

PRELIMINARY STUDIES OF BAT RABIES IN ALBERTA

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INTRODUCTION

RABIES INFECTION in insectivorous bats in North America was first recorded in Florida in 1953 (18). Rabies has been found in 24 species of North American bats and positive reports usually are directly proportional to the number of bats tested (10). Rabies has been reported from all the states in the continental United States of America and from most Canadian provinces (8). Bat rabies was initially reported in Canada in 1957 (1). Bats from Alberta were first diagnosed as rabid in 1971.

In 1971 the Health of Animals Branch, Agriculture Canada, the Veterinary Services Division of the Alberta Department of Agriculture and the Fish and Wildlife Division of the Alberta Department of Lands and Forests (now Recreation, Parks and Wildlife), jointly undertook to monitor the occurrence of rabies in bats in Alberta. Additional objectives included examination of biological and human factors influencing the epizootiology of the disease. This report deals with laboratory studies of rabies-suspect bats and surveys of non-suspect bats examined during the calendar years 1971 through 1975.

MATERIALS AND METHODS

From January 1971 through December 1975, 2501 bats of six species were examined for rabies at the Animal Diseases Research Institute (Western), Lethbridge, Alberta, by the fluorescent antibody technique (FAT) (11) as described by Beaugerard *et al* (6). Suspect bats refer to the 1249 specimens submitted to ascertain if they were rabid. The 1252 remaining bats, collected by or for the authors, are considered as survey bats.

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Collections of approximately 20 survey little brown bats (*Myotis lucifugus*) were made at selected maternity colonies during the summers of 1971 to 1975. These collections were made weekly in 1974 and 1975. Two colonies of little brown bats were depopulated and examined after a positive diagnosis of rabies had been made on initial survey specimens. A third little brown bat colony, with recognized rabies, was sampled but not depopulated. Sporadic collections of this species were also made from nonmaternity roosts and from a hibernaculum.

Collections of 145 big brown bats (*Eptesicus fuscus*) were made chiefly at maternity roosts at irregular intervals from 1971 to 1975. No other species were surveyed.

Species, age and sex were determined on all survey bats during 1971-1975 and on suspect bats during 1974 and 1975. Species and sex were determined on all positive suspect bats prior to 1974.

Young of the year were distinguished from adults by the degree of closure of phalangeal epiphysis and pelage characteristics. Young bats taken prior to 31 December were considered as juvenile, all other bats were classed as adult.

Frequencies were compared, utilizing the simple chi-square test. Values were considered significant at $P < 0.05$.

RESULTS

A. Rabies Infection of Suspect Bats

Since 1971, 4.7% (59/1249) of the suspect bats submitted were diagnosed as rabid (Table I). Of these 25 were silver-haired bats, 20 big brown bats, 11 little brown bats, one hoary bat and two were unidentified (Table II).

TABLE I
INCIDENCE OF RABIES IN SUSPECT BATS: 1971-75

Year	No. Suspect Bats	No. Rabid	Percent Rabid
1971	98	3	3.1
1972	65	4	6.2
1973	249	17	6.8
1974	409	20	4.9
1975	428	15	3.5
1971-75	1249	59	4.7

TABLE II
MONTH OF CAPTURE OF RABIES POSITIVE SUSPECT BATS: 1971-75

Month	Silver-haired	Big Brown	Little Brown	Hoary	Unidentified	Total
Jan.		1				1
Feb.						
Mar.						
April						
May		1	1			2
June	2	4				6
July	1	1	2	1		5
Aug.	7	5	4		1	17
Sept.	14	5	3		1	23
Oct.	1	2	1			4
Nov.		1				1
Dec.						
Total	25	20	11	1	2	59

Most of the rabid bats (67.8%) were collected in August and September. The highest yearly infection rate (6.8%) was in 1973. This declined significantly ($P < 0.05$) to 3.5% in 1975.

Three species, little brown, big brown and silver-haired bats (*Lasionycteris noctivagans*) constituted 97.8% of the identified suspect bats. Little brown bats were most frequently submitted. Annual submissions of this species in 1974 and 1975 were nearly 3.5 times greater than those of 1973 (Table III). In the same period, the infection rate of little brown bats declined significantly ($P < 0.05$) from 5.2% in 1973 to 2.0% in 1974 and 1.0% in 1975.

Numbers of big brown and silver-haired bat submissions remained relatively constant from 1973 to 1975 (Table III). The rabies infection rate of big brown bats increased from 4.3 to 10.8% during that period ($P < 0.10$). From 1974 to 1975 the infection rate of silver-haired bats decreased from 12.3 to 4.8% ($P < 0.20$). Both silver-haired and big brown bats had significantly ($P < 0.005$) greater infection rates than little brown bats for the 1973 to 1975 period.

