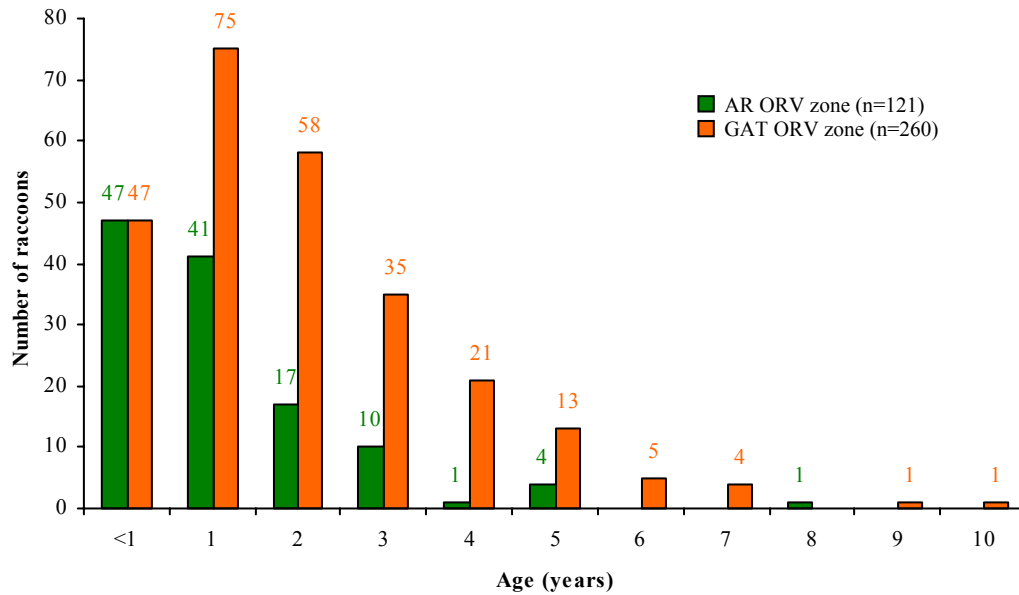


Figure 2. Age class distribution of 381 raccoon tooth samples collected by Wildlife Services during the evaluation phase of the cooperative rabies management program in Tennessee, 2004.

SUMMARY

In 2005, Tennessee WS conducted its fourth year of rabies control activities in the AR ORV zone and its third year in the GAT ORV zone. During bait distribution activities, 199,800 FMP baits were distributed by hand and 238,958 CS and 116,524 FMP baits were distributed by air in portions of 18 eastern Tennessee counties. Post-ORV trapping and focal point trapping resulted in the collection of 497 animals for rabies VNA testing. Enhanced surveillance efforts resulted in the collection and testing of 1,377 animals and revealed the first case of raccoon variant rabies in Knox County.

During 2006, WS will conduct intensive enhanced surveillance in Knox and surrounding counties to determine the prevalence of raccoon rabies. Should additional positives be confirmed, depopulation and/or trap-vaccinate-release projects will likely be used in conjunction with large scale ORV baiting to contain this potential outbreak. Wildlife Services will continue to conduct and coordinate enhanced surveillance for raccoon rabies throughout eastern Tennessee. Efforts will be made to recruit additional local law enforcement agencies, TWRA personnel, and the general public to report and/or collect suspect rabid animals in 28 counties in eastern Tennessee. Additional density study areas and monitoring sites will be secured to look at potential differences in raccoon population trends among different habitats, elevations, and ORV zones.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM TEXAS 2005

BACKGROUND

Two canine rabies epizootics emerged in Texas in 1988: 1 involving coyotes (*Canis latrans*) and dogs (*C. familiaris*) in south Texas and the other involving gray foxes (*Urocyon cinereoargenteus*) in west-central Texas. The south Texas epizootic has resulted in 2 human deaths and required over 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); the Texas Department of State Health Services (TDSHS) formerly the Texas Department of Health; the Texas Cooperative Extension-Wildlife Services; the Texas National Guard; the Centers for Disease Control and Prevention (CDC); the Department of Defense Veterinary Food Analysis and Diagnostic Laboratory (DOD-VFADL) at Ft. Sam Houston; and other local, state, and federal agencies.

ORV PROGRAM 2005

Bait Distribution

For the eleventh consecutive year, WS participated in bait distribution efforts in south Texas (coyote ORV zone) and for the tenth year in west-central Texas (gray fox ORV zone); 2,694,691 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 86,893 km² (33,550 mi²) (Figure 1). Since its program inception in 1995, WS has cooperated to distribute over 25 million ORV baits in Texas.

Coyote.--From 5-13 January 2005, WS participated as a member of the ORVP by helping to distribute 730,590 oral rabies vaccine (ORV) baits over 31,566 km² (12,188 mi²) of south Texas (Figure 1). This 64.4 km wide maintenance barrier is in place to prevent the re-emergence of canine rabies variant from Mexico. Fixed-wing and rotary aircraft distributed 708,990 fishmeal polymer (FMP) baits across portions of 15 counties, while city employees hand distributed 21,600 FMP baits throughout communities in Cameron, Hidalgo, and Webb Counties. Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), provided the fixed-wing aircraft services and the Texas WS program provided the helicopter. Fishmeal polymer baits contain 150 mg of tetracycline biomarker and a 2 ml sachet of Raboral V-RG® vaccine.

Gray fox.--From 15-25 January 2005, WS participated in the aerial distribution of 1,964,101 ORV baits over 55,326 km² (21,362 mi²) to contain a variant of rabies unique to gray foxes in west-central Texas (Figure 1). Gray fox baits are composed of a dog food polymer (DFP) containing 150 mg of tetracycline biomarker and a 2 ml sachet of Raboral V-RG® vaccine. With the gray fox baits supplied by WS during 2005, 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.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure to replace the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but currently it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Texas WS personnel attended dRIT training in October 2005 at the CDC in Atlanta, Georgia. The TDSHS also sent personnel to this training. Implementation of the dRIT in Texas will begin during the collection period of the 2006 ORVP.

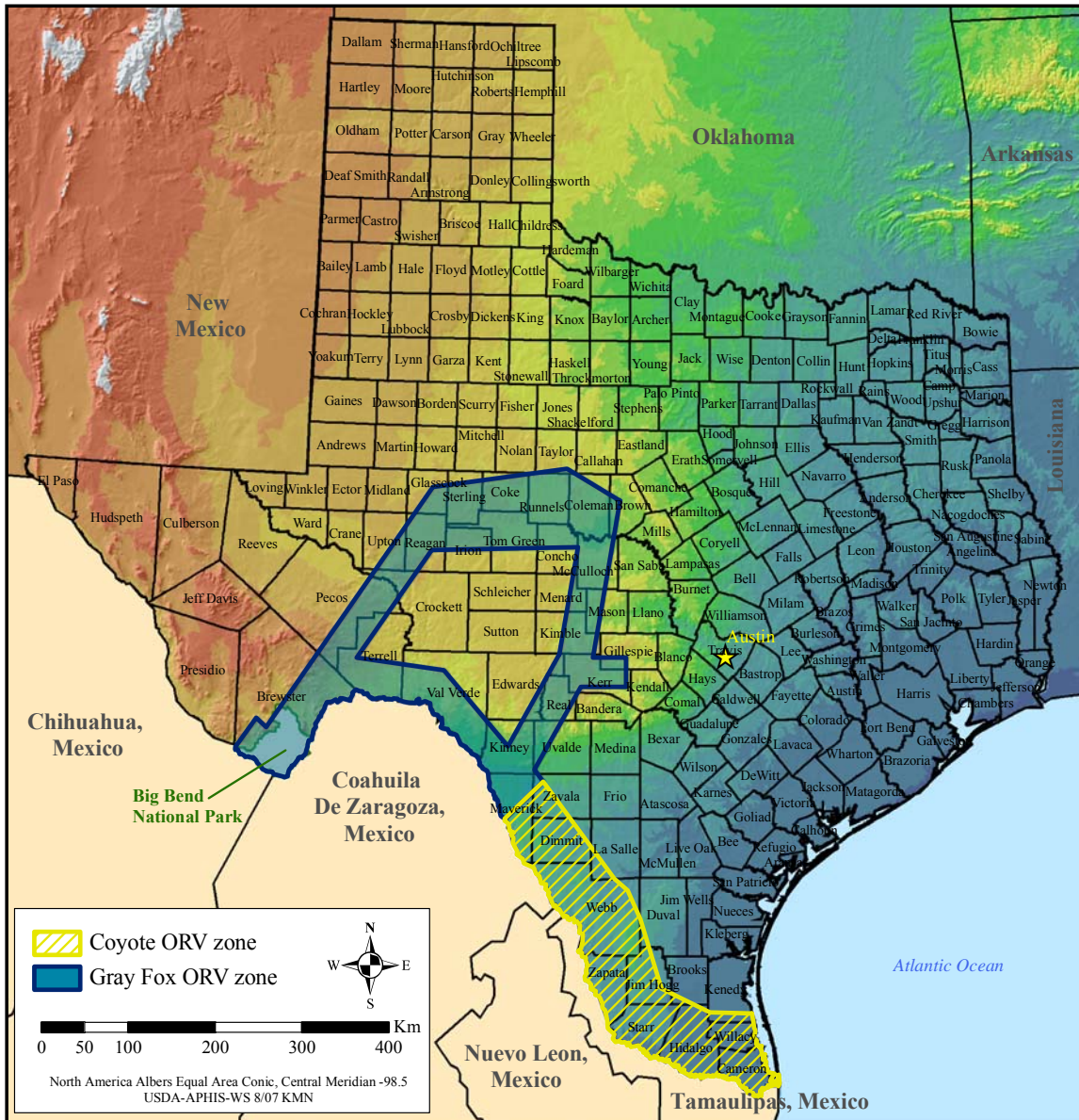


Figure 1. Wildlife Services cooperative rabies management program activities in Texas, 2005.

Laboratory Cooperation

The ORV program in Texas cooperates with the TDSHS Laboratory (TDSHSL), the DOD-VFADL, and Johnston Biotech (JB) (Sania, Ontario, Canada). The Texas ORVP has had an efficient and cooperative relationship with these laboratories since 1995, and they remain critical to the program’s evaluation and surveillance efforts.

Texas Department of State Health Services Laboratory.--The TDSHSL tests full cross sections of animal brainstems plus at least 1 other section to include cerebellum or hippocampus (preferably all 3) for rabies through public health surveillance (specimens involved in a potential or confirmed exposure) and enhanced surveillance testing (samples not involved in an exposure). Unofficially, the TDSHSL tested 11,274 brainstem samples for the rabies virus in the course of routine public health surveillance in 2005 (Table 1). Of these, 749 tested positive for rabies. Samples were submitted from 168 of 254 counties throughout the state. No samples were submitted as part of enhanced rabies surveillance efforts. For detailed information on rabies in Texas please visit:

<http://www.dshs.state.tx.us/idcu/disease/rabies/>

Table 1. Preliminary brainstem samples testing positive for the rabies virus (includes all variants) by the Texas Department of State Health Services Laboratory via the public health surveillance system in Texas, 2005.

Species	Unvaccinated interior of the gray fox zone ^a	Within gray fox ORV zone	Within coyote ORV zone	Remainder of State
Coyotes	0	0	0	0
Foxes	2 (0.3%)	5 (0.7%)	0	15 (2.0%)
Raccoons	0	3 (0.4%)	0	24 (3.2%)
Skunks	10 (1.3%)	27 (3.6%)	0	356 (47.5%)
Bobcats	0	1 (0.1%)	0	0
Bats	1 (0.1%)	2 (0.3%)	19 (2.5%)	233 (31.1%)
Other ^b	2 (0.3%)	4 (0.5%)	0	35 (4.7%)
Total	15	42	19	663

^a Samples submitted from counties interior to the circular gray fox ORV zone where ORV is currently not used.

^b Other includes domestic animals and livestock.

Department of Defense Veterinary Food Analysis and Diagnostic Laboratory.--The DOD-VFADL analyzes wildlife serum samples (submitted by the TDSHS and WS) for levels of rabies virus neutralizing antibodies (VNA). The DOD-VFADL analyzed 296 serum samples for rabies VNA in 2005, representing a 6.1% increase from the 279 samples submitted in 2004. Both the TDSHS and WS anticipate an increase in the number of submissions in 2006.

Johnston Biotech.--Johnston Biotech analyzes coyote and gray fox teeth submitted for age and the presence of tetracycline biomarker. In 2005, JB analyzed 296 tooth samples, representing a 6.1% increase in the number of samples submitted from 2004. The number of submissions in 2006 is expected to increase.

ORV PROGRAM 2005 – EVALUATION

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, inaccuracies happen because older animals do not deposit the biomarker and the 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 (at ≥ 0.05 IU); 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 targeted animals. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations. The 2005 Texas ORV bait distribution occurred in January and 2005 program evaluation data (serology, tetracycline, and age results) were available at the time of this report.

Serology, Tetracycline Biomarker, and Age Results

Coyote.--In 2005, TDSHS and WS collected 115 coyotes, for ORVP evaluation, from within the south Texas vaccination zone. Twenty-nine of 115 coyotes tested (25.2%) within the ORV zone showed a positive rabies antibody response to the vaccine, while 95 of 115 coyotes tested (82.6%) were positive for the tetracycline biomarker included in the bait material (Figure 2). Since the initiation of the ORVP in south Texas, canine rabies cases have declined from 122, reported during the pre-program year in 1994, to 0 in 2000. During 2001 and again in 2004, a single canine rabies case involving a stray dog was confirmed in Laredo, Texas. Both isolated cases occurred within 1 mile of the U.S.-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 increased vaccination clinics for domestic pets throughout the city. No additional cases have been reported since.

