

Skunk Rabies in Ohio

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THE DOG is the primary source of human rabies exposures in the United States at the present time. However, improved stray dog control, longer lasting vaccines, and intensive educational programs have combined to reduce drastically the number of reported cases of canine rabies in most parts of this country (1).

Implementation of these approaches in Ohio has resulted in a change in the major reservoir, as indicated by cases reported, from the dog to wildlife (2). The skunk has been responsible for an increasingly large proportion of the reported wildlife cases, with the 1962 total nearly four times greater than the previous high year, 1949 (fig. 1). In 1962 the Ohio Department of Health Laboratories examined 502 skunk heads and found 311 (62 percent) positive for rabies. The next highest percentages were for 5 of 11 (45 percent) horse brains and 16 of 90 (18 percent) cattle brains. Although a cyclic phenomenon seems to be operating in wildlife rabies, current information does not permit prediction of epizootic years.

Too many biological and sociological variables are involved to permit a complete explanation for this increase in wildlife rabies. However, certain factors have had a strong effect upon this increase in recent years. Measurement of the relative importance of these factors

is difficult and can be achieved only in conjunction with experience and subjective reasoning.

One factor is the increase in the wildlife population itself. When a population grows, epizootics are to be expected. Growth of the skunk population in Ohio accompanied a decline in trapping. The last major harvests of skunk pelts in Ohio occurred in the years 1944 through 1946 (3).

Land use also has changed around metropolitan areas in Ohio. High real estate prices around cities have caused much of the land to become idle rather than being farmed. Land retirement, soil bank, and other programs have contributed to the increase in the number of idle acres available to various species of wildlife.

Other factors affecting populations of small furbearers have been sociological. The leisure habits of the human population have changed during the past two decades. Golf, racing, gardening, and other forms of recreation are more popular now than 20 years ago. Opportunities for exposure to diseased wild animals have increased as families tend to move from cities to open suburban areas. At the same time the number of men between the ages of 21 and 40 who engage in hunting and trapping seems to be decreasing in Ohio (4).

Epizootic years cannot yet be predicted for rabies in skunks, but sufficient data are available to demonstrate decided seasonal differences. Most of the cases in Ohio occur in the 2-month period from mid-March through mid-May (fig. 2). Reported cases during the first 10 weeks of 1962 were compatible with the previous 5-year mean. However, during the following 21 weeks there were 256 cases in contrast to the 5-year mean of only 32 cases for the same period. No change was detected in the seasonal trends of rabies in other species. Although this outbreak

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was essentially statewide (51 of the 88 counties), it seemed to occur primarily in a band of counties extending from the northwest to the southeast (fig. 3). For the most part, these cases were closely grouped geographically within the affected counties. Based on reported cases, the incidence in the surrounding States seemed to be lower and to occur later in the year (see table).

Because of the large number of cases in skunks, population reduction was attempted as a method of control in six counties. Control efforts and results are discussed as well as investigations of a number of cases.

Control Methods

When epizootics of skunk rabies occur near human habitation, control becomes a function of public health agencies. Health officials retain administrative responsibility for curbing the epizootic, and control specialists conduct the technical activities. The entire program should be coordinated with local conservation agencies.

Representatives of all three disciplines comprised the control teams in the Ohio program. An attempt was made to form teams of four men, one each from the local and State health departments and local and Federal wildlife agencies.

When wildlife is involved in an outbreak, the theory and control of wildlife rabies must be integrated into the educational activities. The first job of control officials is to acquaint conservation groups with the characteristics, effects, and epidemiology of the disease. In our experience, tradition and training often make it difficult for conservation agencies and staff to support the premise that population reduction is necessary, but their cooperation is essential in explaining this approach to the public.

Whether a rabies control program is aimed at wildlife or dogs, education of the general public, pet owners, and livestockmen is necessary to reduce human contacts with possible vectors of the disease. This task can best be accomplished by health department personnel speaking to schools and local clubs or preparing releases for the mass media.