Sex, Age and Species and Relation to Collection Period

Submissions of suspect bats established definite patterns. Increasing numbers of little brown bats were submitted from July to August. Submissions declined during September with relatively low numbers submitted during May, June and October (Figure 1). No submissions were made between November and April. A large proportion of the specimens investigated during August and September were little brown bats found hanging under small overhangs on buildings.

Submissions of big brown bats occurred throughout the year, although irregularly from

October through May (Figure 2). Submissions of big brown bats during winter were largely of bats taken in buildings or of bats evidently attempting to enter buildings.

With one exception, silver-haired bats were submitted prior to 16 July and after 13 August in 1974 and 1975, evidently during spring and fall migrations (Figure 3). In the spring, only adult females were submitted and, in the fall, adult females and young. Only two adult males were submitted, both in the fall.

Of the silver-haired bats, 88.2% of the rabid specimens in 1971-1975 were juveniles, significantly ($P < 0.005$) greater than the 44.2% nonrabids which were juvenile during 1974-1975 (Table IV).

The proportion of rabid and nonrabid juvenile and adult suspect big brown bats was not significantly different ($P < 0.80$) (Table IV). Insufficient numbers of rabid little brown and hoary bats were obtained to allow comparisons.

Significant differences did not occur between sex-specific groups of suspect bats (Table V).

Distribution of Human Population and Submission of Bats

The human population of Alberta is concentrated in the south-central and southern area of the province. Accordingly, all but a very small number of submissions were from these areas. The population is further concentrated into urban centers. The three largest, the cities of Edmonton, Calgary and Lethbridge, contributed 46.1% of the submissions in 1974 and 1975 (Table VI). The rabies infection rate among bats from these three cities in the two years was 3.4% compared to 4.7% of bats from the entire province. The infection rates of bats from Calgary, Lethbridge and Edmonton were 5.0, 4.7 and 2.7% respectively. Little brown bats, the species with the lowest infection rate,

TABLE III
INCIDENCE OF RABIES AMONG SUSPECT BATS: 1973-75

Species	1973			1974			1975			All years		
	No. Examined	No. Rabid	% Rabid	No. Examined	No. Rabid	% Rabid	No. Examined	No. Rabid	% Rabid	No. Examined	No. Rabid	% Rabid
Silver-haired	86	10	11.6	73	9	12.3	63	3	4.8	222	22	9.9
Big Brown	93	4	4.3	96	6	6.3	83	9	10.8	272	19	7.0
Little Brown	58	3	5.2	199	4	2.0	207	2	1.0	464	9	1.9
Hoary	3	0	0.0	8	1	12.5	5	0	0.0	16	1	6.3
Small-footed	0	0	0.0	1	0	0.0	3	0	0.0	4	0	0.0
Long-eared	0	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0
Myotis ^a	9	0	0.0	31	0	0.0	66	1	1.5	106	1	0.9
Unidentified												
All Species	249	17	6.8	409	20	4.9	428	15	3.5	1086	52	4.8
Total												

^aSpecimens may be Keen's bat (*Myotis keenii*).

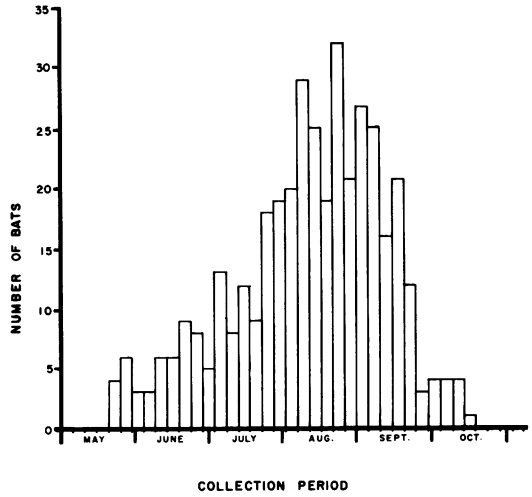


FIGURE 1. Number of little brown bat (*Myotis lucifugus*) submissions by five day collection periods in 1974 and 1975.

constituted 26.7% of submissions from Calgary, 34% from Lethbridge and 65.2% from Edmonton.

B. Rabies Infection of Survey Bats

Of 860 little brown bats collected from 1971 to 1975, 13 or 1.5% were rabid (Table VII). The rabid individuals included 11 from three maternity colonies, one from a hibernaculum and one from a fall collection. Of 247 bats taken from colonies two to three weeks after initial diagnosis of rabies, eight or 3.2% were rabid.

