

# Oral Rabies Vaccination History in Ohio



## Pre-Epizootic Era

Beginning in the late 1970's, a strain of rabies associated with raccoons rapidly spread along the east coast of the United States. As it invaded new areas, there was an explosive increase in rabid raccoons, with many states reporting over 500 cases in a year. Compounding the problem is that raccoon-strain rabies frequently "spills over" into pets, livestock and other wildlife, including those species that we traditionally consider low risk for rabies (groundhog, rabbit, deer, etc).

Prior to the raccoon rabies epizootic entering Ohio, the major source of rabies infection to pets, livestock and humans was skunks and bats. Skunk rabies centered in Holmes County with bat rabies occurring randomly throughout the state.

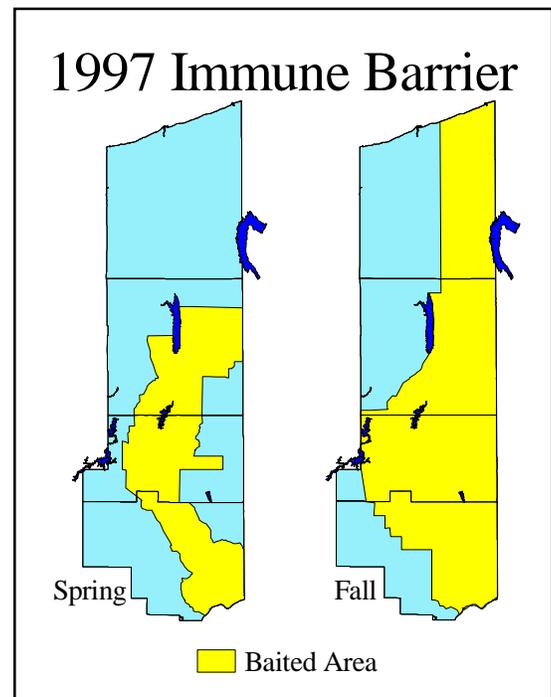
With the movement of raccoon rabies towards northeast Ohio, the Ohio Department of Health (ODH) began communications with the Ohio Department of Agriculture (ODA) and the Ohio Department of Natural Resources (ODNR). Program leaders from these three agencies made up the first Ohio Rabies Task Force, which adopted an Oral Rabies Vaccination (ORV) Contingency Plan to deal with the epizootic. The consensus was that ODH should be the lead agency. ODH encouraged local health departments, wildlife officers, local veterinarians, and nuisance trappers to begin a voluntary effort to turn in suspect raccoons for testing. Early responses were poor, but improved when funds became available to contract with veterinarians to cover decapitation/shipping costs.

## 1997 - The Epizootic Year

Following the first raccoon case, confirmed on March 4 in Mahoning County, cases quickly escalated. Public interest peaked after an April 15 incident in a suburban Youngstown neighborhood, where a 3-year-old boy was attacked in mid-afternoon by a rabid raccoon while riding his tricycle in his yard. Community alarm overwhelmed local resources in Mahoning and surrounding counties for the remainder of that year.

To deal with the situation, ODH assisted local health departments with responding to the epizootic (e.g. public awareness initiatives and animal testing). Baits were distributed in May around the outbreak edge to contain the epizootic. In July 1998, the Ohio Legislature approved funding for the next biennium to continue the ORV program and support local health departments in dealing with the epizootic.

In September, 250,000 ORV baits were distributed from Lake Erie to the Ohio River, and from the Pennsylvania border westward to form a buffer zone, at least 10 miles (16



kilometers) wide in front of all positive raccoon-strain rabies cases. Vaccine-laden bait was dropped over 1,495 sq. mi. (3,872 sq. km.), using one ODNR and two Ohio Department of Transportation helicopters. This proved to be very expensive and time consuming, taking two weeks to complete.

Following each baiting, raccoon trapping was performed to collect blood samples to measure seroconversion (short-term marker of vaccine uptake). Staff was borrowed from the Centers for Disease Control (CDC), United States Department of Agriculture (USDA), and ODA, as well as other ODH programs to complete this effort. In addition, procedures were developed to save jawbones from raccoons to test for tetracycline (long-term marker of bait uptake). In 1997, 174 blood samples and approximately 100 jawbones were collected. About 33 percent of the raccoon blood samples were rabies antibody positive (rabies neutralizing antibody titer  $\geq 1:5$ ), indicating consumption of vaccine.

