

Rabies in Insectivorous Bats in the United States, 1953-65

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RABIES in bats in the United States was first diagnosed in Florida in 1953 (1), and by the end of 1965 infected bats had been discovered in all States except Rhode Island, Alaska, and Hawaii. The deaths of six persons have been attributed to exposure to rabid bats (2); one of these antedated the Florida diagnosis (3). Numerous reports have summarized bat rabies cases in various States or regions (1, 4-10), and the geographic distribution of rabid bats in the continental United States from 1953 to 1960 was reviewed by Enright (11). In our report cases of bat rabies are presented by State, species, and month from 1953 through 1965 with emphasis on differences in species distribution and behavior. Sources of data are reports from the Agricultural Research Service, National Communicable Disease Center, U.S. Livestock Sanitary Association Committee on Rabies, and communications from public health veterinarians and epidemiologists in all State health departments.

Cases in all Species

There are 40 known species of bats, all insectivorous, in the United States; among these are species of colonial bats—those that usually

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congregate in caves, under bridges, or other protected places. Other species are free living and are found either alone or with only a few other members of the same species, usually in trees or shrubs. In the period 1953-65, 25 species of colonial and free-living insectivorous bats were reported to be infected with rabies in the United States; there was a total of 1,869 cases (2.8 percent of the cases in all animal species) reported during this period (table 1).

In 1953, the first year rabies was reported in bats, 0.1 percent of all cases of animal rabies was in bats; by 1965 this percentage had risen to 10.6 percent. Only two States reported rabid bats in 1953, yet 24 had reported them by 1959, and by 1965 all but one of the contiguous States had reported at least one rabid bat (table 1).

Of the 1,869 rabid bats reported, 1,210 (65 percent) were identified as to species (table 2). Of the 40 States that identified bats by species, 24 reported rabies in both colonial and free-living species, 10 reported rabies in colonial species only, and six reported rabies in free-living species only. The number reported rabid is shown by month in table 3; there is a notable concentration (88.2 percent) in the warmest months (May-October). Indeed 45.5 percent of all rabid bats were found in August and September.

Only 12.8 percent of the total were reported in the 6-month period that begins with November, and only eight rabid bats were seen in January. Many northern States (Illinois, Massachusetts, Michigan, Montana, New Jersey, New

York, Ohio, Oregon, Pennsylvania, Washington, and Wisconsin) reported rabid bats during the winter.

Rabies in colonial bats. The number of colonial bats in one cave may reach millions (12). Some colonial species, such as the Mexican freetail (*Tadarida brasiliensis mexicana*), are migratory and are not usually found in

their roosts in the United States from November to March (13), but numerous other colonial species hibernate and stay in one general area for long periods. In the 13 years, 714 cases of rabies in colonial bats were recorded, 59 percent of the identified bats. Members of 20 species of colonial bats were found rabid (table 4). The distribution of the three species of

Table 1. Bat rabies, by State and year, United States, 1953-65

State ¹	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	Total
Alabama				2					2		1	2		7
Arizona					5		2	3	6	6	18	17	14	71
Arkansas									1		16	13	7	37
California		1	2	4	2	8	18	12	34	29	53	53	72	288
Colorado					2		5	4	3	4	18	8	10	54
Connecticut							1						2	3
Delaware											2			2
Florida	8	3	9	11	7	7	7	4	7	14	13	44	38	172
Georgia				6	1	2	1	1	2	5	3	2	15	38
Idaho										1	3	2	15	21
Illinois							2				2	1	13	18
Indiana								2					2	4
Iowa								2	2	5	2		6	17
Kansas								1					5	6
Kentucky									1	1	3		2	7
Louisiana			1							1	1	1	5	9
Maine												4	1	5
Maryland							1		3		2	2	22	30
Massachusetts									1	3	6	1	3	14
Michigan				1	1		1	1	2	4	3	4	4	21
Minnesota				1					3	3	1		4	12
Mississippi												67	42	109
Missouri								2	6		3	1	2	14
Montana		1	4		3	2	9	3	3	1	2	8	5	41
Nebraska						2	2	1						5
Nevada											11	12	2	25
New Hampshire											2	1	1	4
New Jersey								1	7	10	16	18	21	73
New Mexico			1		3	3	3		1	15	15	3	10	54
New York				1		2	2	2	14	8	8	11	14	62
North Carolina											9	2	2	13
North Dakota													1	1
Ohio				2		1	3	1	4	3	4	5	6	29
Oklahoma				2	1				1	1	1	1	36	43
Oregon								7	14	17	15	10	8	71
Pennsylvania	1					1			8	1	3	6	5	25
South Carolina											5	2	2	9
South Dakota									1	1				2
Tennessee									2	19	5	13	30	69
Texas		2	1	11	4	42	24	22	49	35	27	20	31	268
Utah				1					7	1	2	1	2	14
Vermont												1		1
Virginia							2			2	4	2	3	13
Washington									5		19	6	22	52
West Virginia							1			1		3	1	6
Wisconsin					6	3	1		2	5	5	6	1	29
Wyoming													1	1
Total	9	7	18	42	35	73	85	69	191	196	303	353	488	1,869

¹ No rabid bats were reported by Alaska and Hawaii; Rhode Island reported its first rabid bat in June 1967.

colonial bats in which rabies is most frequent (*Eptesicus fuscus*, the big brown bat; *Tadarida brasiliensis mexicana*, the Mexican free-tailed bat; and *Myotis lucifugus*, the little brown bat) is shown in figure 1, with the number of rabid bats indicated in each State. Cases of rabies in the big brown bat were scattered

throughout the country, except the southeastern States. Rabid Mexican freetail have been discovered in most of the States within their geographic range (16).