Two little brown bat colonies sampled for survey purposes were found to have high infection rates (Table VIII). On initial collection, colonies at Penhold and Claysmore had infection rates of 23.8 and 20% respectively. The infection rates of bats taken two to three weeks later at the same colonies were 4.5 and 0% respectively.

The infection rate of 145 survey big brown bats collected since 1971 was 1.4%.

DISCUSSION

In Canada (5) and the northern United States (2) bat rabies is reported more often in big brown bats than in other species. Canada (5) reports 32 or 12.2% of 262 big brown bats tested from 1963 to 1967 to be rabid. As well, 27.3% of 11 silver-haired bats and two or 0.6% of 316 little brown bats are rabid.

In this study, the silver-haired bat is the species most often reported rabid with an infection rate of 9.9%. This species, however, constitutes 20.4% of our submissions compared

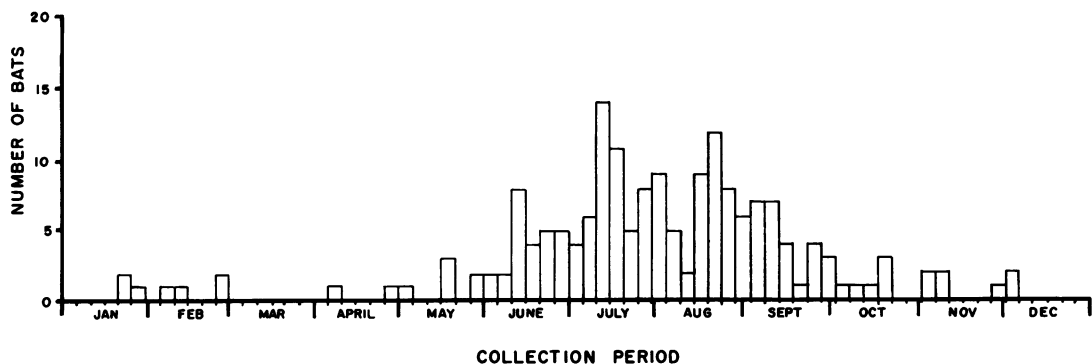


FIGURE 2. Number of big brown bat (*Eptesicus fuscus*) submissions by five day collection periods in 1974 and 1975.

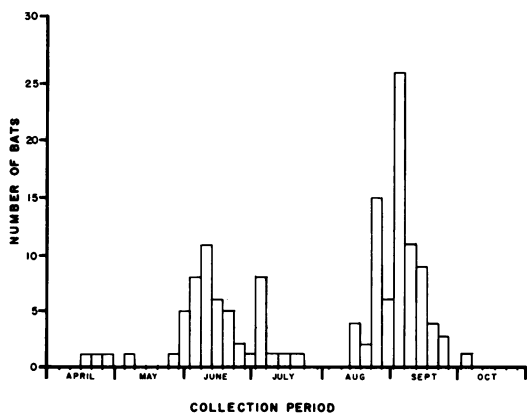


FIGURE 3. Number of silver-haired bat (*Lasiycteris noctivagans*) submissions by five day collection periods in 1974 and 1975.

to 1.8% reported for the whole of Canada from 1963 to 1967. The movements and seasonal distribution of silver-haired bats are poorly understood (4). As this species is found throughout southern Canada (3), explanation of the comparatively large number submitted in Alberta during the period of this study will require more research.

The infection rate of big brown bats (7%) in our study is significantly lower ($P < 0.05$) than the infection rate for the same species reported by Beauregard for the whole of Canada in 1963 to 1967 (5). Conversely, the infection rate of little brown bats in Alberta (1.9%) is considerably higher ($P < 0.25$) than previously reported for Canada (5). From 1973 to 1975 the infection rate of these species tends to become similar to those reported from the whole of Canada and the United States (5, 9) (>10% of big browns and about 1% of little browns). This could result from fluctuation in the infection rate of a well-established

rabies infection, or a trend toward a stabilized rate following a recent introduction of the disease. The infection rate of little brown bats in 1973 (5.2%) is very high for this species and may reflect an unusually high incidence of rabies in the population as a whole in that year.

Constantine (9) suggests that outbreaks of rabies may occur independently in different bat species. Data from our study shows an increasing infection in big brown bats and a decreasing infection in silver-haired and little brown bats, thus supporting this suggestion. In Alberta the big brown bat is a highly sedentary species, whereas the silver-haired bat is a highly migratory species, and the little brown bat is probably migratory. These differences in behavior may, in part, explain the differences in infection rates noted in Alberta.