In 1997, ODH took steps to hire staff to carry out this program, but no dedicated staff was available until 1998. All control efforts were done with staff borrowed from other programs; most notably Environmental Health/Toxicology and Infectious Disease Control. ODH Laboratory (ODHL) submissions almost doubled from 3,335 in 1996 to 5,592 in 1997, also stressing the infrastructure in that bureau. Since the epizootic, ODHL submissions have remained elevated.

A rabies information line (1-888-RABIES-1) was initiated to provide toll free service for those with questions on rabies. During the summer of 1997, this information line was monitored seven days a week. Currently, coverage is provided during the day, with voice mail provided after hours.

Rabies Prevention and Surveillance Grants were offered to 12 northeast Ohio counties. The goals of the grants were to: (1) develop local rabies task forces; (2) develop and implement rabies education and awareness programs (including promoting pet vaccination); and (3) to conduct active surveillance for rabies suspect raccoons. The four border counties were to submit 300 specimens, and the adjacent counties were to submit 100. Global Positioning System (GPS) readings (latitude and longitude) were to be obtained for all raccoon submissions.

The CDC was a source of major support, supplying valuable technical help at every step. They brought several staff members to assist with training ground teams to distribute bait. The CDC conducted serologic testing of raccoons and provided two stipends for graduate students to assist with program and cost evaluation.

The year ended with 62 raccoon-strain cases (59 raccoons, two cats and one skunk).

- [Map of Ohio Animal Rabies 1997](#)

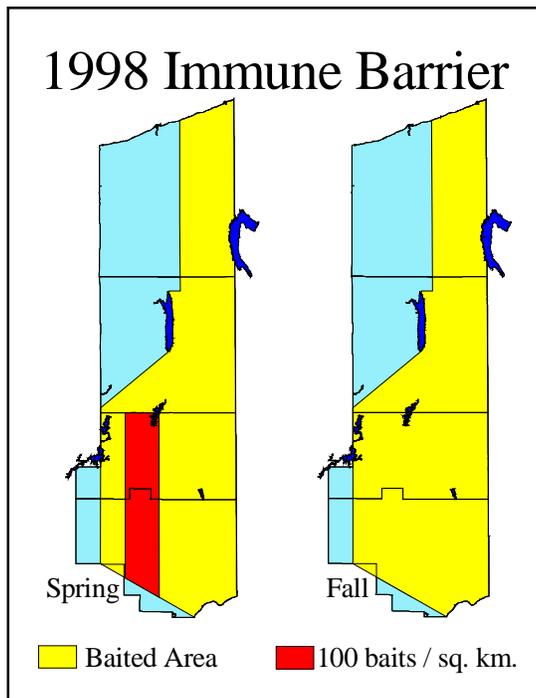
## **1998 - Program Development**

In January, local health departments were offered the services of a statewide courier for the shipment of rabies suspect animal heads to ODHL. Prior to this, health departments had to make their own arrangements, which was becoming a problem, as there was increasing reluctance by some carriers to handle these specimens. There were also frequent shipping delays that compromised test results. This initiative was invaluable, reducing a significant barrier to testing. It also resulted in better lab efficiency, as specimens now arrive in the morning, allowing for same day results in high-risk situations.

Positions of planner, epidemiologist, administrative assistant, and assistant public health veterinarian were filled by June 1998. Geographic information system capabilities were developed to more accurately program flight lines for ORV baiting and to map raccoon cases. The ODHL hired an additional microbiologist.

The USDA Wildlife Services opened a field office in Mahoning County, staffed by two wildlife biologists. Their mission was to assist with baiting, surveillance, and control activities. USDA officials were also

instrumental in contracting the Ontario Ministry of Natural Resources twin otter aircraft. These specially equipped airplanes allowed us to more efficiently disburse vaccine-laden bait.