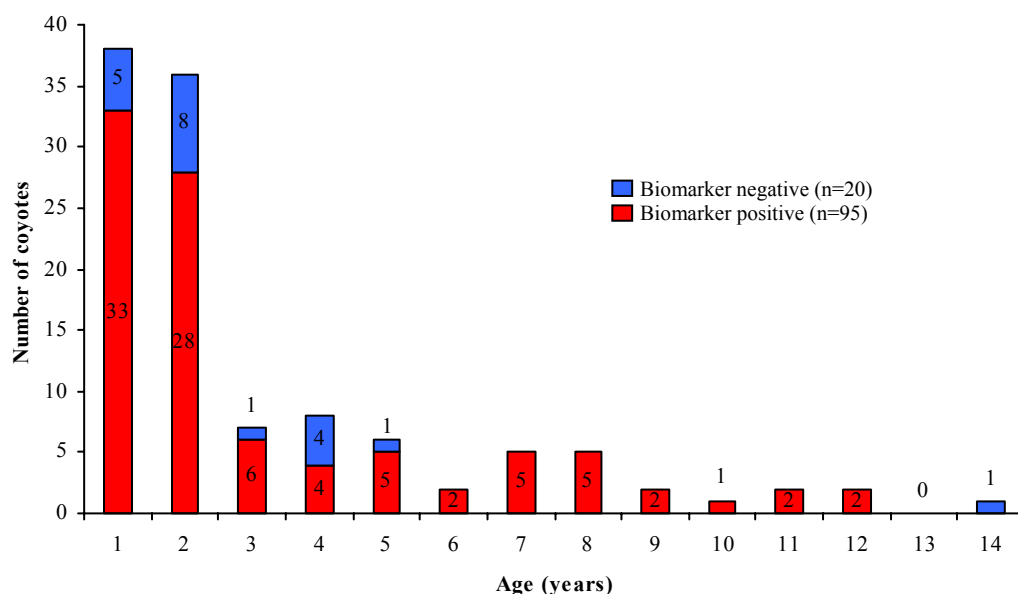


Figure 2. Age class distribution and presence/absence of tetracycline biomarker for 115 coyotes collected during post-bait oral rabies vaccination program evaluation in the coyote zone of south Texas, 2005.

Gray fox.--During the evaluation phase of the 2005 gray fox ORVP in west-central Texas, WS and the TDSHS collected 141 gray foxes. Blood and tooth samples were taken from all gray foxes as well as 26 coyotes, 10 raccoons (*Procyon lotor*), 3 opossums (*Didelphis virginiana*), and 1 striped skunk (*Mephitis mephitis*). Overall, 90 of 181 animals (49.7%) demonstrated a positive rabies VNA response, while 61 of 181 animals (33.7%) tested showed the presence of tetracycline biomarker (Table 2). In addition, the 141 gray foxes were analyzed for age and the population was dominated by 1 and 2 year olds (Figure 3).

Table 2. Serology and tetracycline biomarker results of biological samples collected during post-bait oral rabies vaccination program evaluation in the gray fox zone of west-central Texas, 2005.

Species	Positive rabies VNA ^a response	Presence of tetracycline biomarker	Total
Gray fox	80 (56.7%)	51 (36.2%)	141
Coyote	6 (23.1%)	3 (11.5%)	26
Raccoon	2 (20.0%)	5 (50.0%)	10
Opossum	2 (66.7%)	2 (66.7%)	3
Striped skunk	0	0	1

^a VNA=virus neutralizing antibody (≥ 0.05 IU).

The gray fox ORVP in west-central Texas continues to show success with a decline in the number of confirmed cases involving the gray fox variant of rabies. During the pre-program year of 1995, 244 cases were reported. In 2005, the number of cases declined to 8 and of these, all but 1 occurred within or inside the 32.2 km wide immune barrier. The single case reported outside the west-central Texas zone in 2005 involved the translocation of a bovine (*Bos taurus*) from within the ORV zone in Coleman County to Swisher County, located in the Texas panhandle. Public health surveillance of the surrounding area as well as the adjacent counties has revealed no additional cases.

In response to the isolated case of gray fox rabies, which occurred in 2004 outside of the vaccination zone in Kerr County, a 2,683 km² area was baited in January 2005. Continuous public health surveillance within Kerr County and a 6-county contiguous area has revealed no additional cases. This area is scheduled to receive a second treatment of ORV baits in January 2006.

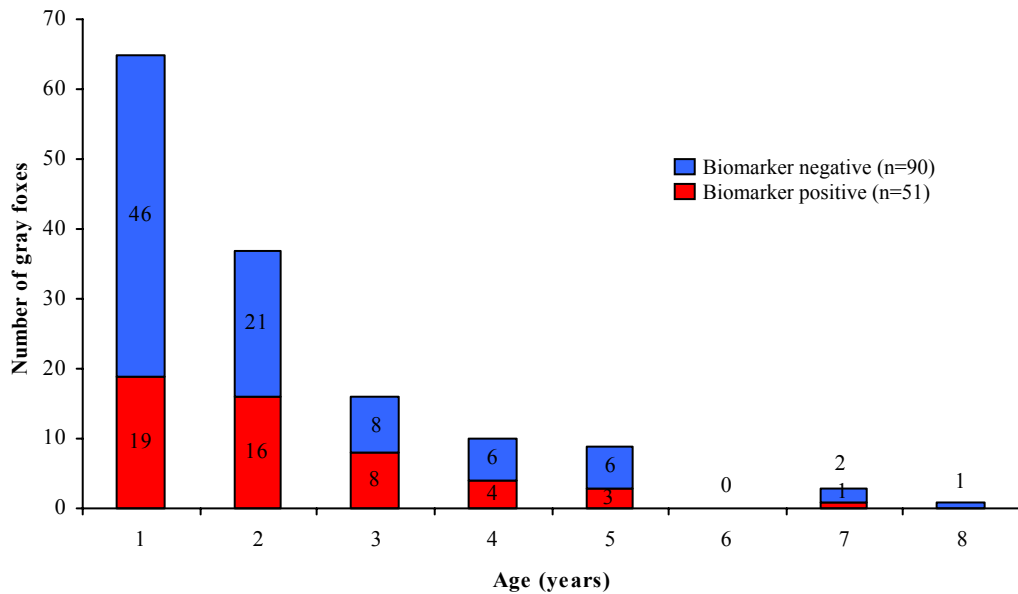


Figure 3. Age class distribution and presence/absence of tetracycline biomarker for 141 gray foxes collected during post-bait oral rabies vaccination program evaluation in the gray fox zone of west-central Texas, 2005.

SUMMARY

Since 1995, 10.81 million ORV baits have been distributed over south Texas by the coyote ORVP. This has proved to be highly effective in the elimination of the canine variant of rabies in that area. A maintenance strategy has been developed to sustain a zone of immunized wildlife along the Texas-Mexico border with only 2 incursions into the zone at Laredo since 2001, thus preventing the re-emergence of the variant. With continued support for the cooperative ORVP effort, similar success is sought in the gray fox epizootic in west-central Texas where 14.55 million ORV baits have been distributed since 1996.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM VERMONT 2005

BACKGROUND

In 1994, the raccoon (*Procyon lotor*) variant of the rabies virus was first confirmed in several Vermont towns on the Massachusetts border. In less than 2 years, raccoon rabies had spread north through 8 counties in Vermont and by May 1996 was just south of Burlington, Vermont's largest city, approximately 70 km (42 miles) south of the U.S.-Canada Border (Figure 1). One year later, on 5 May 1997 an intensive oral rabies vaccination (ORV) program was initiated to prevent further northward spread of raccoon rabies up the Lake Champlain Valley into Quebec, Canada. The initial ORV zone encompassed 1,637 km² (632 mi²) in northwestern Vermont including all of Franklin County and portions of Chittenden and Grand Isle Counties. This area was baited the following year, as well as 556 km² near Lyndonville in response to a rabid skunk (*Mephitis mephitis*) confirmed in the town to the south. In 1999, 2 rabid raccoons were confirmed just south of Newport and the ORV zone was doubled in size to include the Lake Memphremagog basin (south to Lyndonville). In 2001, the ORV zone was expanded again along the Connecticut River Valley in Essex County in response to 2 rabid raccoons: 1 on each side of the river (state border with New Hampshire). The Vermont ORV zone has continued to expand and encompassed approximately 36% of the state in 2005.

Since its inception, the Vermont ORV program has been a cooperative effort between Wildlife Services (WS), Cornell University (CU), the Vermont Departments of Health (VDH) and Fish and Wildlife (VTFW), the Vermont Agency of Agriculture, Food, and Markets (VTAG), the Ontario Ministry of Natural Resources (OMNR), and the Province of Quebec. Wildlife Services has been the major source of federal funds for program implementation. Wildlife Services has also provided federal wildlife management leadership by continuing to play an active role in: program planning and coordination; organizing ground support for aerial bait distribution; working in and navigating aircraft to distribute baits; coordinating the hand distribution of baits in areas too populated to bait by air; enhancing rabies surveillance by collecting suspect rabid animals; and evaluating program efficacy by monitoring post-ORV rabies virus neutralizing antibody (VNA) levels and bait uptake (when appropriate) in raccoons.

ORV PROGRAM 2005

Bait Distribution

For the ninth consecutive year, WS participated in bait distribution efforts in northern Vermont; 342,462 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 8,704 km² (3,361 mi²) in 2005 (Figure 1). Target bait density for the Vermont ORV zone is 70/km². From 26-27 August, 333,192 fishmeal-coated sachet (CS) baits were distributed over 8 counties: Caledonia, Chittenden, Essex, Franklin, Grand Isle, Lamoille, Orleans, and Washington. Fixed-wing aircraft were provided by the OMNR, while WS personnel served as navigators and flight crew in the planes. Ground support for aerial baiting was provided by WS, the OMNR, and CU. From 23 August-2 September, WS distributed 9,270 fishmeal polymer (FMP) baits via ground operations (hand/truck baiting) in 24 small cities and villages. Since its program inception in 1997, WS has cooperated to distribute 2,556,281 ORV baits in Vermont.

Enhanced Surveillance

In 2005, WS enhanced rabies surveillance in the northern part of the state by collecting 7 animals (5 raccoons, 1 red fox [*Vulpes vulpes*], and 1 striped skunk) from 3 counties within the ORV zone. These were road killed, strange acting, and nuisance animals that did not expose a human or domestic animal and otherwise would not have been tested through the public health surveillance system. All 7 animals tested negative for rabies by the VDH.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual

rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Vermont WS personnel attended dRIT training in May 2005 at the Centers for Disease Control and Prevention in Atlanta, Georgia. Currently, the VDH is meeting enhanced surveillance testing needs, however, WS plans on implementing the dRIT in 2006.

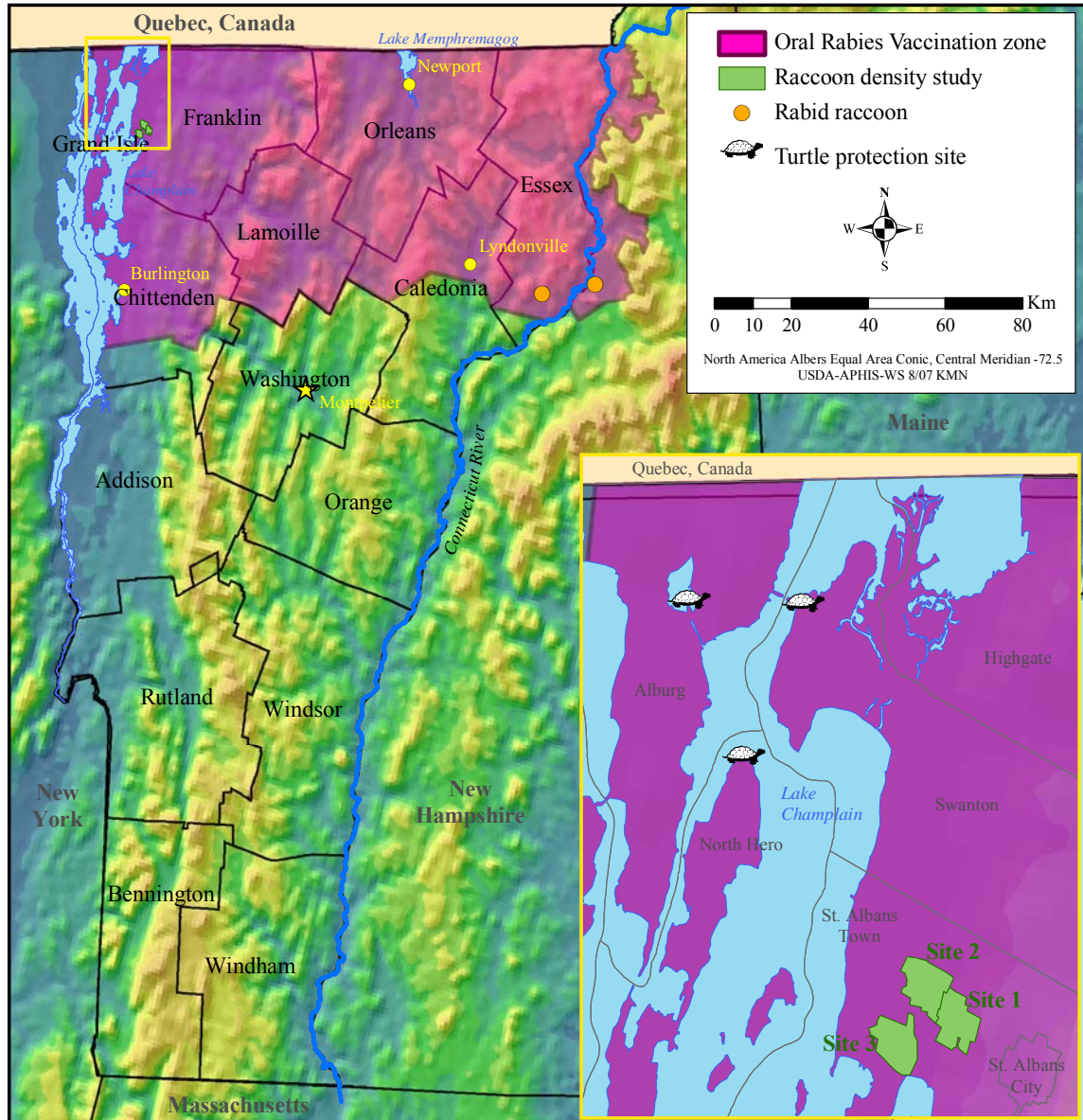


Figure 1. Wildlife Services cooperative rabies management program activities in Vermont, 2005.