The greatest number of rabies diagnoses of bats in Canada (5) and the United States (2) have been reported in August and September. This is also the case in Alberta. The direct relationship between the number of suspect bats submitted and the number of those diagnosed rabid has been recognized (9). In this study, big brown and little brown bats follow this pattern. Few rabies positive silver-haired bats are submitted during the spring migration although relatively large numbers of this species are received. This is to be expected, however, as most of the rabid silver-haired bats are juveniles and of course, could only be submitted during the fall migration.

Sex and age of rabid bats have not been noted to differ from those of nonrabid individuals in Florida (7). In the present study no significant differences in these parameters are noted among big brown or little brown bats. The significantly greater incidence of the disease in juvenile silver-haired bats suggests that a substantial proportion of adults may acquire

RABIES

TABLE IV
AGE PROPORTION OF RABID AND NONRABID SUSPECT BATS

Species	Rabies Positive 1971-75			Rabies Negative 1974-75		
	No. Submitted	No. Juvenile	% Juvenile	No. Submitted	No. Juvenile	% Juvenile
Silver-haired	19	16	84.2	113	50	44.2
Big Brown	13	5	38.5	141	49	34.8
Little Brown	6	3	50.0	331	136	41.1
Hoary	1	0		9	4	44.4
Total	39			594		

TABLE V
SEX PROPORTION OF RABID AND NONRABID SUSPECT BATS

Species	Rabies Positive 1971-75			Rabies Negative 1974-75		
	No. Submitted	No. Male	% Male	No. Submitted	No. Male	% Male
Silver-haired	19	6	31.6	114	32	28.1
Big Brown	16	10	62.5	167	70	41.9
Little Brown	7	3	42.9	337	109	32.3
Hoary	1	0	0.0	9	2	22.2

resistance as juveniles. No significant differences are noted in infection rates of silver-haired bats of either sex.

In Oklahoma, local variation in the numbers of rabid animals reported has been shown to be dependent upon the characteristics of the reporting system (12). In Alberta, the majority of bat submissions are from the heavily-settled central and southern areas. Accordingly, the majority of bat rabies diagnoses are from these areas. Submissions also tend further to originate from within the three largest cities. Publicity and access to facilities in these cities encourage submission of bats. The infection rate of bats from these sources is however, slightly lower than that of the rest of the province. Similarly, a lower infection rate is recorded in bats from areas of more numerous submissions in Florida (7).

Differences of infection rates among the bats from the three cities are related to the relative proportion of species with high and lower infection rates. Thus, bats in the City of Edmonton, from which a high proportion of infrequently rabid little brown bats are submitted, have a lower infection rate than bats in the City of Lethbridge, from which a high proportion of more frequently rabid big brown bats are submitted.

Infection rates of survey insectivorous bats usually vary from 1 to 3% (9); those of the genus *Myotis* are typically near 1%. The infection rate of 1.5% found in our survey of

little brown bats and 1.9% in our suspect bats in Alberta are comparable, suggesting that rabies is not a major factor in the selection of suspect little brown bats by the public. The greater difference in infection rate between survey and suspect big brown bats in our study indicates that rabies is more of a factor in the selection of that species.

Stress has been widely considered a possible contributing factor to rabies infection (13, 16, 17). Soave (15) has shown that stress will activate infection in guinea pigs. However, Sims *et al* (14) were not able to demonstrate this among free-tailed bats (*Tadarida brasiliensis*) which were stressed by pregnancy. In this study, collections from colonies which included rabid bats were made in late June and early July. Most parturition in little brown bat colonies in Alberta occurs in the last week of June (unreported data). The high percentage of rabid individuals collected June 19 (23.8%) and July 4 (20%) and lower infection rates at later times among bats from the same colonies suggests stress associated with reproduction may predispose individuals to infection.

Constantine (10) reports that bats readily bite each other and that the frequency of biting is greater in colonial species. This behaviour pattern could account for the outbreaks of rabies seen within maternity colonies of little brown bats in Alberta, but does not explain the greater incidence of rabies in the noncolonial juvenile silver-haired bats.

