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Authors: Moro, Manuel H., Horman, Joseph T., Fischman, Harvey R., Grigor, Jack K., and Israel, Ebenezer

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SHORT COMMUNICATIONS

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The Epidemiology of Rodent and Lagomorph Rabies in Maryland, 1981 to 1986

Manuel H. Moro,¹ Joseph T. Horman,² Harvey R. Fischman,³ Jack K. Grigor,⁴ and Ebenezer Israel,² ¹ Department of Veterinary Microbiology and Preventive Medicine, College of Veterinary Medicine, Iowa State University, Ames, Iowa 50011, USA; ² Epidemiology Program, Maryland Department of Health and Mental Hygiene, Baltimore, Maryland 21201, USA; ³ Department of Epidemiology, School of Public Health, The Johns Hopkins University, Baltimore, Maryland 21205, USA; ⁴ Center for Special Pathogens, Maryland Department of Health and Mental Hygiene, Baltimore, Maryland 21201, USA

ABSTRACT: Records from the Maryland Public Health Department were screened for confirmed rodent and lagomorph rabies between 1981 and 1986. Questionnaires were designed for collection of information about events that led to the exposure of human and/or domestic animals to rabid rodent or lagomorphs. These species comprised 1.2% of all the reported rabies in the state. Woodchucks (*Marmota monax*) constituted 80.0% of all the reported rodent/lagomorph rabies cases in Maryland. The majority showed aggressive behavior (55.0%). Woodchucks exposed 15 persons (75.0% of all the exposures by rodents/lagomorphs). Domestic animal and human rabies exposure due to rodents and lagomorphs represents a small but significant number of the total exposure to rabid animals.

Key words: Rabies, human exposure, rodent, lagomorph, *Marmota monax*, survey.

Rodents and lagomorphs are animals in which rabies is rarely reported. Examination of thousands of wild and peridomestic rodents in endemic areas in the Americas have revealed only occasional cases of rodent rabies infection. The reported results serve to reinforce the perception that these species do not serve as reservoirs of the disease in nature and play a minor role in transmission (Winkler et al., 1972). Numerous exposures have been reported of rabid rodents or lagomorphs to humans but no case of human rabies in the U.S. has ever been documented by contact with these species (Morbidity and Mortality Weekly Report, 1984).

In parts of Europe, repeated isolations

of rabies viruses with unusually low virulence in early mouse passages have been made from wild rodents (Muridae and other Muridae). Some of these isolates reacted in an identical manner with panels of monoclonal antibodies, suggesting similar antigenic determinants to those of European fox rabies virus (Carey and McLean, 1983; World Health Organization, 1984). A similar observation has been described in the Southeast and mid-Atlantic states of the United States, where virus isolates from four rodents including three woodchucks (*Marmota monax*) and an eastern chipmunk (*Tamias striatus*) showed similar antigen determinants to those of raccoon (*Procyon lotor*) rabies viruses supporting the relationship between rabies in raccoons and rodents (Fishbein et al., 1986; Smith et al., 1984).

Since 1981, concurrent with the epizootic of raccoon rabies, an increase in the number of rodents, lagomorphs, and other animals diagnosed positive for rabies has been observed in the mid-Atlantic states (Beck et al., 1986; Fishbein et al., 1986). In Maryland, from 1981 to 1986, 34,647 animal specimens were submitted for laboratory rabies testing (Maryland Department of Health and Mental Hygiene, 1981-1986). Rodents and lagomorphs comprised 16.0% of the total. Of the 3,583 animals diagnosed positive for rabies, rodents and lagomorphs accounted for 1.2%. Consis-

TABLE 1. Laboratory confirmed rabid rodents and lagomorphs in Maryland, 1981 to 1986.