ORV bait distributions were conducted in April and October. Using the twin otters, each distribution took less than one week. About 725,000 ORV baits were dropped over 1,539 sq. mi. (3,987 sq. km.). During the summer, USDA biologists and four ODH college interns collected 421 blood specimens from live-trapped raccoons, which were tested by CDC. Serology again revealed that 32 percent of raccoons were antibody positive. There was a wide variation in seropositivity (from 10-60 percent) between individual trap sites. Areas baited multiple times had higher seropositivity than first time areas. Males were more likely than females to be adequately immunized. Ground baiting was reaching a greater proportion of raccoons than air baiting. Seroprevalence was not significantly different in juvenile or adult animals; nor were there serologic differences noted by habitat (forest, agricultural, or urban).

As of July 1, ODH modified program support to local health departments by separating out surveillance activities from rabies prevention activities. Rabies education and prevention grants were awarded to the 10 counties that applied. For surveillance, ODH reimbursed county health departments for

each suspect raccoon submitted. For reimbursement, specimens had to be sick, or have exposed a person or pet. All raccoons had to be testable. GPS readings on all submissions were required for reimbursement, often requiring a second site trip by health department staff. After December 31, ODH changed the policy, requiring township and full address in lieu of GPS readings for negative specimens.

In 1998, raccoon rabies cases decreased to 20 raccoons, two cats, one fox, and three skunks. All the rabid raccoons were found within the existing immune barrier. Two of the skunks with raccoon-strain rabies were from Ashtabula County.

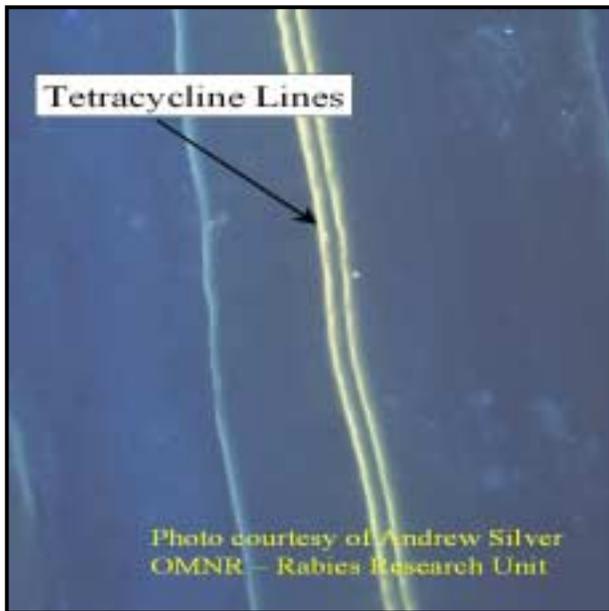
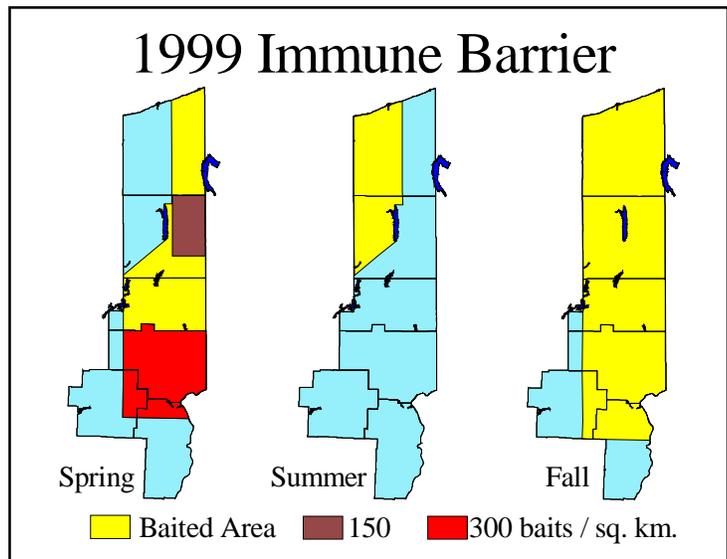
- [Map of Ohio Animal Rabies 1998](#)