Rabies in free-living bats. Rabies virus was isolated from 496 bats of free-living species during the 13 years (table 4), 41 percent of the

Table 2. Bat rabies, by State and type of bat, United States, 1953-65

State ¹	Total positive	Colonial	Free living	Not identified
Alabama	7		7	
Arizona	71	32	6	33
Arkansas	37		12	25
California	288	149	97	42
Colorado	54	14	9	31
Connecticut	3			3
Delaware	2	2		
Florida	172	14	57	101
Georgia	38	4	32	2
Idaho	21	4	3	14
Illinois	18	2	5	11
Indiana	4		2	2
Iowa	17	4	7	6
Kansas	6	3		3
Kentucky	7			7
Louisiana	9	3	4	2
Maine	5			5
Maryland	30			30
Massachusetts	14	12		2
Michigan	21	21		
Minnesota	12	7	1	4
Mississippi	109	4	105	
Missouri	14		6	8
Montana	41	31	6	4
Nebraska	5	3	1	1
Nevada	25	15	7	3
New Hampshire	4	4		
New Jersey	73	53	10	10
New Mexico	54	42	9	3
New York	62	61	1	
North Carolina	13			13
North Dakota	1	1		
Ohio	29	25	1	3
Oklahoma	43	37	5	1
Oregon	71	42	16	13
Pennsylvania	25	19	1	5
South Carolina	9			9
South Dakota	2		1	1
Tennessee	69	17	20	32
Texas	268	64	58	146
Utah	14	4		10
Vermont	1	1		
Virginia	13	2		11
Washington	52	17	6	29
West Virginia	6	1		5
Wisconsin	29			29
Wyoming	1		1	
Total	1,869	714	496	659

¹ No rabid bats reported by Alaska and Hawaii; Rhode Island reported its first rabid bat in June 1967.

Table 3. Bat rabies, by State and month, United States, 1953-65¹

State ²	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	No month given	Total
Alabama					1		2	3	1					7
Arizona	1		1	4	12	6	1	26	16	3	1			71
Arkansas				1		2	6	11	15	2				37
California	1	4	7	23	29	35	38	31	56	54	5	4		287
Colorado						7	13	7	5	2			20	54
Connecticut								1	1	1				3
Delaware							1	1						2
Florida	1	5	3	12	22	12	31	28	27	10	5	13	15	184
Georgia			1	5	3	1	3	8	9	5	1		³ 2	38
Idaho						3	2	1	1				4	11
Illinois					2	3		2	6	3	1	1		18
Indiana				1				2	1					4
Iowa						1	2	4	8	1	1			17
Kansas						1	1	1	2				1	6
Kentucky							3	2	1					6
Louisiana		1	1				1	2	3				1	9
Maine								1	3	1				5
Maryland													30	30
Massachusetts			1			1	3	5	2			1	1	14
Michigan					1	2	1	8	1	4	3	1		21
Minnesota			2			1		3	2	4				12
Mississippi				1	3		3	38	52	5	6	1		109
Missouri				1				5	4	1			3	14
Montana					2	2	4	16	9	7		1		41
Nebraska								3					2	5
Nevada		1			1	2	2	11	7		1			25
New Hampshire					1	1		1	1					4
New Jersey	1		1	2	8	8	15	16	11	6	3		2	73
New Mexico				1	5	9	5	7	16	6	2		3	54
New York			2		5	9	14	15	8	6	1	2		62
North Carolina				1	2			2	4	3		1		13
North Dakota								1						1
Ohio			1	2	4	1	1	8	5	4	2	1		29
Oklahoma													43	43
Oregon	2	1		3	3	4	7	18	15	12	6			71
Pennsylvania	1				2	7	6	3	5		1			25
South Carolina			1	1		1		2	1	3				9
South Dakota						1			1					2
Tennessee					6	16	6	21	15	4	1			69
Texas	1	2	9	21	31	20	37	48	51	35	10	3		268
Utah					1			1		1			11	14
Vermont								1						1
Virginia					1		1	2	6	2		1		13
Washington						4	4	6	29	8	1			52
West Virginia					1	1	1	1	1			1		6
Wisconsin		1			3	4	5	6	5	4		1		29
Wyoming								1						1
Number of bats per month	8	15	30	79	149	165	223	379	405	194	52	31		
Number of States reporting rabid bats per month	7	7	12	15	24	29	34	41	39	27	19	13		

¹ There are discrepancies between totals on this and other tables because they include only earlier data.
² No rabid bats were reported by Alaska and Hawaii;

Rhode Island reported its first rabid bat in June 1967.
³ Reported by Florida State Board of Health.

total number of identified bats. Figure 2 shows the distribution of cases in the three free-living species in which rabies was most commonly reported—*Lasiurus borealis*, the red bat; *Lasiurus cinereus*, the hoary bat; and *Lasionycteris noctivagans*, the silver-haired bat. By far the greatest number of rabid red bats, 103, was reported by Mississippi; Texas reported 38, and Georgia 25 cases. Rabid hoary bats were reported by 24 States, the greatest number of States reporting any one species. California reported 82 rabid hoary bats during the 13 years.