Population Monitoring

From 1997-2003, WS conducted 36 raccoon density studies in northern Vermont to establish population trends in areas of common agricultural habitat and to determine density indices in urban settings (>7,000 people) and at higher elevations (>500 m). Other states with ORV programs conducted similar studies during that time using an established protocol of 50 cage traps, set for 10 consecutive nights (500 trap nights) on a target study area of 3 km². Density indices from nationwide studies ranged from 0-38 raccoons/km². Based on the growth of WS' National Rabies Management Program (NRMP), which now spans from Maine to the Gulf of Mexico and includes many different habitats supporting varying raccoon densities, we recognized the need to refine the NRMP raccoon density study protocol to include areas supporting less typical low or high raccoon population densities. We

acknowledged that the standard 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 days of trapping as an index to raccoon density.

For the second consecutive year, on 26 September 2005, WS initiated 3 raccoon density studies using 50 cage traps set for 20 consecutive nights (1,000 trap nights), each on a 3 km² study area. The 3 study sites were adjacent to each other and in the town of St. Albans (Figure 1 inset). In cooperation with WS personnel from Illinois, 106 unique raccoons were captured on the 3 contiguous sites, representing 9 km², over 3,000 trap nights (Table 1). A preliminary look at 2 years worth of data from this 20-day study may indicate that 10 days of trapping is sufficient as an index to raccoon density in areas of typical agricultural habitat found in the Northeast.

Table 1. Index to raccoon densities during 20-day studies on 3 sites in St. Albans Town (Franklin County), Vermont, 2005.

	Site 1		Site 2		Site 3	
	Days 1-10	Days 1-20	Days 1-10	Days 1-20	Days 1-10	Days 1-20
Time of study	26 Sep.-16 Oct.		26 Sep.-16 Oct.		26 Sep.-16 Oct.	
Macrohabitat	Agriculture		Agriculture		Agriculture	
Area (km ²)	3.01		3.17		3.25	
Target trap nights	500	1,000	500	1,000	500	1,000
Unique raccoons	26	32	28	38	33	36
Recaptured raccoons	18	25	5	16	7	26
Non-target captures	8	13	9	12	30	60
Raccoon density index ^a	8.6	10.6	8.8	12.0	10.2	11.1

^a Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

During the 3 studies, 104 raccoons were immobilized, processed and released. One raccoon was found dead in a trap and 1 raccoon was euthanized due to a potential human exposure. Both raccoons tested negative for rabies. In addition, 11 unique skunks were captured during the 3 studies. Ten skunks were immobilized, processed and released (blood samples collected from 9 of them). One skunk was found dead just outside of a trap; it tested negative for rabies. An additional 30 skunks were trapped and released without processing because they were late-year juveniles, too small to have consumed a bait. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Post-ORV Monitoring

Post-ORV monitoring in the Vermont ORV zone was conducted 4-8 weeks after ORV bait distribution. Sampling included raccoons and skunks from density studies and non-density study "roadside trapping". In addition to the 106 unique raccoons and 11 unique skunks captured in Franklin County during the density studies, cage traps were used to immobilize, process and release 134 unique raccoons and 2 unique skunks from Caledonia, Franklin and Orleans Counties. One additional skunk was trapped and released without processing because it was a late-year juvenile, too small to have consumed a bait.

Non-target Captures

Non-target (not processed) animals captured and released by WS in 2005 included: 31 striped skunks, 7 domestic/feral cats (*Felis catus*), 4 fishers (*Martes pennanti*), 3 muskrats (*Ondatra zibethicus*), 2 Eastern cottontails (*Sylvilagus floridanus*), 1 beaver (*Castor canadensis*), 1 ruffed grouse (*Bonasa umbellus*), 1 mink (*Mustela vison*), 1 Norway rat (*Rattus norvegicus*), 1 gray squirrel (*Sciurus carolinensis*), and 1 red squirrel (*Tamiasciurus hudsonicus*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Vermont cooperates with the VDH Laboratory (VDHL) and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC). Wildlife Services has had an

efficient and cooperative relationship with both laboratories since 1997, and they remain critical to the surveillance and monitoring phases of the ORV program in Vermont.

Vermont Department of Health Laboratory.--The VDHL tests animal brainstems for rabies via routine public health surveillance throughout the state (specimens involved in a potential or confirmed exposure usually submitted by Game Wardens, WS, veterinarians, and the public). The VDHL also tests animals to enhance rabies surveillance in counties within the ORV zone (specimens not involved in an exposure and usually submitted by WS). The VDHL tested 306 animals for the rabies virus in 2005 (Table 2), representing a 14.7% decrease from the number of samples tested in 2004. Animals were submitted from all 14 counties throughout the state, including the ORV counties. Of the raccoons tested statewide by the VDHL, 47.7% came from a county treated with ORV. The VDHL confirmed 59 rabid animals in 2005: 36 raccoons, 11 skunks, 6 big brown bats (*Eptesicus fuscus*), 5 little brown bats (*Myotis lucifugus*), and 1 gray fox (*Urocyon cinereoargenteus*) from 9 counties; all terrestrial animals had the raccoon variant of rabies.

Raccoons, skunks, foxes and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 57.5% of the animals tested for rabies by the VDHL in 2005 are reported by WS as “other.” For a full listing of rabid animals in Vermont by town, county and species from 2002 to the present please visit:

<http://healthvermont.gov/prevent/rabies/Rabies.aspx>

Table 2. Animals tested for rabies by the Vermont Department of Health Laboratory in Vermont, 2005 (statewide rabies positives in parentheses).

	Statewide	Within ORV counties
Raccoons	86 (37)	41 (47.7%)
Skunks	23 (10)	10 (43.5%)
Foxes	19 (1)	5 (26.3%)
Coyotes	2 (0)	0
Other ^a	176 (11)	66 (37.5%)
Total	306 (59)	122 (39.9%)

^a Other animals included: bats, cats, dogs, other domestic pets, and woodchucks.

New York State Department of Health’s Rabies Laboratory at the Wadsworth Center.--The WC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA. In 2005, Vermont WS submitted 250 blood serum samples (239 raccoons and 11 skunks) for rabies VNA analysis to the WC. This represented a 27% decrease from the 343 samples submitted by WS in 2004. The Vermont ORV program anticipates similar numbers of serum sample submissions to the WC in 2006. For more information about the Rabies Laboratory at the WC please visit: <http://www.wadsworth.org/rabies/>

ORV PROGRAM 2004 – EVALUATION

Vermont’s 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon and skunk blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and teeth are analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain a biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, WS live-trapped 329 unique raccoons and 16 unique skunks to evaluate the effectiveness of ORV bait distribution. Some of those raccoons were trapped during efforts to reduce predation on State Threatened turtles prior to annual ORV on 3 sites that had been aerially baited since 1997 (Figure 1 inset). The majority of the

raccoons (and all skunks) were trapped 2-8 weeks after ORV distribution. Blood samples were collected from 327 raccoons and all 16 skunks. Tooth samples were collected from 314 raccoons, but no skunks. Serum samples were sent to the WC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA).

Sixty-three raccoons (19.3%) demonstrated a positive rabies antibody response (Table 3), while no skunks sampled had detectable levels of rabies VNA (≥ 0.05 IU). The raccoon tooth samples collected in 2004 were analyzed for tetracycline biomarker presence, although FMP baits have not been aerially distributed in the Vermont ORV zone (on a broad scale) since 2000. In 2004, FMP baits were distributed by hand in 24 small cities and villages and likely account for the 21 tooth samples that showed the presence of tetracycline biomarker.

Table 3. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during cooperative rabies management program activities in Vermont, 2004.

	Turtle protection trapping	Fall ORV evaluation	Total
Sample collection timeframe	4-7 May	21 Sep.-29 Oct.	2004
Weeks post-ORV	36	2-8	
ORV bait type (aerial)	CS ^a	CS	
Unique raccoons	25	304	329
		Serology	
Testable blood samples	25	302	327
Positive rabies antibody response (≥ 0.05 IU)	2 (8.0%)	61 (20.2%)	63 (19.3%)
		Tetracycline biomarker	
Testable tooth samples	25	289	314
Presence of tetracycline biomarker ^b	1 (4.0%)	20 (6.9%)	21 (6.7%)

^a CS=coated sachet.

^b Fishmeal polymer baits (which contain tetracycline) were distributed by hand in areas too populated to bait by air and likely account for the tooth samples that showed the presence of biomarker.

Age Results.--In 2004, 313 raccoon teeth were aged using premolars of live-captured animals collected during turtle protection (in May) and fall post-ORV trapping activities (Figure 2). Age results are typical, with the May population dominated by adult animals (≥ 1 y.o.) and the fall population dominated by young of the year juveniles (<1 y.o.).

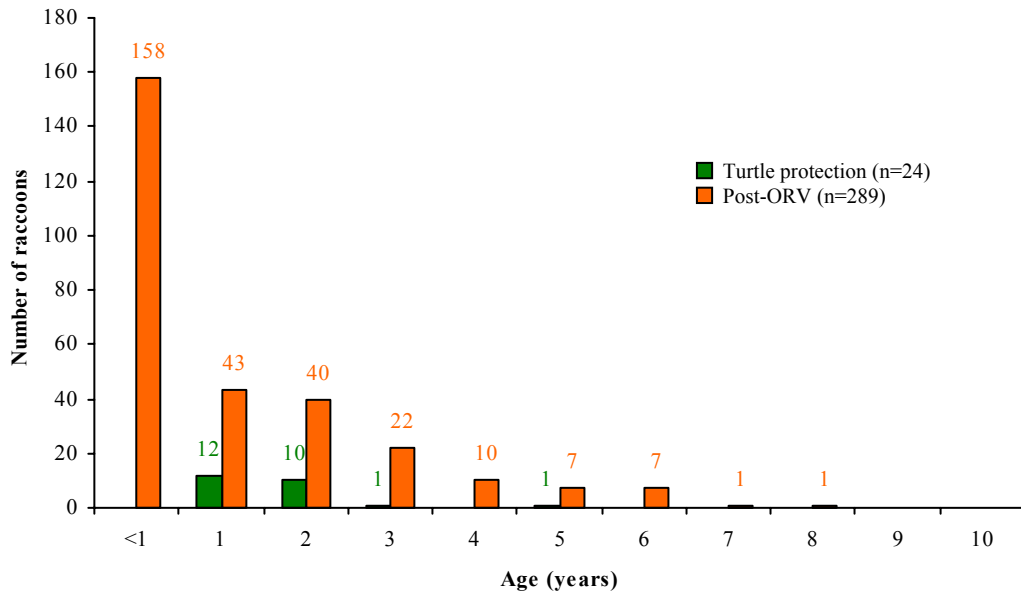


Figure 2. Age class distribution of 313 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program in Vermont, 2004.

SUMMARY

The summer of 2005 marked the ninth year of WS cooperative participation in the Vermont ORV Program. Over those 9 years, the VDH has confirmed 604 cases of the raccoon variant of rabies in Vermont; only 18 (3.0%) 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 more than 2.5 million ORV baits, containing Raboral V-RG®, over northern Vermont since 1997 has been instrumental in preventing raccoon rabies from spreading northward.

During the 2005 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 2005 included New York, Maine, Massachusetts, 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 variant of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM VIRGINIA 2005

BACKGROUND

In 1977, raccoon (*Procyon lotor*) rabies was 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 and has now become enzootic in all of the East Coast states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and eastern Ohio. Wildlife Services (WS) became involved in an oral rabies vaccination (ORV) program to control raccoon rabies in Virginia in 2002. The ORV program in Virginia is part of the Appalachian Ridge (AR) ORV project and of a larger, cooperative effort to stop the westward spread of the raccoon variant of rabies in the eastern United States.