## 1999 - Expansion into Ashtabula

The spring ORV campaign took place April 15 – May 1, using 750,000 ORV baits to cover 1,723 sq. mi. (4,462 sq. km.). The increased number of baits was used for a one-time bait density study. Areas in Trumbull and Columbiana Counties, where rabies has continued to persist, were baited at 150 (one bait/1.65 acres) and 300 baits per sq. km. (one bait/0.82 acre), respectively. Mahoning and Ashtabula County bait density remained at 75 baits/sq. km. (1 bait/3.29 acres). In late spring, following the spring baiting, two raccoons and a chipmunk were confirmed with raccoon-strain rabies just west of the barrier in Ashtabula and northern Trumbull Counties. This was where the barrier was narrow, only 10 miles wide. In mid-June, an emergency bait distribution was conducted widening the northern barrier to 25 miles (40 kilometers), the same width as in Mahoning and Columbiana Counties. In September, the entire 25 mile wide by 108 mile (174 kilometer) long area was retreated. USDA was able to petition for additional federal funds to purchase 74,000 additional baits to assist with the area increase. In 1999, a total of 1,459,442 baits were distributed over 2,509 sq. mi. (6,497 sq. km.).

USDA Wildlife Services staff, three ODH college interns, and an Ohio State University (OSU) graduate student conducted extensive live trapping to evaluate effect of bait density. During 10 weeks of trapping, 695 raccoons were captured. Of these, 96 were recaptures, 11 were juveniles, and 588 were unique raccoon blood samples. The recaptures and juveniles were not included in the study. There was no significant increase in seroprevalence between the areas baited with 150-baits/sq. km. vs. the area baited with 75-baits/sq. km. (27 percent vs. 22 percent). However, the study demonstrated a significantly higher rabies seroprevalence rate in raccoons from the area baited with 300 baits/sq. km. vs. the area baited with 75 baits/sq. km. (41 percent vs. 22 percent), when corrected for number of times an area had been baited (three, four, or five times).

The bait density study results suggest the present bait density (75 baits/sq. km.) is sufficient to control raccoon rabies unless there is a localized rabies outbreak, where the high bait density may be needed to stop further spread.



Following three years of collecting raccoon jawbones (1997 - 1999), tetracycline deposition results were received for 791 jawbones. Tetracycline, which is included in the bait matrix, is deposited in the bones of animals when the bait is consumed. Although consumption of the bait matrix does not guarantee consumption of the vaccine, tetracycline deposition in the jawbones is an indicator of what proportion of raccoons are contacting the bait. Each raccoon was mapped by township using the GPS reading or address where the raccoon was collected. All specimens were then assessed for number of times the area was baited. A raccoon from a particular township was included in the analysis only if the township was at least 75 percent baited during a specific baiting operation. Only 10 percent of the jawbones were tetracycline positive after one baiting and 31 percent were positive after two baitings. After three or more baitings, 33-36 percent of the jawbones were

positive. This percentage is lower than what has been reported by other states and may reflect a higher turnover in Ohio's raccoon population.

An ORV Working Group was created to evaluate the current strategy and plan for coming years. Participants include wildlife biologists from USDA and ODNR, and key staff from ODH, ODA, and OSU. The Ohio Rabies Task Force continued to meet to approve the strategy.

There were several educational initiatives completed in 1999. These included the development and distribution of rabies pamphlets and posters. The booklet, *Dealing with Rabies*, was updated. About 400 notebooks and pamphlets were mailed to health departments, dog wardens, and animal control officers. Copies were also forwarded to ODA, ODNR, and OSU, as well as other requesting agencies. A mailing to 17,000 physicians included the new recommendations from the CDC Committee on Immunization Practices

(ACIP) and the [Dealing with Rabies](#) booklet. Thirty-second television and radio Public Service Announcements (PSAs) were made and distributed to health departments and all radio stations in northeast Ohio. An eight-foot display board, *Take the Bite of Rabies*, was made available for loan to requesting agencies. In addition, on March 17, ODH sponsored a one-day rabies seminar in Canton, attracting 150 attendees. A rabies slide set was also developed for public health, medical, and veterinary professionals to utilize for presentations.

In conjunction with CDC and OSU, a survey was mailed to more than 1,500 northeast Ohio physicians, veterinarians, animal control agencies, and health departments to ascertain the impact and costs associated with raccoon rabies. This will be utilized by an OSU graduate student in a future cost-benefit analysis.

In July, rabies prevention grants were offered at the same level as in 1998. Eleven counties received grants. Surveillance contracts were again made with 12 county health departments. Some reduction was made to the four key counties, as their submissions decreased.