The control program was aimed at a 6- to 12-week reduction of the number of skunks in the

Figure 1. Cases of rabies reported in Ohio, 1938-62

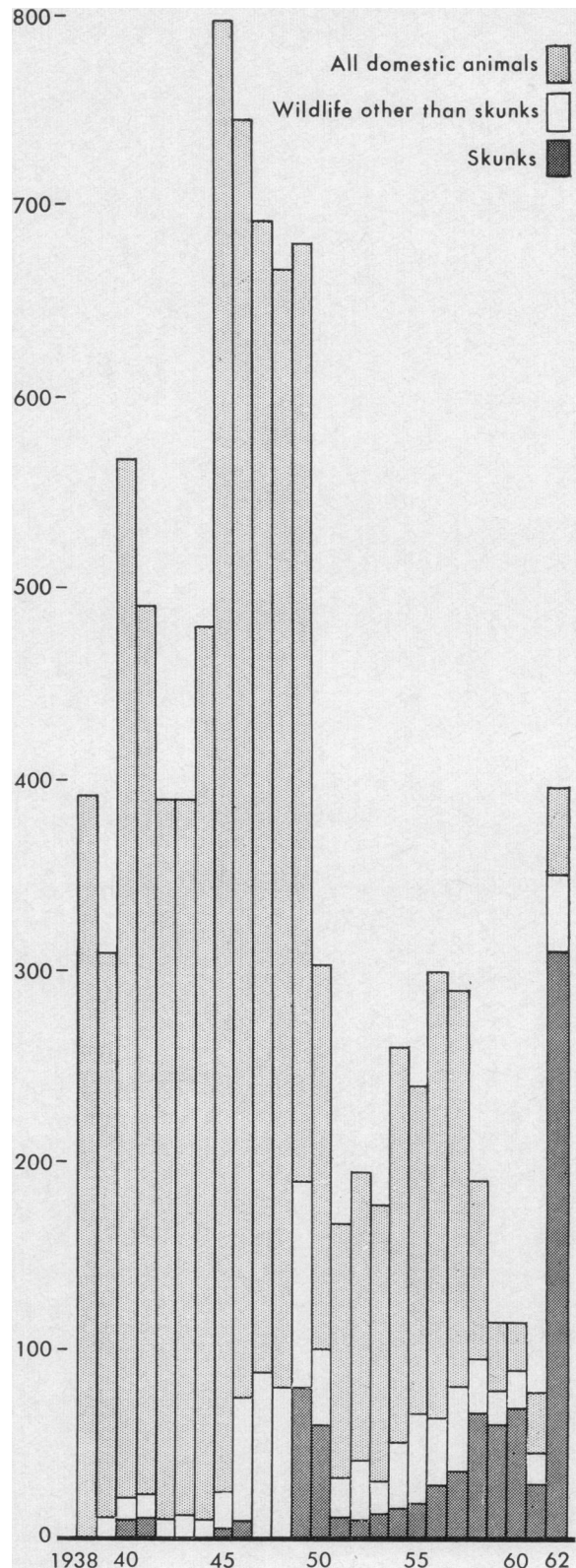
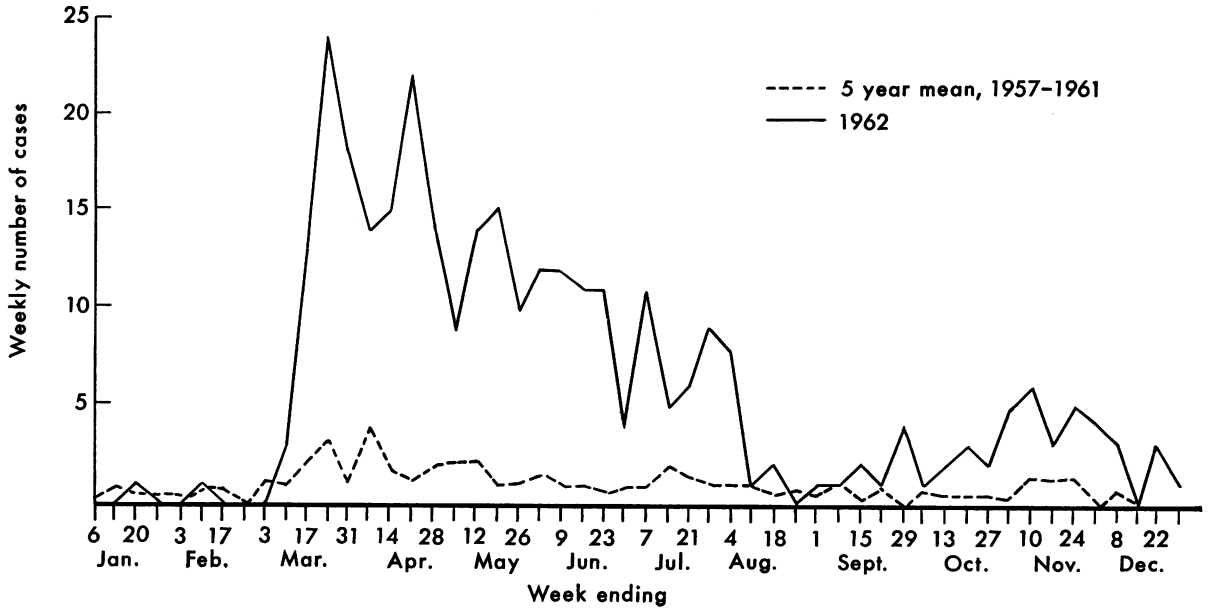