Year	Total confirmed rabid animals	Raccoons		Rodents and lagomorphs	
		Number	%	Number	%
1981	50	7	14.0	1	2.0
1982	152	118	77.6	1	0.7
1983	838	735	87.7	7	0.8
1984	1,100	964	87.6	18	1.6
1985	760	672	88.0	9	1.2
1986	683	586	85.8	8	1.2
Total	3,583	3,082	86.0	44	1.2

tent with the principal role raccoons play in rabies epidemiology and the observed rabies epizootic, approximately 86.0% of the rabies-positive submissions were raccoons. The purpose of this paper is to present and discuss the major epidemiological findings of the 44 cases of rabies in rodents and lagomorphs that were documented in Maryland between 1981 and 1986.

Records from the Maryland Public Health Department were screened for confirmed rodent and lagomorph rabies between 1 January 1981 and 31 December 1986. The time period was selected because it coincided with the occurrence of the raccoon rabies epizootic in Maryland. A case was defined as a rodent or lagomorph that was reported positive for rabies by a Maryland rabies laboratory. The cases included 35 woodchucks, five squirrels (species not determined), two beaver (*Castor canadensis*), one domestic rabbit (*Oryctolagus cuniculus*) and one rat (*Rattus norvegicus*). Laboratory confirmation was based upon a positive fluores-

cent antibody (FA) test (Dean and Ableseth, 1973).

Questionnaires were designed to record information regarding events that led to the exposure of humans and/or domestic animals to rabid rodent or lagomorphs. Telephone interviews were conducted with persons who were directly involved in reporting the case. In those instances in which the person could not be contacted, only data from the records were used.

Data gathered from the questionnaires assessed information relevant to each exposure event: date of occurrence, exposure setting by county and type (rural, suburban, or urban), species involved, behavior and time of day when animal was first observed, species and number of domestic animals exposed, number of persons exposed, and circumstances and type of human exposure.

During the period of study, rodents and lagomorphs comprised 1.2% of all the reported rabies in the state. The number and percent of rabid rodents and lagomorphs as well as rabid raccoons relative to the total number of rabies-positive animals is shown in Table 1 by year.

Woodchucks constituted 80.0% of all the reported rodent/lagomorph rabies cases in Maryland. A similar pattern was observed in Delaware, Pennsylvania, Virginia, and West Virginia as Table 2 shows.

Among all the Woodchucks submitted for testing in Maryland, the range of positives during the study period was 1.4 to 3.2% (Table 3).

Squirrels accounted for 34.0% of the rodent and lagomorph submissions, but only

TABLE 2. Number (% woodchucks) of confirmed rabid rodents/lagomorphs in the mid-Atlantic states, 1982 to 1986.

States	1982	1983	1984	1985	1986	Total
Delaware	0	1 (100)	1 (100)	0	0	2 (100)
Maryland	1 (100)	7 (70)	18 (78)	9 (78)	8 (88)	43 (79)
Pennsylvania	2 (100)	4 (75)	8 (38)	10 (70)	5 (100)	29 (69)
Virginia	6 (100)	6 (100)	1 (100)	1 (100)	0	14 (100)
West Virginia	1 (100)	0	0	0	0	1 (100)
Total	10 (100)	18 (83)	28 (68)	20 (75)	13 (92)	89 (80)

TABLE 3. Number (% positive) of rodents/lagomorphs tested for rabies by species in Maryland, 1981 to 1986.

Type of animal	1981	1982	1983	1984	1985	1986	Total
Woodchuck	31 (3.2)	72 (1.4)	215 (2.3)	445 (3.2)	278 (2.5)	191 (3.1)	1,232 (2.8)
Squirrel	132 (0)	197 (0) ^a	235 (0)	543 (0.4)	425 (0.5)	398 (0.3)	1,930 (0.3)
Beaver	0	0	5 (40.0)	2 (0)	1 (0)	1 (0)	9 (2.2)
Rabbit	26 (0)	64 (0)	102 (0)	202 (0.5)	231 (0)	141 (0)	766 (0.1)
Rat	39 (0)	100 (0) ^b	37 (0)	60 (1.7)	81 (0)	87 (0)	404 (0.3)
Other ^c	183 (0)	134 (0)	177 (0)	193 (0)	252 (0)	275 (0)	1,214 (0)
Total	411 (0.2)	567 (0.2)	771 (0.9)	1,445 (1.3)	1,268 (0.7)	1,093 (0.6)	5,555 (0.8)

^a Included chipmunks.