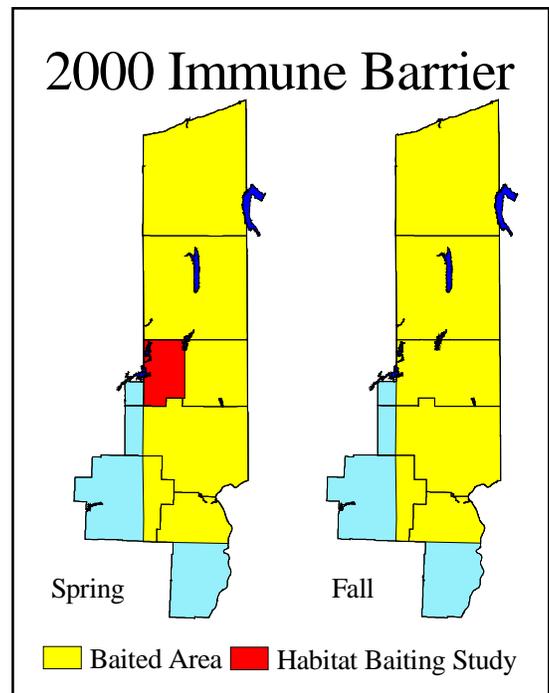
Raccoon rabies cases continued to decline, with only six cases (five raccoons and one chipmunk) testing positive in 1999. There was no confirmed raccoon rabies in Mahoning County since March 1998 and no further cases in Columbiana County since April 1999. Community concern about rabies declined to near-normal levels. As the ORV program becomes institutionalized, new issues arise demanding attention. Included are residents, who for various reasons, do not want aerial distribution over their property and health departments who feel less urgency to participate in the program.

- [Map of Ohio Animal Rabies 1999](#)

## 2000 – No Raccoon Rabies Cases

Year 2000 marked the fourth year of the program, with 1,070,239 baits distributed over the same 2,509 sq. mi. (6,497 sq. km.) rabies immune barrier as in fall 1999. During the spring, 549,679 baits were distributed and during the fall, 520,560 were distributed. Roughly 85 percent of the area was covered by air (helicopter and fixed wing airplanes) with the remaining 15 percent baited by ground teams. With good control of raccoon rabies, ground baiting, which selectively targets optimal raccoon habitat, was decreased from 75 to 65 baits/sq. km. Beginning with the September baiting, supplementary helicopter distribution of ORV baits around ponds, rivers, highways and small lakes was reduced, as airplanes largely cover these areas. The decrease in ground bait density and helicopter baiting reduced bait utilization by 59,205.

The April baiting included a habitat baiting study in Mahoning County. It was conducted in conjunction with the Southeast Wildlife Cooperative Disease Study and USDA Wildlife Services. The purpose of the study was to determine if seroprevalence was higher in habitat baited areas than straight line (airplane) baited areas. Such information would be helpful in addressing any future emergency control efforts. The 150 sq. mi. (388 sq. km.) study area was in western Mahoning County and the control area was in eastern Trumbull County. Both areas were baited at 75 baits/sq. km. In the control area, fixed wing aircraft flew the standard straight flight lines 1,640 feet (0.5



km.) apart. In the study site, the helicopter flew flight lines 400 feet (122 meters) apart, but deviated to either side of the assigned lines to place baits in what appeared from the air to be better raccoon habitat. Between May and the end of June, USDA Wildlife Biologists and ODH interns collected 158 raccoon serum specimens from the habitat baited area (Mahoning County) and 165 specimens from the control area (Trumbull County). Rabies seroprevalence rates in the two areas were 34.2% and 35.2%, respectively. Statistical analysis did not indicate these seroprevalence rates were significantly different. It was concluded that in this study, aerial habitat baiting did not improve seroprevalence over that obtained by airplanes flying straight flight lines.

No raccoon rabies cases were reported in Ohio during 2000. Although state support to encourage raccoon rabies testing continued, the four key counties submitted fewer raccoon specimens. This could be a good sign, indicating fewer sick raccoons, but it may also indicate a decreased level of interest. Of special note was Mahoning County, which was the first focus of infection, but has not had a case since March 1998. It is generally accepted that an area is “rabies free” after 24 months with no cases of terrestrial rabies.