The raccoon variant of rabies occurs throughout Virginia, with the exception of 3 counties (Dickenson, Lee, and Wise) on the southwestern border with Kentucky (Figure 1). According to the Virginia Department of Health (VDH), Office of Epidemiology, infected raccoons accounted for 247 (49.9%) of the 495 animal rabies cases reported in Virginia during 2005. During the past 8 years (January 1998-December 2005) raccoons have accounted for 2,448 (56.8%) of the 4,308 laboratory confirmed cases of animal rabies statewide. Wildlife Services is working in cooperation with the VDH, the Virginia Department of Game and Inland Fisheries, and local animal control officers to provide as many rabies surveillance specimens as possible.

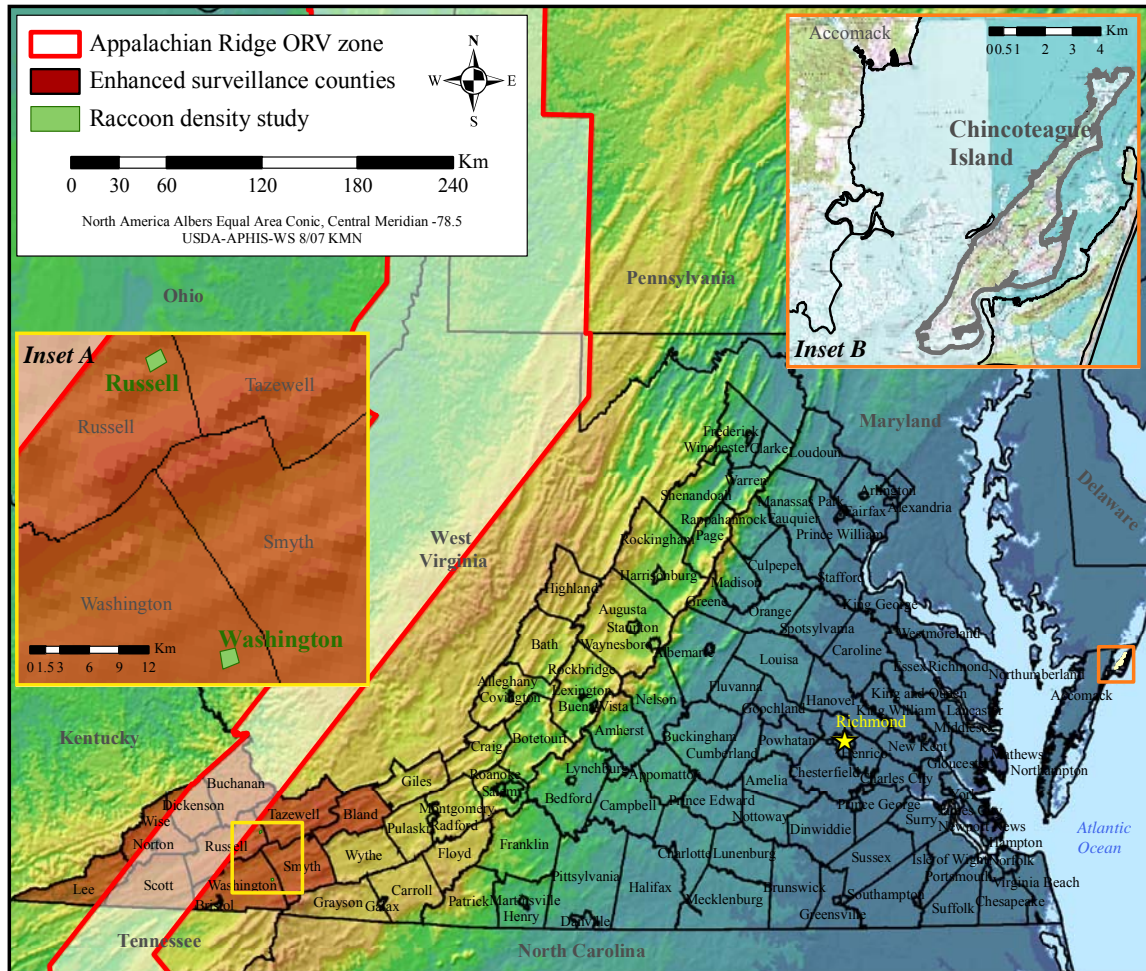


Figure 1. Wildlife Services cooperative rabies management program activities in Virginia, 2005.

ORV PROGRAM 2005

Bait Distribution

For the fourth consecutive year, WS participated in bait distribution efforts in southwestern Virginia as part of the larger AR ORV zone; 305,173 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 5,257 km² (2,030 mi²) in 2005 (Figure 1). Since its program inception in 2002, WS has cooperated to distribute 1,465,824 ORV baits in Virginia.

From 9-16 August 2005, 293,293 fishmeal-coated sachet (CS) baits were distributed over 9 counties in southwestern Virginia. Fixed-wing aircraft and pilots were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS personnel served as navigators and flight crew in the planes. Planes flew at approximately 150-300 meters altitude and flight lines were spaced approximately 500 meters apart. Baits are distributed via ground operations (hand and vehicle) in areas too populated to bait by air. On 29-31 August 2005, WS distributed 11,880 fishmeal polymer (FMP) baits in several urban and suburban areas of southwest Virginia: Castlewood, Clinchco, Clintwood, Coeburn, Gate City, Grundy, Haysi, Lebanon, Norton, St. Paul, Weber City, and Wise.

Enhanced Surveillance

During 2005, WS cooperated with the VDH and County animal control officers to collect 44 animals from counties in or adjacent to the ORV zone to enhance rabies surveillance in southwestern Virginia (Figure 1). These were road killed, strange acting, or nuisance animals that otherwise would not have been tested through the public health surveillance system. The Virginia Department of General Services – Division of Consolidated Laboratory Services (VDCLS) tested 19 of these animals: 16 raccoons from Tazewell County, 1 raccoon from Scott County, 1 raccoon from Wise County, and 1 striped skunk (*Mephitis mephitis*) from Tazewell County. The skunk, collected east of the ORV zone, tested positive for rabies, while the raccoons all tested negative.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Virginia WS personnel attended dRIT training in April 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, GA and began implementing the test on 13 July 2005. In 2005, WS tested 25 of 44 enhanced surveillance samples (56.8%) using the dRIT and 2 tested positive for rabies (Table 1). In addition, WS tested 51 raccoons from Chincoteague Island using the dRIT (see *Other Rabies Management Program Activities* section).

Table 1. Animals tested for rabies by Wildlife Services using the Direct Rapid Immunohistochemistry Test from counties within or adjacent to the ORV zone in Virginia, 2005 (rabies positives in parentheses).

County	Raccoon	Gray fox	Red fox	Total
Bland	1			1
Dickenson	1			1
Russell	5		1	6
Scott	1			1
Tazewell	1			1
Washington	10 (1) ^a			10 (1)
Wise	4	1 (1) ^b		5 (1)
Total	23 (1)	1 (1)	1	25 (2)

^a Collected east of the ORV zone.

^b Collected within the ORV zone.

All positives and 10% of all negative samples were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples. Antigenic typing conducted by the CDC determined that the rabies virus in the positive raccoon was consistent with the raccoon variant found in the eastern U.S. and the positive gray fox (*Urocyon cinereoargenteus*) was consistent with a variant found in Eastern red bats (*Lasiurus borealis*). Wildlife Services will continue to use the dRIT in 2006 to enhance surveillance of suspect rabid animals in Virginia.

Population Monitoring

In 2005, WS conducted 2 raccoon density studies (1 each in Washington and Russell Counties) using the National Rabies Management Program standard protocol of 50 cage traps set on a target study area of 3 km² for 10 consecutive nights (Figure 1 inset A). The 2 studies were conducted just east of the current bait zone to provide raccoon density estimates for areas that may be included in future ORV zones. Both studies also provided an index to raccoon densities in agricultural environments, representative of habitat found throughout the Virginia ORV zone. During the 2 studies, 92 unique raccoons were captured and blood and tooth samples were collected from most of them (Table 2). During the Washington County study, 27 raccoons were immobilized, processed and released, 7 raccoons were euthanized at the landowner's request or because of injuries/wounds, and 2 raccoons were found dead in traps. Brainstem samples were collected from the 9 raccoons and tested for rabies by WS using the dRIT. One sample tested positive and was confirmed as the raccoon variant of rabies. During the Russell County study, all raccoons were immobilized, processed and released. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Table 2. Index to raccoon densities in Russell and Washington Counties, Virginia, 2005.

	Washington	Russell
Time of study	6-16 July	19-29 July
Macrohabitat	Agriculture	Agriculture
Target trap nights	500	500
Unique raccoons	36	56
Recaptured raccoons	6	6
Non-target captures	45	43
Area (km ²)	2.72	2.61
Raccoon density index ^a	13.2	21.5

^a Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

Post-ORV Monitoring

During September and October 2005, WS conducted trapping activities 4-7 weeks post-aerial ORV bait distribution in Dickenson, Russell, Scott, and Wise Counties. Over 1,392 trap nights, 196 unique raccoons were captured on public and private lands (194 and 195 serum and tooth samples were collected, respectively). One raccoon was found dead in a trap, while 195 raccoons were immobilized, processed and released.

Other Rabies Management Program Activities

In April 2005, the VDH requested assistance from Virginia WS with a rabies outbreak on Chincoteague Island in Accomack County (Figure 1 inset B). Prior to 2005, the only confirmed case of rabies on Chincoteague was a domestic cat (*Felis catus*) that tested positive in 1996. According to the VDH, the cat had been picked up out of state, brought to the island, and raised indoors. It had apparently been exposed to rabies prior to being adopted. Concern was raised when 5 cases of rabies in raccoons were confirmed during February-May 2005. Chincoteague Island (approximately 18 km²) is the only developed island off of Virginia's eastern shore and a popular tourist destination during the summer months. The VDH was concerned about potential rabies exposures to residents and tourists from a large population of urban raccoons living among the homes and businesses on the Island.

In response to the outbreak, Virginia WS implemented a rabies control and surveillance program on Chincoteague Island from 6-22 June 2005. Over the 17-day period (during approximately 1,100 trap nights) WS

trapped and euthanized 51 raccoons to reduce the population of nuisance animals in town and limit potential human exposures to rabies. All samples were tested for rabies by WS using the dRIT and 13 (25.5%) tested positive for rabies. All positives were confirmed by the CDC as raccoon rabies variant. After the control program was completed, no additional cases of rabies were confirmed on Chincoteague Island in 2005.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 158 opossums (*Didelphis virginiana*), 7 domestic/feral cats, 6 woodchucks (*Marmota monax*), 3 Eastern box turtles (*Terrapene carolina*), 3 Eastern cottontails (*Sylvilagus floridanus*), 3 domestic/feral dogs (*Canis familiaris*), 3 snapping turtles (*Chelydra serpentina*), and 1 striped skunk.

Non-target animals that were captured and euthanized by WS in 2005 included: 26 opossums, 13 woodchucks, and 1 feral cat. In addition, 1 woodchuck was captured and found dead in the trap.

Rabies Laboratory Cooperation

The ORV program in Virginia cooperates with the VDCLS and the CDC.

Virginia Division of Consolidated Laboratory Services.--The VDCLS tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure). They also work with WS to test a limited number of enhanced surveillance samples (specimens not involved in an exposure) from areas within and adjacent to the ORV zone. In 2005, the VDCLS tested 3,962 samples for the rabies virus and confirmed 495 cases of rabies (Table 3).

Raccoons, skunks, foxes, coyotes (*Canis latrans*), and bobcats (*Lynx rufus*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 76.9% of the animals tested for rabies in Virginia in 2005 are reported by WS as “other.” For a full listing of rabid animals from Virginia in 2005 please visit the VDH’s rabies website:

<http://www.vdh.virginia.gov/epidemiology/DZEE/Rabies/>

Table 3. Animals tested for rabies by the Virginia Department of General Services – Division of Consolidated Laboratory Services in Virginia, 2005.

	Statewide		Within and adjacent to Virginia ORV zone ^a	
	Number tested	Number rabid	Number tested	Number rabid
Raccoons	582	247	60 (10.3%)	7
Skunks	172	122	8 (4.7%)	3
Foxes	148	57	10 (6.8%)	2
Coyotes	6	0	1 (16.7%)	0
Bobcats	7	1	0	0
Other ^b	3,047	68	142 (4.7%)	3
Total	3,962	495	221 (5.6%)	15

^a Samples from Buchanan, Dickenson, Lee, Russell, Scott, Smyth, Tazewell, Washington, and Wise Counties.

^b Other animals included: bats, cats, cows, dogs, goats, horses, and woodchucks (groundhogs).

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). Virginia WS submitted 285 blood serum samples for rabies VNA analysis to the CDC in 2005. This represents a 25.6% increase from the 227 samples submitted by WS in 2004. The Virginia ORV program anticipates similar numbers of serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology, and prevention and control) on a national level please visit the CDC’s rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

Virginia’s 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, WS live-trapped 228 raccoons during raccoon density studies conducted prior to annual ORV and fall post-ORV evaluation activities (Table 4). Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson’s Laboratory LLC (Milltown, Montana, USA). The samples collected during density studies prior to annual ORV in 2004 either came from areas that were previously baited (in 2003 and/or 2002) or were less than 2 km from a previous year’s ORV zone. This may explain the relatively high presence of rabies VNA and tetracycline for samples collected prior to annual ORV in 2004.

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during cooperative rabies management program activities in Virginia, 2004.