^b Included mice.

^c Included chipmunks, gerbils, guinea pigs, hamsters, mice, muskrats and voles.

0.3% tested positive. Overall rabies prevalence in rodents and lagomorphs has slightly increased since 1982, reaching its highest point in 1984 with 1.3% of prevalence of all animals tested.

Positive rodents were reported in all the counties west of the Chesapeake Bay with the exception of Calvert. Four counties (Baltimore, Frederick, Howard, and Montgomery) reported 60.0% of all the cases during the years of study (Fig. 1).

Fifty-two percent of the rodent/lagomorph specimens were collected in suburban areas and 48.0% from rural (agricultural and park) areas. Specific areas of collection included private yards (67.0%), pastures/croplands (15.0%), roadsides (6.0%) and parks (9.0%).

Thirty-eight of the 44 rodents/lagomorphs (86.0%) were found alive, one animal was reported to exhibit "normal" behavior and 29 exhibited abnormal

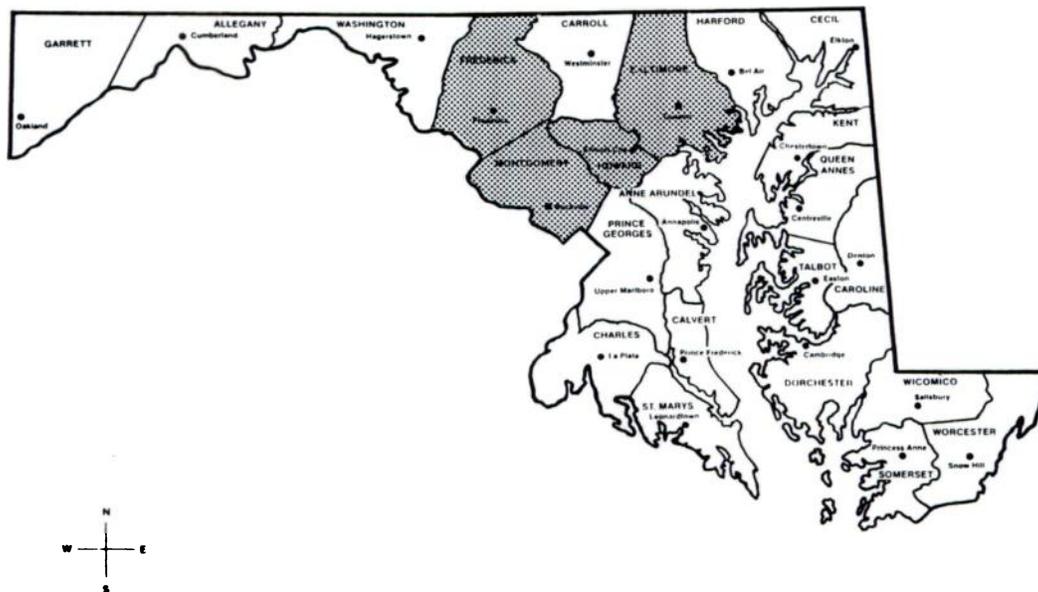


FIGURE 1. Counties reporting the majority of raccoon and rodent/lagomorph rabies cases (dotted area), Maryland, 1981 to 1986.

behavior. No information was available on eight animals. Abnormal behavior included aggressiveness (55.0%), overly friendly (10.0%), and "sick" (35.0%). Behavior described as "sick" included incoordination, paralysis, and wandering near houses (disorientation).

The time of day that live animals were found varied as follows: daylight (65.0%), dusk (10.0%), dark (6.5%) and unknown (18.5%). Distribution of reports through the year was: summer (41.0%), fall (30.0%), spring (20.0%) and winter (9.0%).

Forty-three domestic animals were exposed to rabies by 24 rodents; 19 woodchucks, three squirrels, one rat, and one beaver. Dogs were the domestic animal most frequently exposed, with 41 potential transmission encounters. Two cat exposures also occurred. Of the 41 dogs exposed, 36 (88.0%) were currently vaccinated against rabies, as were the two cats.