Although the Ohio raccoon rabies situation appeared under control, the raccoon rabies situation in West Virginia became a new focus of concern. The northern panhandle of West Virginia consists of four counties (Hancock, Boone, Ohio, and Marshall Counties), separated from Columbiana, Jefferson, Belmont, and Monroe Counties by the Ohio River. Although raccoon rabies was occasionally confirmed in this area since 1993, in recent years there were more cases and new movement of the epizootic along the southeast shore of the Ohio River. The Ohio River was viewed as a barrier protecting Ohio from incursion of raccoon-strain rabies from West Virginia. However, USDA Wildlife biologists identified several bridges, which permit relatively easy opportunities for West Virginia raccoons to cross into Ohio. Further expansion of the West Virginia epizootic threatens the Ohio immune barrier. In January 2000, the Ohio Department of Health hosted a meeting, attended by representatives from the CDC Rabies Program; USDA Animal and Plant Health Inspection Service (APHIS), Veterinary Services and Wildlife Services; Illinois, Indiana, Kentucky, Michigan, and West Virginia Health/Agriculture Departments; northeast Ohio primary raccoon rabies counties; Southeast Cooperative Wildlife Disease Study; Cornell and Ohio State Universities; ODA, ODNR, and ODH. Coming out of this meeting was a consensus to join with Texas and New York-Vermont efforts to pursue more federal funds for multi-state regional efforts. A Central Regional Initiative was proposed to extend Ohio’s ORV immune barrier southward into West Virginia to stop further westward spread of raccoon rabies across West Virginia, thereby reducing pressure on Ohio counties along the Ohio River. This would also protect Kentucky and several other central states from raccoon-strain rabies. The

ORV Working Group continued to work with surveillance, strategy, and planning issues. The group revised Ohio’s contingency plan to use if raccoon rabies breaches the immune barrier or if there is a raccoon rabies case detected near the western border of the immune barrier.

Rabies prevention grants and raccoon surveillance contracts continued in 2000. For FY 2001, grants and contracts were expanded and offered to Monroe and Washington Counties because of the increased rabies activity across the Ohio River in West Virginia.

In March, the [\*Dealing with Rabies\*](#) booklet, the Year 2000 Rabies and Psittacosis Compendiums, and the [\*Take the Bite out of Rabies\*](#) brochure were provided to the Ohio Veterinary Medical Association for mailing to all Ohio veterinarians. A Rabies Treatment Algorithm, targeted for use by emergency room physicians and other medical professionals that administer rabies treatments, was completed.

Although no terrestrial animal rabies cases were confirmed in 2000, public concern with bat rabies increased. There was substantial media coverage during July and August, fueling public concerns. To assist local health departments and other agencies dealing with animal bites and wildlife, [\*Bats and Rabies, A Public Health Guide\*](#), was published and widely disseminated throughout the state. Although late summer and early fall submissions are usually higher than other months, the media coverage probably contributed to a record

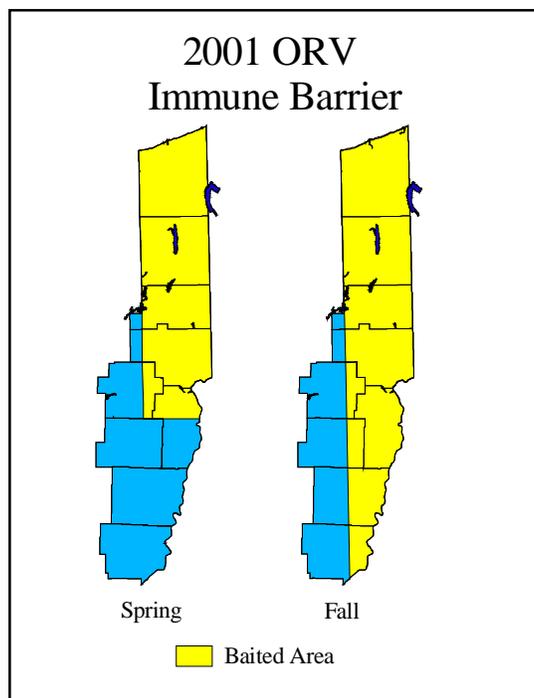
number of bat submissions. August and September bat submissions were 492 and 177, respectively. Previously, the highest number of bats tested was in September 1997, when 356 bats were tested. For the entire year, a record 1,093 bats were tested with 52 rabies positive (4.8 percent positive). This percentage of positive bats falls within the expected range of 3-5 percent positive of all bats submitted for testing. Usually 800-900 bats are tested each year.