Figure 2. Weekly reports of skunk rabies in Ohio, 1957-62



vicinity of recent positive cases. A basic premise was that, after exposure to the index case, a skunk would remain in his territory until the onset of symptoms. The home range was estimated to be less than one-half mile in radius in most instances.

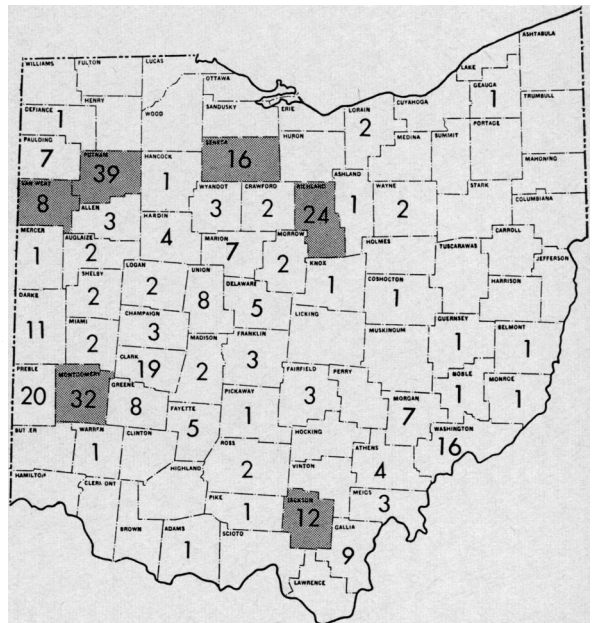
Control operations were conducted in six counties (fig. 3). When a case of skunk rabies from one of these counties was confirmed at the Ohio Department of Health Laboratory, the control team went to the spot where the animal had been found. Favorable skunk habitat in the area was mapped through aerial reconnaissance and confirmed on foot. Poisoned eggs were set and dens were gassed in all potential habitats within one-half mile of the site.

Gassing of skunk dens with carbon monoxide cartridges was effective although where fire was a hazard, heavier-than-air chloropicrin was used. Gassing is selective if applied during the season when groundhogs are defending their dens, simplifying identification of the burrow occupant.

Poisoning skunks with eggs injected with strychnine was the other control method, a technique that is selective for three species. Skunk, opossum, and raccoon are the only animals in Ohio which will be taken commonly with egg sets. Sets can be placed by competent technicians in such a manner as to minimize attraction

of species other than the striped skunk. Strychnine also has the advantage of killing the skunk quickly, so usually it can be recovered for laboratory examination.

Figure 3. Geographic distribution by county of 314 cases of skunk rabies reported in Ohio, 1962



NOTE: Shaded area denotes counties where control activities were conducted.

The bitter taste of strychnine is offset by using a mixture consisting of 7 parts honey and 2 parts water to 1 part of strychnine. One cubic centimeter of the warmed mixture is inoculated into an egg using a 15-gauge needle and a 20-cc. syringe. The end of the egg is then sealed with paraffin and the word "Poison" is stamped on opposite sides in 1/2-inch high letters. Additional safety features are the proper placement of sets and the use of 15-day embryonated eggs containing methylene blue dye in the strychnine solution. Two eggs per set are sufficient. In areas where there might be hazard to hogs, only one egg should be used per set.