	Density studies (prior to annual ORV)	Fall AR ^a evaluation	Total
Sample collection timeframe	14 Jun.-29 Jul.	13 Sep.-8 Oct.	2004
Weeks post-ORV	n/a	4-8	
ORV bait type	n/a	FMP ^a	FMP
Unique raccoons	99	129	228
		Serology	
Testable blood samples	98	129	227
Positive rabies antibody response (≥ 0.05 IU)	10 (10.2%)	48 (37.2%)	58 (25.6%)
		Tetracycline biomarker	
Testable tooth samples	82	128	210
Presence of tetracycline biomarker	19 (23.2%)	76 (59.4%)	95 (45.2%)

^a AR=Appalachian Ridge; FMP=fishmeal polymer.

Age Results.--In 2004, 209 raccoon teeth were aged using premolars of live-captured animals collected during summer density studies (prior to annual ORV distribution) and fall post-ORV trapping activities (Figure 2). Age results are typical, with the summer population dominated by adult animals (≥ 1 y.o.) and the fall population dominated by young of the year juveniles (< 1 y.o.) and 1 y.o. animals.

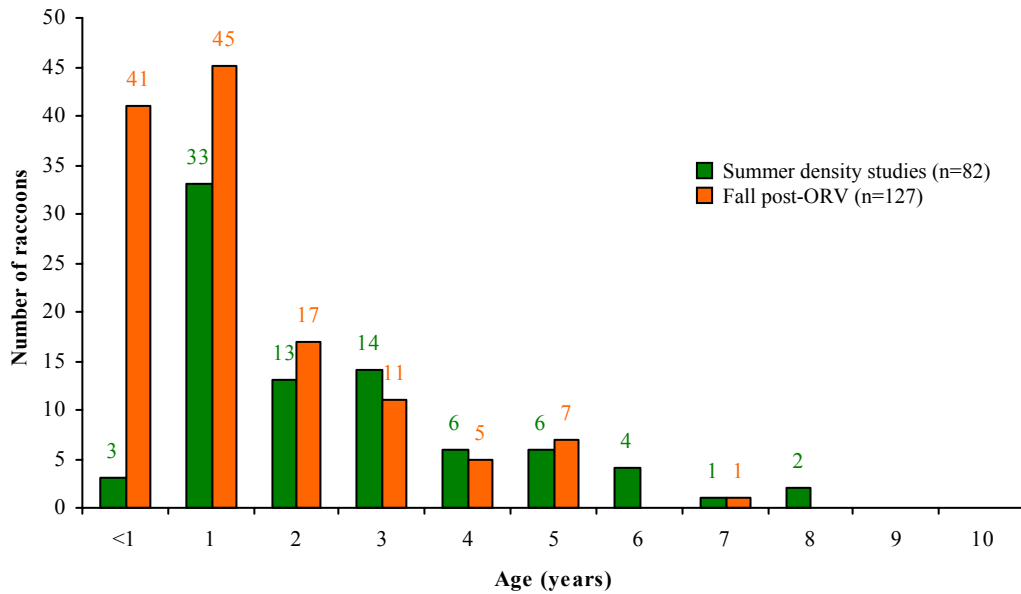


Figure 2. Age class distribution of 209 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program in Virginia, 2004.

SUMMARY

During 2005, WS completed its fifth year of cooperative participation in rabies management in Virginia, and its fourth year conducting ORV bait distribution activities. Other activities in 2005 included: enhancing surveillance of raccoon rabies by collecting and testing road killed, strange acting and nuisance animals from counties within and adjacent to the ORV zone; conducting raccoon population density studies in ORV naïve areas east of the current zone; and trapping post-ORV bait distribution to monitor and evaluate raccoon serology and biomarker uptake in southwestern Virginia.

In 2006, WS will continue to conduct raccoon density studies and enhanced rabies surveillance within and adjacent to the current AR ORV zone. Future ORV baiting strategies in Virginia will continue to be tied to national and international planning efforts to contain, and explore strategies to eliminate, the raccoon variant of the rabies virus in North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM WEST VIRGINIA 2005

BACKGROUND

Raccoon (*Procyon lotor*) rabies was first introduced into West Virginia in 1977, from raccoons translocated from the southern United States to Hardy County (Figure 1). 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. Wildlife Services (WS) became involved in an oral rabies vaccination (ORV) program to control raccoon rabies in West Virginia in 2001. The ORV program in West Virginia is part of the Appalachian Ridge (AR) ORV project and of a larger, cooperative effort to stop the westward spread of the raccoon variant of rabies in the eastern United States.

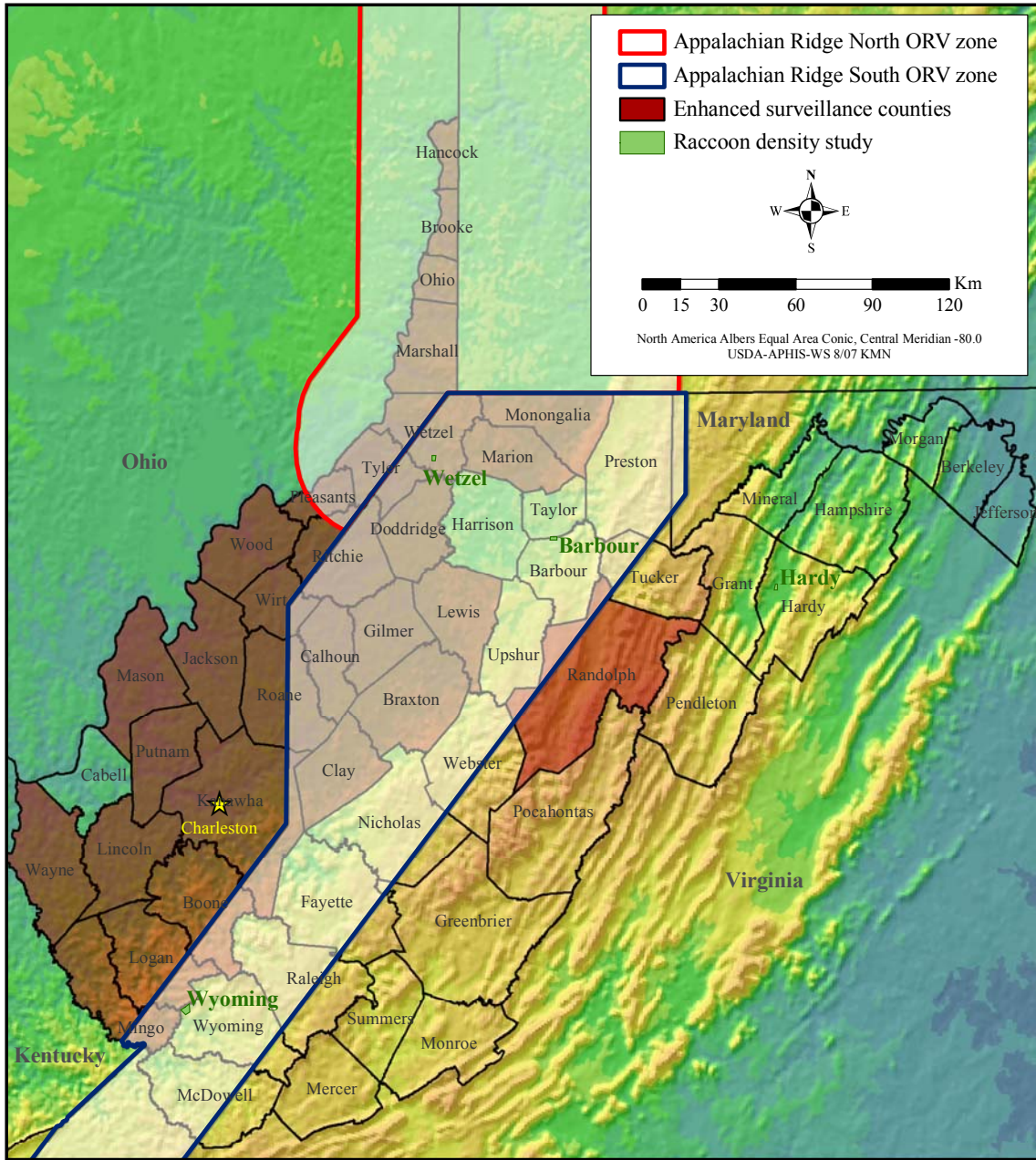


Figure 1. Wildlife Services cooperative rabies management program activities in West Virginia, 2005.

In 2005, 75 confirmed cases of rabies were reported in West Virginia, 34 of which were found in raccoons. Striped skunks (*Mephitis mephitis*) were the second most common carrier of rabies in West Virginia with 18 cases confirmed in 2005, but other species included: 6 domestic/feral cats (*Felis catus*), 6 foxes (*Canidae* spp.), 6 bats (*Chiroptera* spp.), 2 domestic/feral dogs (*Canis familiaris*), 1 bobcat (*Lynx rufus*), 1 white-tailed deer (*Odocoileus virginianus*), and 1 sheep (*Ovis aries*).

The West Virginia ORV program is coordinated by the WV Department of Agriculture (WVDOA), while surveillance is being conducted by the WV Department of Health and Human Resources (WVDHHR), Wildlife Services (WS), and County Departments of Health. Wildlife Services provides funding and operational support, including coordination of ORV bait distribution activities, raccoon population monitoring, and program evaluation through live trapping efforts. The West Virginia Division of Natural Resources (WVDNR) provides permits for handling wildlife, access to state owned property, and expertise in raccoon ecology and management.

ORV PROGRAM 2005

Bait Distribution

For the fifth consecutive year, WS participated in bait distribution efforts along the AR in West Virginia via 2 distinct baiting efforts (a south and north campaign); 1,720,485 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 26,021 km² (10,047 mi²) in 2005 (Figure 1). Since its program inception in 2001, WS has cooperated to distribute 7,194,337 ORV baits in West Virginia. Ground support for aerial baiting was provided by: the WVDHHR, the WVDOA, the WVDNR, the Ohio National Guard, the Ohio Department of Health, and WS employees from West Virginia, Virginia, Tennessee, Kentucky, Ohio, Pennsylvania, and Mississippi (WS' National Wildlife Research Center field station).

Appalachian Ridge South.--In 2005, the southern portion of the West Virginia AR ORV zone covered 23,387 km² (9,030 mi²) in 35 counties (Figure 1). From 9-16 August, 1,550,290 ORV baits were distributed; 985,694 fishmeal polymer (FMP) and 536,581 fishmeal-coated sachet (CS) baits via fixed-wing aircraft. From 16-23 August, 28,015 FMP baits were distributed via ground operations (hand baiting). Fixed-wing aircraft and pilots were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS personnel served as navigators and flight crew in the planes.

Appalachian Ridge North.--In 2005, the northern portion of the West Virginia AR ORV zone covered 2,634 km² (1,017 mi²) in 9 counties (Figure 1). From 6-15 September, 170,195 ORV baits were distributed; 166,875 CS and 3,320 FMP baits via fixed-wing aircraft. Fixed-wing aircraft were provided by the Ontario Ministry of Natural Resources, while WS personnel served as navigators and flight crew in the rear of the plane.

Enhanced Surveillance

In 2005, WS enhanced surveillance of raccoon rabies by collecting and submitting 249 animals from 29 counties in or adjacent to the West Virginia ORV zone (Table 1). Of the animals collected, 82 were euthanized due to abnormal behavior (78 raccoons, 2 red foxes (*Vulpes vulpes*), 1 coyote [*Canis latrans*], and 1 striped skunk). The other 167 animals were collected during road kill surveillance. One of 249 animals tested positive for rabies and that was a bat variant. All animals captured by WS in 2005 were handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines and all animals euthanized were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Wildlife Services personnel attended dRIT training in March 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. Wildlife Services is planning implementation of the dRIT in January 2006 when laboratory construction is complete.

Table 1. Animals submitted for rabies testing by Wildlife Services (rabies positives in parentheses) in or adjacent to ORV counties in West Virginia, 2005.

County	Raccoon	Skunk	Coyote	Red fox	Gray fox	Bobcat	Total
Boone	3						3
Braxton	2						2
Brooke	6						6
Calhoun	24	4					28
Clay	1						1
Doddridge	1						1
Gilmer	3	2					5
Hancock	2						2
Jackson ^a	9	1					10
Kanawha	8						8
Lewis	2						2
Lincoln ^a						1	1
Logan	3		1				4
Marion	2						2
Marshall	45						45
Mason ^a	1						1
Mingo	1		1				2
Monongalia	4			1			5
Ohio	5						5
Pleasants	9		1				10
Putnam ^a	2						2
Randolph	1						1
Ritchie	23						23
Roane	2	1					3
Tyler	6						6
Wayne ^a	2				1		3
Wetzel	13						13
Wirt	14			1			14 (1) ^b
Wood ^a	36	3	1				40
Total	230	11	4	2	1	1	249 (1) ^b

^a ORV not applied in this county.

^b Bat variant of rabies.

Population Monitoring

In 2005, WS conducted 4 raccoon density studies (1 each in Barbour, Hardy, Wetzel, and Wyoming Counties) using the National Rabies Management Program (NRMP) standard protocol of 50 cage traps set on a target study area of 3 km² for 10 consecutive nights (Figure 1). The Wyoming study was inadvertently conducted on a study area nearly 8 km². The Barbour, Wetzel, and Wyoming County studies were each conducted on wildlife management areas, managed by the WVDNR and were representative of habitat found throughout much of the state with forested rolling hills and permanent streams; the Barbour site also had 3 large corn food plots. The 3 studies were also in the 2005 West Virginia ORV zone. The Hardy County study was conducted east of the current bait zone in an ORV naïve area (never previously treated with ORV). Raccoon density estimates are critical for use in future plans to potentially shift the ORV zone to the east. The Hardy study site was composed of forest, pasture, and corn fields. Over 2,000 trap nights, 76 unique raccoons were captured and blood and tooth samples were collected from most of them (Table 2). All raccoons were immobilized, processed and released.