- [Map of Ohio Animal Rabies 2000](#)

## 2001 – ORV Baiting in WV and PA

The Spring 2001 baiting was conducted in late March. The 2,509 sq. mi. treatment area was the same area baited in 2000. Bait densities remained at 75 baits/sq. km. for aerial baiting and 65 baits/sq. km. for ground baiting. As in the previous fall's baiting, 520,560 baits were distributed, with about 85% by air and 15% by ground baiting teams.

The Fall 2001 bait operation was expanded to include areas in West Virginia and Pennsylvania. Funding for the expanded area came from the USDA. Prior to the baiting, West Virginia initiated active surveillance to establish the western front of the epizootic. Using that information, the flight lines were extended south and west to a point south of Charleston, West Virginia. Pennsylvania's participation was limited to a 19 mile-wide stretch along Lake Erie's southeast shore and connected Ohio's ORV immune barrier in Ashtabula County to New York's barrier in Chatauqua County. The Pennsylvania baited area involved 724 sq. mi. (1,875 sq. km.) in two counties, Ohio's baited area increased to 3,289 sq. mi. (8,518 sq. km.) in nine counties, and the West Virginia barrier included 4,582 sq. mi. (11,867 sq. km.) in 22 counties.



The baiting began September 10 with an optimal completion time of eight days with good weather and three airplanes. The September 11 terrorist attacks in New York, Washington, and Pennsylvania, prompted numerous FAA shutdowns and restrictions of our aerial baiting. The airplane baiting eventually finished on September 25. Ground baiting continued on schedule. Bait density was 75 baits/sq. km. except that the Ohio ground baiting density remained at 65 baits/sq. km. Over 1.6 million baits were distributed in Fall 2001, including 656,985 baits in Ohio. This was an increase of 26% compared to Spring 2001.

### Fall 2001 ORV Bait Distribution Summary

State	Area (Square miles)	Hand Distribution	Plane & Helicopter Distribution
Ohio	3,289	60,840	596,145
Pennsylvania	724	138,000	0
West Virginia	4,330	60,840	763,689
Total	8,343	259,680	1,359,834

USDA Wildlife biologists conducted pre-baiting and post-baiting trapping. They collected approximately 600 serum specimens. Results are pending from CDC. A raccoon movement study was started prior to during the fall bait drop. Thirty raccoons (16 males, 14 females) were trapped and radio-collared. This study is in progress to find the survival rate, seasonal home ranges, maximum movement, and den site characteristics of the raccoons.

Although it seemed Ohio would have another year with no raccoon rabies cases, this was not to be. In early November, a raccoon exhibiting odd behavior from Lowellville in Mahoning County tested rabies positive. The positive raccoon was found less than a mile from the Pennsylvania border and raised speculation about whether this was a raccoon wandering from Pennsylvania or resurgence of raccoon rabies in Ohio. Mahoning County health officials provided alerts to the media and surveillance was intensified, but few specimens were submitted as winter weather decreased raccoon movement.

In 2001, ODH continued to support local health department rabies awareness/education and raccoon surveillance. Skunks and foxes were added as surveillance specimens, because these animals also serve as good sentinels for raccoon rabies activity.

Overall, in the target 14 county area, raccoon surveillance increased from 735 in 2000 to 746 raccoons submitted in 2001. However, raccoon submissions from the four Ohio counties bordering Pennsylvania (Ashtabula, Trumbull, Mahoning, and Columbiana) decreased from 302 in 2000 to 261 in 2001. Submission of suspect raccoons for rabies testing remains the most effective surveillance tool to detect raccoon-strain rabies cases.

A new initiative in 2001 was to create a zoonoses section on the ODH website. Pages on rabies prevention, animal bite procedures, the ORV program, and links to other rabies sites were developed. The site includes interactive maps on animal bites and rabies statistics that can be searched by year and county. This should serve as a ready reference for most questions on rabies and other zoonotic diseases. Rabies maps were updated as animal rabies cases were reported. Other updates were added as material was prepared or program changes occurred. In addition, the Rabies Treatment Algorithm, completed in 2000, was sent to hospital emergency rooms and infection control practitioners throughout the state.

- [Map of Ohio Animal Rabies 2001](#)
- [Map of Ohio Animal Rabies 2002](#)