The following case history is an example of exposure of a domestic animal to rabies by a woodchuck. A woodchuck appeared in a private yard and immediately attacked three dogs that were on the property. The woodchuck was severely injured by the dogs and euthanized by county personnel. The three dogs suffered minor scratches and were considered to be exposed to rabies. Due to the fact that the animals had a current rabies vaccination, they were revaccinated and observed for 90 days. Human exposure was considered to have occurred by "indirect contact," i.e., contact with a person, animal, or inanimate object that was previously in contact with a rabid animal. Both owners received post-exposure rabies treatment.

Twenty humans were exposed by 10 rodents/lagomorphs including eight woodchucks, one squirrel and one domestic rabbit. Fifteen of these persons (75.0%) were exposed by woodchucks; each exposed an average of 1.8 people.

The most common types of exposure to rabid rodents and lagomorphs were contact of saliva with mucous membranes

(40.0%), indirect (35.0%), bite (20.0%) and scratches (5.0%). Most of the exposure occurred in persons over the age of 18 (78.0%). Males had a slightly higher rate of exposure (60.0% versus 40.0% for females).

Exposure to rabies by rodents and lagomorphs represented <5.0% of the total human rabies exposures in Maryland, the vast majority (74.0%) of human exposures were associated with raccoons (Maryland Health Department, 1981–1986).

Rabid rodents may show aggression toward humans. In one case, an 88-yr-old woman was in her garden when she was attacked and knocked down by a woodchuck. During the attack she was bitten repeatedly on the extremities, head, and face. The rodent was finally shot by a neighbor. In this incident, a total of seven persons were considered to have been exposed to rabies, including neighbors, paramedics, and a nurse. Rabies virus was isolated from the buccal cavity of the woodchuck.

Although rabies virus typically circulates among a single primary reservoir species, it also may be transmitted to other domestic and wildlife species (spillover). However, spillover infrequently results in development of an enzootic in the secondary species. This may be related to differences in antigenicity and pathogenicity of rabies virus strains, differences in host susceptibility, or to ecological factors (Beck et al., 1986; Smith et al., 1984). The enzootic of raccoon rabies observed in Maryland has tended to follow a similar pattern of "spillover" from raccoons to other species such as woodchucks and rabbits which were considered rabies-free. During the period of study approximately 55.0% of the reported rabies in raccoons came from the same four counties that reported 60.0% of rabies in rodents/lagomorphs.

Woodchucks are widely distributed in the states along the east coast and are among the most common wild rodent in the area (Goodmann, 1975). Their body size and rugged constitution enables them

to resist and survive an attack by larger animals such as rabid raccoons. These conditions could explain the higher survival from raccoon bite exposure and thus increase the chance of contact with humans and consequently increase probability of being reported. Also woodchucks compete with raccoons for den sites in areas of intense rabies activity (Fishbein et al., 1986; Lee and Funderburg, 1982).

Most of rabid raccoons have been found at private yards (60.0%) and during daylight hours (71.0%) (Jenkins and Winkler, 1987). A similar feature was found in rodents/lagomorphs (67.0% and 65.0%, respectively). These could be attributed to the higher probability of being observed at daylight by humans as well as to the proximity to urban settings.

The seasonal difference observed in reporting of rabid raccoons (higher in spring and early autumn) in contrast to woodchucks (higher in summer) could be attributed to a difference in breeding seasons as well as population dynamics of those species.

Reports of changes in behavior in rabid rodents are difficult to measure and evaluate objectively. Nonetheless, aggressive behavior on the part of woodchucks toward humans and domestic animals was a feature reported in 45.0% of the cases.

Domestic animal and human rabies exposure from rodents and lagomorphs and specifically from woodchucks justifies continued surveillance and examination of these species in endemic areas. Other rodent/lagomorph species should be examined if a human exposure occurs in circumstances of an unusual or unprovoked attack or a bite by an animal that appears sick.

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