The area around Dayton in Montgomery County is flat with interspersed woodlots, farms, fields, and small villages. It is ideal habitat for skunks because of numerous fence rows, fallow fields, ungrazed woodlots, abandoned orchards, culverts, and brush piles. In some places the skunk population was known to exceed 20 per square mile. This number is quite high. In this open farming country, it was possible to cover adequately all the potential skunk habitats economically with a small crew, but in southeastern Ohio where there are fewer people and larger areas of cover for skunks, this thoroughness was not practical. Instead, it was necessary to protect the individual farmstead rather than try to eliminate the disease from the woodland areas.

Results

No domestic animals or persons were poisoned during this entire program. The specificity of the technique was not so good as desired, even when employed by properly trained personnel. During one operation when 360 eggs were placed in sets, an attempt was made to recover every animal killed. A total of 76 dead animals was

found: 24 skunks, 25 opossums, 22 raccoons; and 1 each of the following species was found dead and assumed to have been poisoned by the eggs—groundhog, buzzard, crow, redheaded woodpecker, and purple grackle.

Destruction of potential contacts or incubating animals, not rabid animals, was the purpose of control; however, five skunks killed by the control teams during the year were Negri positive. Two died as a result of ingesting strychnine eggs and three were shot; these three seemed to be clinically normal. One was found in an open field during daylight hours but evidenced fear of humans. The other two were immature skunks found together when a den was dug out in mid-June.

Only one rabid skunk was reported within one-half mile of any of the control areas after reduction was attempted. This case occurred 5 months after completion of the program.

Statistical evaluation of the 1962 reports and 5-year mean revealed a significant difference ($P < .05$) between the actual and expected number of reported cases of skunk rabies following the reduction programs. Montgomery County was analyzed separately, but because of small numbers it was necessary to group the other five counties—Jackson, Putnam, Richland, Seneca, and Van Wert—for analysis.

Despite the apparent statistical success, the number of skunks known to have been killed in Jackson, Richland, and Van Wert Counties was so small that it should have exerted little effect on the total population.

The Putnam County outbreak had progressed beyond the point of a few small foci. Control efforts in that area were inadequate.

It was possible in 112 instances to determine accurately the circumstances under which the rabid animal was found. Commonly, the ani-

Monthly incidence of reported skunk rabies in six contiguous States, 1962

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Ohio.....	1	1	58	67	54	41	37	9	8	11	20	7	314
Indiana.....	0	0	0	7	10	10	8	1	1	1	0	0	38
Kentucky.....	0	0	0	0	1	2	0	0	0	0	0	0	3
Michigan.....	1	0	2	2	4	6	0	0	0	0	0	0	15
Pennsylvania.....	0	0	0	1	0	3	1	5	1	1	2	3	17
West Virginia.....	0	0	0	0	1	1	0	0	0	0	0	0	2
Total.....	2	1	60	77	70	63	46	15	10	13	22	10	389

mal was first noticed wandering aimlessly in the daylight hours. In 15 instances it was discovered in the yard of a home, 12 times in a barnyard, and 5 times each in barns, open fields, and along highways. One skunk wandered into a schoolyard during recess; however, no children were exposed. One skunk was found on the porch of a home, while another remained in a cellar with a litter of kittens for 4 days.

The skunks apparently did not wander over a large area in the four instances where continued observations could be made. One was observed on two adjoining farms during a 3-day period. Another remained in a small village for 2 days. Two skunks remained in the yards where they were first noted, one for 6 hours, the other for 2 days.

Four skunks were seen overtly attacking dogs and 26 were found fighting with chained dogs, suggesting the skunk was the instigator. Ten more were found fighting individually with unchained dogs, and 3 others were carried in by dogs; the aggressor could not be determined in these 13 cases. In four cases separate litters of kittens were attacked. Another three skunks were killed while chasing cattle. Aggressiveness by the skunk was obvious in these seven cases.

In five cases the skunks entered or were clawing at the doors of buildings. Two others were found dead, one in a kennel and one in a schoolyard. Another was sleeping peacefully with a litter of newborn pigs when first seen.

Five cases occurred in pet skunks. Three of these were juveniles which developed rabies within 3 weeks of capture. One had been captive for 6 months and the other for 18 months, and their method of confinement could not preclude exposure occurring during captivity.

Incoordination or staggering was the most commonly reported sign, occurring in 35 of 95 cases. Viciousness was noted in 37, while 25 were friendly. Only five persons noted the skunk was "foaming at the mouth" and three reported lower jaw paralysis. It was commonly observed that many of the skunks did not threaten to scent and did not have a strong odor until actually seized, hit, or shot.