Table 2. Index to raccoon densities in Hardy, Barbour, Wetzel, and Wyoming Counties, West Virginia, 2005.

	Hardy^a	Barbour	Wetzel	Wyoming
Time of study	6-16 June	11-21 July	11-21 July	18-28 July
Macrohabitat	Agriculture	Agriculture	Forested	Forested
Target trap nights	500	500	500	500
Unique raccoons	21	28	16	11
Recaptured raccoons	11	6	5	0
Non-target captures	38	11	2	1
Area (km ²)	2.59	3.27	2.92	7.84
Raccoon density index ^b	8.1	8.6	5.5	1.4

^a ORV not applied in this county.

^b Raccoon density index (raccoons/km²) = unique raccoons ÷ area.

Post-ORV Monitoring

During September through November 2005, WS conducted trapping activities 4-8 weeks post-ORV bait distribution in Barbour, Braxton, Brooke, Calhoun, Clay, Gilmer, Lewis, McDowell, Monongalia, Nicholas, Preston, Ritchie, Roane, Upshur, Wirt, and Wyoming Counties. As a result, biological samples were collected from 279 animals: 262 raccoons, 9 striped skunks, 6 coyotes, 1 gray fox (*Urocyon cinereoargenteus*), and 1 red fox. Of these, 142 (130 raccoons, 6 coyotes, and 6 striped skunks) were euthanized at the landowner's request, while 137 (132 raccoons, 3 striped skunks, 1 gray fox, and 1 red fox) were released. Unfortunately, the euthanized animals were not tested for rabies.

Other Rabies Management Program Activities

Comparison of Raccoon Density Indices.--In 2005, WS continued a 3-year cooperative effort with the WVDNR to compare WS' raccoon density estimates with the West Virginia raccoon field trial survey. The raccoon field trial survey is conducted by the WVDNR, in cooperation with the West Virginia Coon Hunter's Association, in 4 regions throughout the state based on similarities in hunting pressure and habitat. The survey monitors raccoon populations by using night hunt scorecard information and results in an index expressed as the average number of raccoons seen on a 2-hour cast of the hounds. Similar data is collected by game agencies in other southeastern states. In 2003, WS and the WVDNR began having hunters conduct raccoon field trial surveys at 3 selected sites immediately following the completion of WS raccoon density studies. The purpose of this has been to make a relative comparison of the 2 indices to determine if both indicate the same general trends in raccoon populations. Preliminary data suggests that the 2 indices do correlate with regard to low, medium, and high raccoon densities. Wildlife Services and the WVDNR plan to continue this cooperative effort to collect additional data. The comparison of these 2 indices may prove useful as WS' NRMP expands into additional areas by enabling the program to utilize existing raccoon field trial data to predict population densities.

Habitat Characteristics Study.--For the fourth consecutive year in 2005, WS collected habitat data to determine the relationship of habitat composition and elevation to raccoon relative abundance. 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. Several habitat characteristics were measured at 200 trap locations during raccoon trapping activities. At each trap location a 7.97 m (26.3 ft) diameter plot was sampled, with the trap centered in each plot. These preliminary data confirm the proximity of raccoons to sources of water (Table 3). Wildlife Services will continue to collect these data in 2006.

Table 3. Mean habitat characteristics measured at trap locations that captured and did not capture raccoons in West Virginia, 2005.

Habitat Characteristics	Capture site	Non-capture site
Basal area ^a (ft ²)	2.19	2.31
Trees >11" dbh ^b	1.10	1.35
Trees <11" dbh	4.29	4.70
Ground vegetation cover (%)	62.07	69.54
Canopy cover (%)	51.50	55.50
Distance (m) to water-intermittent	4.20	33.32
Distance (m) to water-permanent	35.00	55.04
Slope (%)	5.49	8.15
Elevation (ft)	1,232	1,144
Den sites per plot	0.21	0.19
Number of tree/shrub species per plot	3.50	2.54
Red Oak (<i>Quercus rubra</i>)	3.29	3.50
White Oak (<i>Quercus alba</i>)	2.00	1.46
Beech (<i>Fagus grandifolia</i>)	1.29	1.54
Hickory (<i>Carya spp.</i>)	1.33	1.71
Black walnut (<i>Juglans nigra</i>)	0	2.00
Common apple (<i>Malus sylvestris</i>)	1.00	2.00
Pear (<i>Pyrus communis</i>)	1.60	1.87
Black cherry (<i>Prunus serotina</i>)	2.00	1.00
Flowering dogwood (<i>Cornus florida</i>)	13.00	4.40
Blackberry (<i>Rubus spp.</i>)	1.25	2.67
Grape (<i>Vitis spp.</i>)	1.14	2.00
Autumn Olive (<i>Elaeagnus umbellata</i>)	7.83	4.00

^a Calculated using a 20-factor prism.

^b dbh=diameter at breast height.

Non-target Captures

Non-target animals captured and released by WS in 2005 included: 114 opossums (*Didelphis virginiana*), 8 Eastern cottontails (*Sylvilagus floridanus*), 8 woodchucks (*Marmota monax*), 6 domestic/feral cats, 2 fox squirrels (*Sciurus niger*), 1 domestic/feral dog, 1 gray squirrel (*Sciurus carolinensis*), 1 muskrat (*Ondatra zibethicus*), and 1 striped skunk.

Non-target animals that were captured and euthanized by WS in 2005 included: 16 opossums, 12 woodchucks, and 1 feral cat. These animals were all euthanized at the landowner's request.

Rabies Laboratory Cooperation

The ORV program in West Virginia cooperates with the WVDHHR and the CDC.

West Virginia Department of Health and Human Services.--The WVDHHR tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure usually submitted by conservation officers, veterinarians, and the public) and enhanced surveillance (specimens not involved in an exposure and usually submitted by WS). In 2005, the WVDHHR tested 1,373 samples for the rabies virus and confirmed 75 cases of rabies in West Virginia. Of the 1,373 samples 455 were tested because of human exposures, 170 were tested because of domestic animal exposures, and 738 were tested for other reasons. The 2005 samples were submitted from all 55 counties throughout the state. For a full listing of rabid animals from West Virginia by species and location from 2002-2005 please visit the WVDHHR's rabies website: <http://www.wvdhhr.org/idep/a-z/a-z-rabies.asp>

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). West Virginia WS submitted 349 blood serum samples for rabies VNA analysis to the CDC in 2005. This represents a 4.9% decrease from the 367 samples

submitted by WS in 2004. The West Virginia ORV program anticipates similar numbers of serum sample submissions to the CDC in 2006. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: <http://www.cdc.gov/ncidod/dvrd/rabies/>

ORV PROGRAM 2004 – EVALUATION

West Virginia's 2005 ORV program evaluation data (serology, tetracycline, and age results) were not available at the time of this report. Therefore, 2004 ORV program evaluation data are presented below.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of 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 sera evaluation as well.

In 2004, WS live-trapped 370 raccoons during density studies conducted in ORV naïve areas, prior to annual ORV and during fall post-ORV evaluation activities (Table 4). Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA).

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during cooperative rabies management program activities in West Virginia, 2004.

	Density studies (ORV naïve area) ^a	Density studies (prior to 2004 ORV) ^b	Fall AR ^c (post-ORV)
Sample collection timeframe	7 Jun.-16 Jul.	6 Jul.-7 Aug.	13 Sep.-14 Oct.
Weeks post-ORV	n/a	39-44	4-8
ORV bait type	n/a	FMP ^c	FMP
Unique raccoons	51	70	249
		Serology	
Testable blood samples	51	71 ^d	245
Positive rabies antibody response (≥ 0.05 IU)	0	19 (26.8%)	64 (26.1%)
		Tetracycline biomarker	
Testable tooth samples	24	52	216
Presence of tetracycline biomarker	0	26 (50.0%)	140 (64.8%)

^a Density studies conducted in Grant, Hardy, and Mercer Counties were ORV naïve (never treated with ORV).

^b Density studies conducted in Barbour, Wetzel, and Wyoming Counties were last treated with ORV in October 2003.

^c AR=Appalachian Ridge; FMP=fishmeal polymer.

^d Two serum samples were tested from the same raccoon.

Age Results.--In 2004, 314 raccoon teeth were aged using premolars of live-captured animals collected during summer density studies (prior to annual ORV distribution) and fall post-ORV trapping activities (Figure 2). Age results are typical, with the summer population dominated by adult animals (≥ 1 y.o.) and the fall population dominated by young of the year juveniles (< 1 y.o.) and 1 y.o. animals.

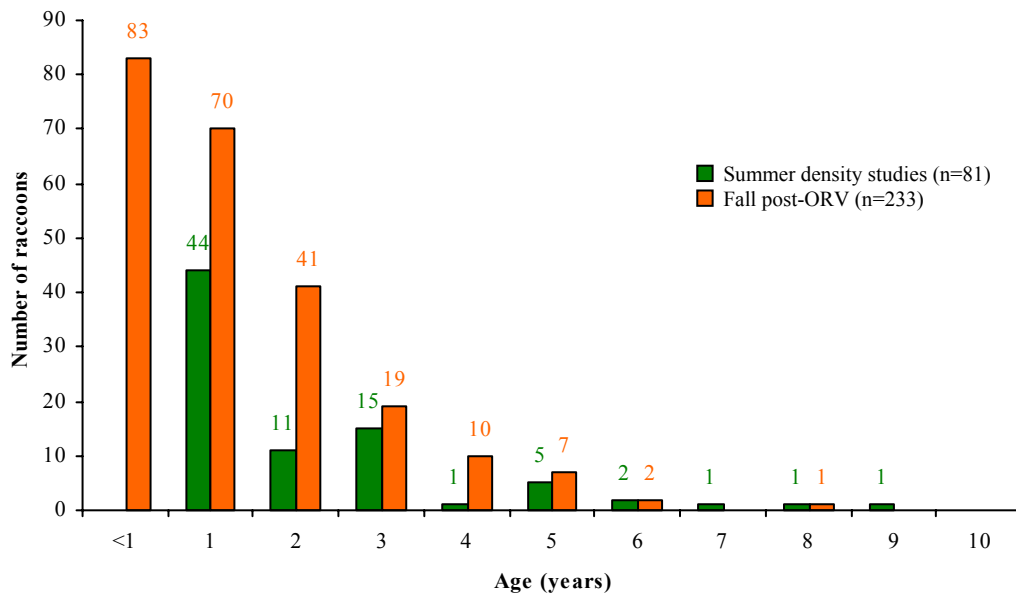


Figure 2. Age class distribution of 314 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program in West Virginia, 2004.

SUMMARY

During 2005, WS completed its fifth year of cooperative participation in rabies management in West Virginia including ORV bait distribution activities. Other activities in 2005 included: enhancing surveillance of raccoon rabies by collecting and testing road killed, strange acting and nuisance animals from counties within and adjacent to the ORV zone; conducting raccoon population density studies within the AR ORV zone and in ORV naïve areas east of the current zone; and trapping post-ORV bait distribution to monitor and evaluate raccoon serology and biomarker uptake throughout West Virginia’s portion of the AR ORV zone.

In 2006, WS will continue to: conduct enhanced rabies surveillance within and adjacent to the current AR ORV zone; investigate the influence of elevation and habitat by collecting pertinent habitat data at each trap location; conduct raccoon density estimates at sites >1,067 meters in elevation; and monitor and evaluate ORV program efficacy by collecting raccoon serology.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM WYOMING 2005

BACKGROUND

The striped skunk (*Mephitis mephitis*) is the primary reservoir of terrestrial rabies in Wyoming. The North Central skunk variant of the rabies virus is endemic in the northeastern counties of Wyoming and typically occurs throughout the Missouri River drainage system (Figure 1). A bat variant of the rabies virus, common in big brown bats (*Eptesicus fuscus*), occurs throughout the state.