MAJOR SOURCES OF SUSPECT BATS: 1974-75

Location	Little Brown			Big Brown			Silver-haired			Other			Unidentified			% Prov. Total
	No. Submitted	% City Total	No. Submitted	% City Total	No. Submitted	% City Total	No. Submitted	% City Total	No. Submitted	% City Total	No. Submitted	% City Total	No. Submitted	% City Total		
Edmonton	120	65.2	23	12.5	9	4.9	1	0.5	31	16.8	184	22.0	31	16.8	22.0	
Lethbridge	49	34.0	58	40.3	18	12.5	7	4.9	12	8.3	144	17.2	12	8.3	17.2	
Calgary	16	26.7	10	16.7	26	43.3	0	0.0	8	13.3	60	7.2	8	13.3	7.2	
Total	185		91		53		8		51		388		51			
Prov. Total	408		177		136		17		97		835		97			
% Prov. Total	45.3		51.4		39.0		47.1		52.6		46.5		52.6		46.5	

TABLE VII
RABIES INFECTION RATES OF SURVEY LITTLE BROWN BATS: 1971-75

Year	Survey			Depopulation			Total		
	No. Collected	No. Positive	% Positive	No. Collected	No. Positive	% Positive	No. Collected	No. Positive	% Positive
1971	40	0	0.0				40	0	0.0
1972	91	2	2.2				91	2	2.2
1973	149	5	3.4	179	8	4.5	328	13	4.0
1974	285	0	0.0	68	0	0.0	285	0	0.0
1975	295	6	2.0	247	8	3.2	363	6	1.7
Totals	860	13	1.5	247	8	3.2	1107	21	1.9

TABLE VIII
INCIDENCE OF RABIES IN SAMPLES OF THREE *Myotis lucifugus* MATERNITY COLONIES^a

Colony	No. Bats in first Collection	Date	No. Rabid (%)	No. Bats in second Collection	Date	No. Rabid (%)	Total No. Bats	No. Rabid (%)
Penhold	21	June 19/73	5 (23.8)	179	July 24-27/75	8 (4.5)	200	13 (6.5)
Claysmore	25	July 4/75	5 (20.0)	63	July 24/75	0 (0.0)	88	5 (5.7)
Bashaw	20	July 9/75	1 (5.0)	5	July 25/75	0 (0.0)	25	1 (4.0)
Total	66		11 (16.7)	247		8 (3.2)	313	19 (6.1)

^aPenhold and Claysmore colonies were in attics of occupied residences.

SUMMARY

Rabies infection varied significantly between three common species of bats in Alberta during the period 1973 to 1975. Changes in yearly intraspecific infection rates between 1973 and 1975 indicated a trend toward infection rates reported from other areas. Silver-haired bats are more commonly rabid in fall during emigration than in spring during immigration. The majority of rabid bats are from heavily settled areas where submissions are the highest. Outbreaks of rabies infection of short duration occur within maternity colonies of little brown bats.

RÉSUMÉ

Le nombre de cas de rage diagnostiqués chez trois espèces de chauves-souris, communes en Alberta, varia beaucoup, de 1973 à 1975. Les variations relatives au taux d'infection de ces espèces ressemblaient à celles d'ailleurs. Chez les chauves-souris argentées, les cas de rage s'avèrent plus nombreux au temps de leur migration automnale qu'à celui de leur retour printanier. La majorité des chauves-souris enrégées provenaient des régions urbaines d'où le laboratoire reçoit le plus grand nombre de cas suspects. De brèves éruptions de rage se produisirent au sein des colonies de maternité des petites chauves-souris brunes.

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LETTER TO THE EDITOR

SOAP POISONING IN A DOG

DEAR SIR:

In May 1977, I examined a one and one-half year old poodle-terrier cross bitch (weighing about five lbs) which was in a depressed state. TPR were normal and no other remarkable signs were present. However, history was of major interest.

On the previous evening the owner had taken the dog out for a walk at approximately 7:30 p.m. The dog, in the course of its exercise, managed to find a spilt garbage can and began to chew a light green material. This was described as being of soapy or waxy consistency. The owner removed this material from the dog's mouth and returned home. The amount swallowed was not known. The owner went out for the evening and returned about 11:30 p.m. (four hours later). He found that the dog had vomition and diarrhea and was depressed. The vomitus was unremarkable except that it was exceeding frothy and contained chunks of the above-mentioned green material. The feces was watery and dark

brown to blackish in color.

The following morning the vomition and diarrhea were no longer evident, but the dog was depressed and remained so for another day. The owner brought some of the green material from the vomitus to the Western College of Veterinary Medicine toxicology laboratory. This material was examined and it was found to be of the consistency and color of some common soaps and had properties consistent with soap. Its fatty acid composition was approximately 50%.

A diagnosis of soap poisoning was made. No treatment was undertaken. The dog was depressed for two days after the episode, but recovered uneventfully.

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