Human exposure was rare, occurring only 13 times in 313 cases where this information was available. Five of these 13 were from contact

with the pet skunks previously mentioned. Ninety dogs, 10 cats, and 7 farm animals were bitten by skunks. No exposure was evident in 193 cases.

Discussion

Detailed planning of wildlife rabies control programs is difficult because of the lack of basic ecologic information. First, the average home range or territory of individual skunks at different seasons of the year varies according to the habitat. There is no factor which can be applied to determine how far a skunk in the incubation stage of rabies will travel; neither do we know how many other skunks can be expected to be within his area of contact. The critical population level for maintenance of the disease cannot be determined without this basic information. Rabid skunks may not be interested in feeding and often in the prodromal stages cannot be differentiated from normal animals. Thus, any program limited to killing sick animals is impractical. Experiences in other States have further shown that large-scale intensive and extensive operations are necessary to eliminate the disease once it has become established (5).

Lack of detailed information on the skunk population precludes objective determination of the effectiveness of these techniques in population reduction.

The number of kills cannot be determined accurately, for some skunks were killed in their dens by gassing.

Population reduction by gassing and poisoning is an effective means of controlling skunk rabies under certain circumstances. If reduction can be achieved within approximately 2 weeks after discovery of the index case, there is a good chance of destroying most of the wild animals which this animal might have exposed. Even if some incubating animals are not destroyed, the probability of transmission to other animals is greatly decreased in the area of population reduction. Arithmetic reduction of the population should result in geometric reduction of contact probability.

Poisoning and gassing cannot be applied with any degree of effectiveness or safety unless the operations personnel are well acquainted with the techniques of animal control and applied

ecology. It is seldom satisfactory to substitute people from such allied fields as wildlife management, pest control activities, and trapping because of their lack of knowledge in these areas. However, it is possible to combine personnel from conservation agencies, health departments, or other groups into control teams, providing technical supervision remains in qualified hands. Because of the scarcity of such qualified people, control programs often must be small.

Rabies control programs have been instituted in the States of Virginia and West Virginia in the last few years with encouraging results (6). The basic approach is the same as that used in Ohio, to reduce the susceptible population long enough to break the chain of infection, but the target has been primarily rabies in the red and the grey fox, wider-ranging species than the skunk. This necessitates covering larger areas and therefore requires more manpower, more time, and more intensive supervision than the type of control program conducted in the Ohio counties.

While the programs in these two States in general have been successful, the operating personnel have also found areas where the outbreaks had progressed to such a degree that considerable time and effort was required before there was a significant decrease in the number of rabid animals reported (6). In western States wildlife control programs using poison bait have been successful, although they dealt with the even wider-ranging coyote (7).

Possible reasons for poor results in some areas are: (a) a reporting system inadequate to delineate properly the extent of the disease before control is started, (b) failure to employ enough qualified people for a sufficient time for thorough coverage, (c) reduction efforts initiated too late or over too small an area, (d) terrain too rough to permit adequate coverage, and (e) insufficient reduction of contacts.

More knowledge is needed concerning the pathogenesis and epizootiology of the disease itself, for the epidemic curve of the 1962 skunk outbreak in Ohio seems to suggest simultaneous exposure rather than animal-to-animal contact. The role of such factors as lengthened incubation during winter, activation of latent virus by the stresses of reproduction or crowd-

ing, nonbite transmission, and interspecies transmission must be delineated.

Summary

Skunk rabies reached epizootic proportions in Ohio during the spring of 1962, when 256 cases were reported during a 21-week period. The Ohio Department of Health Laboratories examined 502 skunk heads for rabies during the year; 62 percent were positive.

Most commonly observed symptoms of the rabid skunks were lack of scenting, incoordination, and either aggressiveness or friendliness. Most were seen wandering about during daylight hours. Dogs were exposed more commonly than man or other domestic animals.

Control teams composed of health and wildlife personnel conducted local skunk population reduction programs. Techniques used were gassing of dens with carbon monoxide cartridges and poisoning with eggs containing strychnine.

Campaigns were carried out in six counties with no accidental poisonings of persons or domestic animals. The only animals killed in large numbers were skunks, opossums, and raccoons. The incidence of skunk rabies in the immediate areas was drastically reduced following the programs. The reduction was greater than expected, based on the 5-year mean and the incidence in contiguous counties.

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