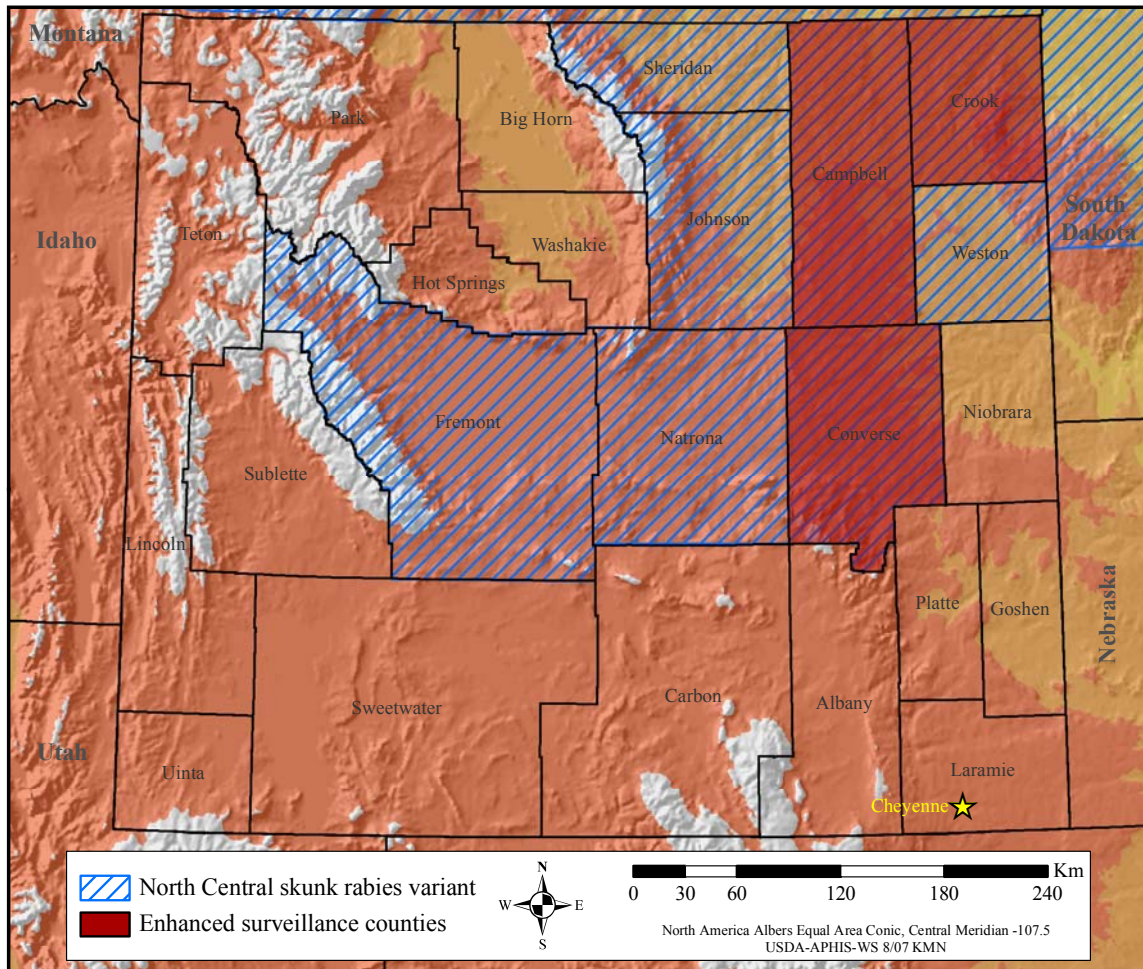


Figure 1. Wildlife Services cooperative rabies management program activities in Wyoming, 2005.

In 2002, the Wyoming Legislature directed the Wyoming Animal Damage Management Board (ADMB) to develop and implement a wildlife rabies management program. The Board, as directed by statute, was charged with promulgating rules pertaining to rabies prevention in wildlife including: surveillance; public education and prevention; vaccination protocol; post-exposure procedures and quarantines; and entering into agreements with law enforcement agencies to carry out quarantine provisions. To comply with this directive, the ADMB signed a memorandum of understanding with Wildlife Services (WS) to provide specimens (primarily skunks) from across the state to the Wyoming State Veterinary Laboratory (WSVL) in Laramie for rabies testing.

In 2003 and 2004, Wyoming WS assisted in a multi-state, long-term study coordinated by WS' National Wildlife Research Center to evaluate bait acceptance of oral rabies vaccine (ORV) placebo baits by skunks. The ultimate goal is to pair an attenuated virus vaccine with a bait matrix highly preferred by skunks for use in a broad-based ORV bait distribution program in the western U.S.

In 2005, WS assisted the ADMB with statewide rabies surveillance for the second consecutive year. A history of rabies in northeast Wyoming and the availability of additional special funds resulted in the hire of a seasonal (180-day) WS employee to conduct enhanced rabies surveillance in Campbell County. Additional rabies surveillance was conducted in 3 counties in eastern Wyoming (Goshen, Niobrara and Weston) as an adjunct to a coyote (*Canis latrans*) plague serosurvey funded by the ADMB in cooperation with the Wyoming Department of Health.

RABIES MANAGEMENT PROGRAM 2005

Bait Distribution

There is currently no ORV bait distribution program in Wyoming.

Statewide Rabies Surveillance

Wildlife specialists in the state live trapped skunks between February and November 2005 in the course of performing their normal work duties. Of 155 samples (heads or carcasses) submitted by WS (120) and other entities/individuals (35), 153 were suitable for rabies testing. This included 129 skunks (not identified to species), 21 raccoons (*Procyon lotor*), 2 bats (not identified to species), and 1 coyote. Nine animals, all skunks, tested positive for rabies by the direct fluorescent antibody (dFA) test. Five of these skunks came from Johnson County and the other 4 were collected in Campbell County.

Enhanced Surveillance

The employee hired to conduct enhanced surveillance focused on skunk trapping and submitted a total of 30 specimens to the WSVL for rabies testing from 3 counties (Figure 1). This total included 22 skunks and 1 coyote from Campbell County, 2 skunks from Converse County, and 5 raccoons from Crook County. Four of the skunks from Campbell County tested positive for rabies. The numbers reported here are included in the statewide totals listed in the preceding paragraph.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Wyoming WS is not planning training or implementation of the dRIT because the WSVL is meeting enhanced surveillance testing needs.

Targeted Rabies Surveillance

During the plague serosurvey, WS collected and submitted 50 coyotes each from Goshen, Niobrara and Weston Counties to the WSVL for rabies testing. One of the samples from Goshen County was unsuitable for testing and the remaining 149 coyotes tested were negative for rabies.

Rabies Laboratory Cooperation

The WSVL in Laramie, Wyoming conducts all rabies testing on animals collected in the state. In addition to enhanced surveillance testing, the lab tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure). In 2005, the WSVL tested 736 animals for rabies and confirmed 18 (2.4%) rabid animals including 15 skunks and 3 bats. Statewide prevalence of rabies in skunks increased from 2 cases in 2004 (n=185 samples tested) to 15 cases in 2005 (n=129 samples tested).

One of the biggest rabies surveillance challenges faced by the WSVL is acquiring an adequate and representative number of surveillance samples from each Wyoming county. In 2006, the Lab expects to gain

funding from the Wyoming Department of Agriculture to continue the statewide surveillance program. For more information on rabies in Wyoming please visit: <http://www.wyorabies.org/index.htm>

SUMMARY

In 2005, WS focused on a general statewide surveillance program targeting skunks with more intensive surveillance conducted in northeast Wyoming. Additional rabies surveillance of coyotes was conducted in eastern Wyoming. No ORV placebo bait studies were conducted in Wyoming in 2005. In 2006, WS will continue to cooperate with the ADMB and the WSVL to enhance rabies surveillance in Wyoming.

NATIONAL WILDLIFE RESEARCH CENTER CONTROLLING WILDLIFE VECTORS OF RABIES 2005

BACKGROUND

The National Wildlife Research Center (NWRC), located in Fort Collins, Colorado, is the research arm of Wildlife Services (WS). To assist WS' operational National Rabies Management Program (NRMP), oral rabies vaccination (ORV) program, the NWRC, Wildlife Disease Research Program (WDRP), was requested to conduct a 5-year research project that began in Fiscal Year (FY) 2001 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. This project ended on 1 October 2005. The goal was to obtain basic information on rabies in wildlife reservoirs and vectors. Pen and laboratory studies were conducted at the NWRC and Colorado State University, while field studies were conducted in Alabama, Arizona, Ohio, Pennsylvania, and Texas, all states with current ORV programs (Figure 1). Studies involved research on: bait development to better deliver rabies vaccines, such as the currently licensed Raboral V-RG® (V-RG) (Merial Limited, Athens, Georgia, USA) for raccoons (*Procyon lotor*) and skunks (*Mephitidae* spp.); ecology of raccoons, gray fox (*Urocyon cinereoargenteus*), and striped skunks (*Mephitis mephitis*) in rural and urban areas; better use of biomarkers to evaluate vaccine uptake by target and non-target wildlife; evaluating geographic barriers for wildlife dispersal that may affect the spread of rabies; determining long-term efficacy of V-RG vaccine in raccoons; evaluating the biosafety of V-RG vaccine in non-target wildlife; determining if infrared thermography can be used as a surveillance tool to detect rabies infected wildlife; and others.

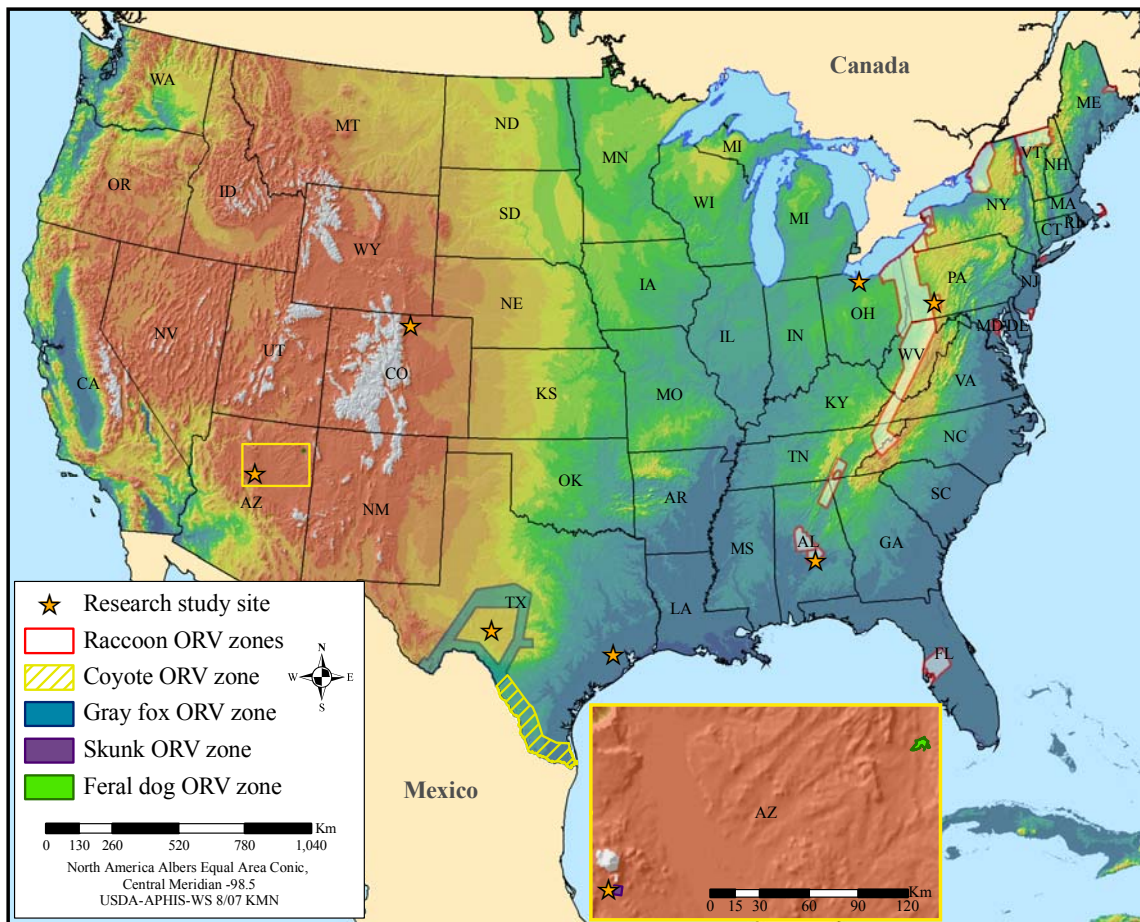


Figure 1. Wildlife Services' (WS) National Wildlife Research Center cooperative rabies research sites and WS' operational oral rabies vaccination (ORV) zones in the United States, 2005.

RESEARCH PROGRAM 2005

NWRC, WDRP Research Studies

“The Determination of the Immunological Response to an Oral Rabies Vaccine in Raccoons by Characterizing the Persistence of the Protective Antibody Titers and Challenge of the Protection” (QA 1218).--This is currently an ongoing study in cooperation with Colorado State University. This study will determine the immunological response to the V-RG vaccine in raccoons by characterizing the persistence of the protective antibody titers and challenge of the protection. Sixty-nine raccoons were separated into 7 treatment groups and vaccinated orally with the V-RG vaccine in October and November 2004. Blood sampling occurred at biweekly intervals for the first 3 months post vaccination, then once a month and will culminate at 18 months. One treatment group received a booster vaccination in November 2005 which was 12 months post the original vaccination and blood is being drawn biweekly post booster vaccination for 2 months, then blood draws will continue monthly for all remaining treatment groups into May 2006. This study has led to the development of a new modified 96-well plate rapid immuno-fluorescent focus inhibition test (RIFFIT) to analyze all serology. The 6 month treatment group was challenged with a virulent street strain of raccoon rabies in May 2005; this group had a 90% survival rate (70% positive rabies virus neutralizing antibody [VNA] response). The serology for the 1 raccoon that did succumb to rabies in this group showed that it had no rabies VNA response following vaccination. In November 2005, the 1 dose 12 month treatment group was challenged and the 2 dose 12 month treatment group was challenged in December 2005. Both groups are currently in a CSU Biosafety Level 3 (BSL-3) facility. In May 2006, the 1 dose and 1 dose plus booster vaccinated groups will be challenged (18 months post original vaccination). In June 2006, the 2 dose vaccinated group will be challenged as well (18 months post original vaccination).

“Ecology of the Gray Fox in Relation to Oral Rabies Vaccination Programs in Texas” (QA 1223).--This study began in 2004; a collaboration by NWRC scientists, Texas WS, and the Texas Department of State Health Services (TDSHS). The overall objective of this study is to provide ecological information on gray foxes and the gray fox variant of rabies to support ORV operations in west-central Texas. Specific objectives include: 1) evaluating movements, dispersal, and/or home ranges of gray fox via radio telemetry and GPS technology at and near breaks in the ORV zone; 2) analyzing gray fox gene flow at and away from breaks in the ORV zone; 3) determining the presence of background rabies and canine distemper VNA in gray foxes and bobcats (*Lynx rufus*) in areas outside of the ORV zone; 4) evaluating non-target effects of ORV; 5) evaluating survival of adult and sub-adult gray foxes; 6) evaluating population abundances of gray fox; and 7) examining habitat layers in relation to gray fox home range, movements, and/or abundance using GIS software. To date, scientists have trapped and radio and/or GPS collared nearly 40 gray foxes. One long distance gray fox movement (straight line distance of >13 km) has already been detected. In addition, through a cooperative agreement with Texas A&M University-Kingsville, scientists plan to utilize genetic samples collected by Texas WS and the TDSHS. Genetic analyses will begin in early 2006. A term wildlife biologist and a term technician, stationed in Kerrville, TX, were hired to conduct the majority of field work (which began in January 2005 and continues to date).

“Efficacy of Oral Rabies Vaccination Relative to Bait Density and Raccoon Population Density” (QA 998).--This study was completed in FY 05. In most areas of the current raccoon ORV program, baits are distributed at a density of 75/km². However, few studies have examined the relationship between bait density and population density on the presence of rabies VNA in raccoons. A graduate student at Ohio State University (OSU), in collaboration with NWRC scientists at the Sandusky Field Station in Ohio, conducted experimental baitings in August 2003 and 2004, 150 km west of the ORV zone where there was no history of raccoon rabies. Scientists collected blood samples from raccoons to determine the presence of rabies VNA. Teeth were also collected to determine the presence of tetracycline biomarker (found in fishmeal polymer [FMP] baits). Scientists also used line-transect and mark-recapture methods to estimate the size of the target raccoon population. During 2003, 41% of serum samples collected prior to ORV distribution (ORV naïve) demonstrated a positive rabies VNA response, but none had elevated titers (≥ 0.25 IU). Only 4% of serum samples collected after 2003 bait distribution (Sep-Oct) had elevated titers. During 2004, 9% of samples collected prior to that year's ORV distribution (Mar-Aug) and 4% of post-ORV samples had elevated titers. Post-bait tetracycline prevalence from teeth indicated that 17% and 24% of the population contacted baits in 2003 and 2004, respectively. Scientists attribute the low proportions of elevated rabies VNA titers and tetracycline to the high density of raccoons on the study area. The adult raccoon population estimate based on 2003 model M_{bh} was 619 ± 83 (95% CI). Assuming an annual birthrate of 1.5 juveniles/adult, 1,548 raccoons were present at the time of the 2003 baiting, resulting in just <1 bait distributed per raccoon. A high

proportion of raccoons with positive rabies VNA responses in an area with no history of raccoon rabies or vaccination efforts demonstrated a need for ORV naïve serology in order to accurately measure the effect of ORV distribution. These scientists contend that without incorporating ORV naïve serology and population density estimates, an ORV program could under-bait high density populations and overestimate the number of vaccinated animals.

“Manipulation and Consumption of ORV Baits by Raccoons” (QA 1217).--This study 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 bio-marked without eating or effectively puncturing the sachet containing the vaccine. This results in a population having higher biomarker prevalence versus positive rabies VNA prevalence. There has also been concern (based on 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 FMP bait and puncture the vaccine sachet. This study evaluated these possible explanations in a pen setting and provided insight into whether they play a role in the monitoring discrepancies mentioned above. Manipulation, consumption, and video documentation of 3 ORV baits (FMP and fishmeal coated sachet [Merial Ltd.] and Artemis ultralight [Artemis Technologies Inc., Guelph, Ontario, Canada]) is complete. Data suggests that in over 50% of feeding occurrences, both juvenile and adult raccoons tend to break open the FMP bait resulting in the sachet popping out and remaining untouched. This would be viewed as an unsuccessful vaccination had these baits contained V-RG.

“Use of Infrared Technology to Detect Rabies Infection in Raccoons” (QA 1227).--This study began in 2004 and was completed in 2005. Scientists at the NWRC utilized a forward looking infrared (FLIR) camera (model ThermaCAM® E65 [FLIR Systems, Inc., Boston, MA, USA]) to monitor raccoon body surface temperature. This was compared with body temperature collected via a remote transmitter (model 1310 [Advanced Telemetry Systems, Inc. {ATS}, Isanti, Minnesota, USA]) implanted subcutaneously in the dorsum of the neck. Each implant transmitted temperature data to a remote receiver (ATS model R4500S Receiver/Datalogger with Digital Signal Processing). The objective was to determine if the use of infrared thermography could detect changes in body surface temperature at specific sites on the body associated with experimental infection of raccoon rabies in captive raccoons under controlled conditions. It was determined that infrared thermography can quantify changes in body surface temperature at different sites on the body of raccoons. The study demonstrated that inflammation, especially in the area of the nose and rostrum, due to rabies infection, can be detected during the clinical stage of infection. The application of this technique in controlled environments, especially with captive animals should prove useful to scientists, veterinarians, and health care workers concerned with possible rabies infection in animals.

Scientists attempted to compare these thermal images with thermal images of raccoons naturally infected with canine distemper to determine if the thermal patterns in infected raccoons were unique to rabies. Although the nose temperatures and thermal images of raccoons infected with canine distemper were different compared to rabies infected raccoons, results were inconclusive due to the lack of controlled experimental conditions concerning the raccoons infected with canine distemper. This technique should prove useful in controlled environments; however, field application of this technique may be problematic without further research under varying field conditions. It is anticipated that this technology can also be developed for different disease infections in wildlife and domestic animals. A manuscript on this study has been submitted for scientific publication.

NWRC, WDRP Collaborative University-Based Research

Pennsylvania State University.--The NWRC continues to fund and collaborate with Pennsylvania State University on a study titled “Zoogeography of Raccoons in Pennsylvania.” Dr. Gary San Julian is the major advisor and 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 the trapping season. 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. The NWRC is

funding salary and travel in FY 06 for the graduate student conducting this study. We anticipate final results of this study to be forthcoming during FY 07.

Ohio State University.--The NWRC funded and collaborated with OSU and the NWRC Sandusky Field Station on a study titled "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 Paul Ramey is the MS graduate student. Objectives were to: 1) estimate the density of raccoons on the study site (NASA Plumb Brook Station); 2) quantify background prevalence of rabies VNA; 3) quantify ingestion/encounter rates of ORV baits; 4) quantify post-ORV bait distribution prevalence of rabies VNA; and 5) quantify prevalence of rabies VNA 1 year after ORV bait distribution. Study results suggest at a bait density of 75/km² and at a raccoon density of 61.7/km² that 1.14 baits per raccoon would not be sufficient to effectively vaccinate the raccoon population on the study area. Upon post-ORV baiting, 8% had positive rabies VNA and 17% showed presence of tetracycline biomarker. Field studies were completed in 2004. Funding was terminated at the end of FY 05. Final results of the study will be available in FY 07 in the form of a master's thesis and scientific publications.

Texas A & M University.--The NWRC is funding and collaborating with Texas A & M University and Caesar Kleberg Wildlife Research Institute on a study titled "Behavioral Ecology of Striped Skunks within Urban and Suburban Areas." Dr. Scott Henke is the major advisor and Denise Ruffino is the PhD graduate student. The objectives are to: 1) determine movements, habitat utilization, and seasonal food habits of striped skunks in urban and suburban areas of Houston, Texas; 2) compare behavioral patterns of urban/suburban skunks with those of adjacent rural skunks; and 3) determine the presence of rabies VNA in captured skunks. Preliminary results are: 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. Researchers will soon begin evaluating 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. Funding of the study by the NWRC will continue through June 2006. Final results of the study may be available FY 07.

Northern Arizona University.--The NWRC partially funded, in conjunction with Arizona WS, a study titled "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 Mark Weissinger is the MS graduate student. The objectives are to: 1) determine den locations and denning behavior, home range, sensitivity to relocation, and daily and seasonal movements of skunks in Flagstaff, Arizona; and 2) determine the optimal time of year to vaccinate for rabies. Preliminary results indicate that: 1) over half of the radio-collared skunks (11 of 17) in the study made long-distance movements into wildlands surrounding the city; 2) 33% of sites monitored by cameras showed use by multiple skunks, dogs (*Canis familiaris*), cats (*Felis catus*), fox, and raccoons investigating these sites; 3) striped skunks could act as vectors transferring disease across the wildland-urban interface; and 4) 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 (*Chiroptera* spp.) 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. Funding by the NWRC ended at the end of FY 05. Final results of the study should be available in FY 06.

Auburn University.--The NWRC, WDRP is funding and collaborating with Auburn University, Alabama WS, and the NWRC Olympia Field Station on a study titled "Raccoon Movements in Alabama and the Effect of Natural Barriers on Preventing the Western Spread of Rabies." Co-advisors are Dr. Jim Armstrong and Dr. Wendy Arjo and Christine Fisher is the M.S. graduate student conducting a portion of the work in central Alabama. Additionally, in cooperation with Alabama WS, a study site outside the rabies enzootic area is also being monitored. The objective is to describe and compare movement patterns, home range size, and habitat use of raccoon populations within and outside rabies enzootic areas in Alabama. Over 100 raccoons between the 2 sites have been captured and blood samples are currently being analyzed. In addition, 35 animals have been radio-collared in the western site both north and south of the Alabama River. Recent study results using GPS radio collars have concluded that raccoons do cross the Alabama River and that 24 animals collared in the western site (outside the enzootic area) died mostly due to hunting. Preliminary results also indicate that: 1) density between the 2 sites is similar (7.3 raccoons/km² at the central site and 6.3 raccoons/km² at the western site); and 2) most dens in central Alabama are in older hardwood trees and not conifer trees. The NWRC is funding this study until the end of FY 06.

Field studies were terminated in early FY 06. Final results of the study can be expected later in FY 06 or early FY 07.

SUMMARY

Scientists at the NWRC have completed a 5-year project on rabies research in support of the ORV program. Accomplishments include: evaluation of baits that could lead to new baiting strategies (coated sachet) that have increased vaccination rates in raccoons and reduced costs to the ORV program; determined which baits are more accepted by raccoons and striped skunks, which could lead to increased bait consumption and vaccination rates; determined the best and most cost effective baiting density and strategies for raccoons at one location which should have applicability at similar habitats within ORV zones; developed an encapsulation process for the tetracycline biomarker that will enhance its stability in field environments and reduce taste aversion in raccoons, which has provided an additional index to bait uptake and vaccination rates in wildlife; increased the understanding of the ecology and behavior of raccoons, striped skunks, and gray foxes that should lead to enhanced baiting strategies for these species; determined that the V-RG vaccine is safe in an additional 4 species of animals that may ingest the vaccine laden baits; determined that the V-RG vaccine is efficacious at least up to 1 year following vaccination; determined that juvenile raccoons consume existing baits at least as well and possibly at a higher rate than adult raccoons; found that some fatty acids that are present in existing baits could be used as a biomarker, at least during short-time periods after ingestion by raccoons; and determined that infrared thermography can be used in an experimental setting to detect signs of rabies infection in raccoons exhibiting clinical signs. These accomplishments by NWRC research scientists over the past 5 years, which were funded by WS' NRMP, have provided information that may be applied for more efficient use of resources to vaccinate free-ranging raccoons against rabies. These findings should enhance efforts at preventing the spread of the raccoon rabies variant which in turn should have positive impacts on human health organizations in prevention of rabies in humans.

A project review and stakeholders meeting held at the NWRC facility in Fort Collins in July 2005 determined the need for another 5-year project; funding from WS operations is expected for FY 06-10 for the NWRC, WDRP to continue research in support of the NRMP, ORV program. As a result of a newly developed rabies project document titled, "Investigating the ecology, control, and prevention of terrestrial rabies in free-ranging wildlife (FY06-FY10)" scientists are in the process of developing proposals to initiate 13 new studies over the next 5 years. Newly developed objectives include: 1) determining the significance of demography, behavior, movements, and dispersal of raccoons and striped skunks as they may relate to the transmission of rabies and virus trafficking across ecosystems; 2) developing and/or evaluating methods and technologies for use by the ORV program to increase efficacy in vaccinating free-ranging wildlife against rabies which may reduce or eliminate the transmission of rabies from wildlife to humans, pets, livestock, and other wildlife; 3) obtaining information on the ecology of gray fox for possible development of improved baiting strategies for the ORV program in Texas; and 4) evaluating long term efficacy of the V-RG vaccine and factors that may interfere with or reduce vaccination rates in free-ranging raccoons.

Five ongoing studies have been carried over from the last 5-year funding cycle and will continue into FY 06 (QA 1218, QA 1223, the Auburn University study, the Pennsylvania State University study; and the Texas A & M University study), while 13 new studies are planned for the next 5 years. The NWRC will continue to conduct research and collaborate with others to assist the NRMP in carrying out its mission of containing and eventually eliminating terrestrial rabies from the United States.