Rabies in unidentified bats. Seven States never identified bats as to species; 659 rabid bats from 38 States were not identified as to species; that is, 35 percent of the 1,869 rabid bats reported.

Discussion

The number of rabid insectivorous bats reported in the United States has increased over the years. This increase may indicate a true increase in the number of rabid bats or better reporting as a result of a more acute awareness

Table 4. Cases of rabies in colonial and free-living bats, by species and State, United States, 1953-65

Generic and common name	Total cases	States reporting cases
COLONIAL		
<i>Eptesicus fuscus</i> , big brown bat.....	204	21 States (fig. 1). ¹
<i>Tadarida brasiliensis mexicana</i> , Mexican free-tailed bat ²	199	6 States (fig. 1).
<i>Myotis lucifugus</i> , little brown bat ³	45	13 States (fig. 1).
<i>Pipistrellus hesperus</i> , western pipistrel.....	27	Arizona 9 ⁴ , California 6, Nevada 12.
<i>Antrozous pallidus</i> , pallid bat.....	19	Arizona 2, California 10, New Mexico 4, Oklahoma 2, Oregon 1.
<i>Myotis grisescens</i> , grey myotis.....	16	Tennessee 15, Florida 1.
<i>Myotis evotis</i> , long-eared myotis.....	14	California 3, Montana 7, Utah 1, Washington 3.
<i>Tadarida brasiliensis cynocephala</i> , Florida free-tailed bat ²	10	Florida 8, Georgia 1, Louisiana 1.
<i>Nycticeius humeralis</i> , evening bat.....	7	Georgia 2, Mississippi 4, Tennessee 1.
<i>Myotis californicus</i> , California myotis.....	7	California 5, Montana 2.
<i>Corynorhinus townsendii</i> , western big-eared bat.....	7	California 2, Colorado 1, Oregon 2, West Virginia 1, Washington 1.
<i>Myotis yumanensis</i> , Yuma myotis.....	7	Arizona 1, California 2, Montana 1, Washington 3.
<i>Myotis subulatus</i> , small-footed myotis.....	6	Arizona 1, California 1, Colorado 1, Montana 2, and Washington 1.
<i>Pipistrellus subflavus</i> , eastern pipistrel.....	5	Florida 4, Tennessee 1.
<i>Myotis velifer</i> , cave myotis.....	4	Kansas 2, Texas 2.
<i>Myotis volans</i> , long-legged myotis.....	4	California 1, Montana 3.
<i>Myotis austroriparius</i> , Mississippi myotis.....	2	Florida 1, Georgia 1.
<i>Macrotus waterhousii</i> , leaf-nosed bat.....	1	California.
<i>Tadarida molossa</i> , big free-tailed bat.....	1	New Mexico.
<i>Mormoops megalophylla</i> , leaf-chinned bat.....	1	Texas.
<i>Myotis keenii</i> , Keen myotis.....	1	Washington.
<i>Myotis</i> , species not identified.....	128	California 11, Nevada 1, New Hampshire 4, New York 61, Ohio 5, Oklahoma 29, Pennsylvania 11, Virginia 1, Washington 5.
FREE LIVING		
<i>Lasiurus borealis</i> , red bat.....	223	16 States (fig. 2).
<i>Lasiurus cinereus</i> , hoary bat.....	170	24 States (fig. 2).
<i>Lasionycteris noctivagans</i> , silver-haired bat.....	36	9 States (fig. 2). ⁵
<i>Lasiurus intermedius floridanus</i> , yellow bat ⁶	41	Florida 39 ⁴ , Texas 2.
<i>Lasiurus seminolus</i> , Seminole bat.....	26	Alabama 7, Florida 14, Georgia 3, Louisiana 1, Texas 1.

¹ The Provinces of British Columbia, reference 14, and Ontario, reference 15, have also reported rabies in big brown bats.

² In this report *T. brasiliensis mexicana* and *T. brasiliensis cynocephala* have been listed separately although they are subspecies of 1 species.

³ All *Myotis* species have been considered colonial

although some may be free living on some occasions.

⁴ Number reported by State, 1953-65.

⁵ Cases reported in British Columbia, reference 14.

⁶ First case of bat rabies reported in the United States was in a yellow bat, reference 1.

⁷ Closely related to the red bat and at times has been considered its subspecies, reference 16.

Figure 1. Rabies in three species of colonial bats, United States, 1953-65

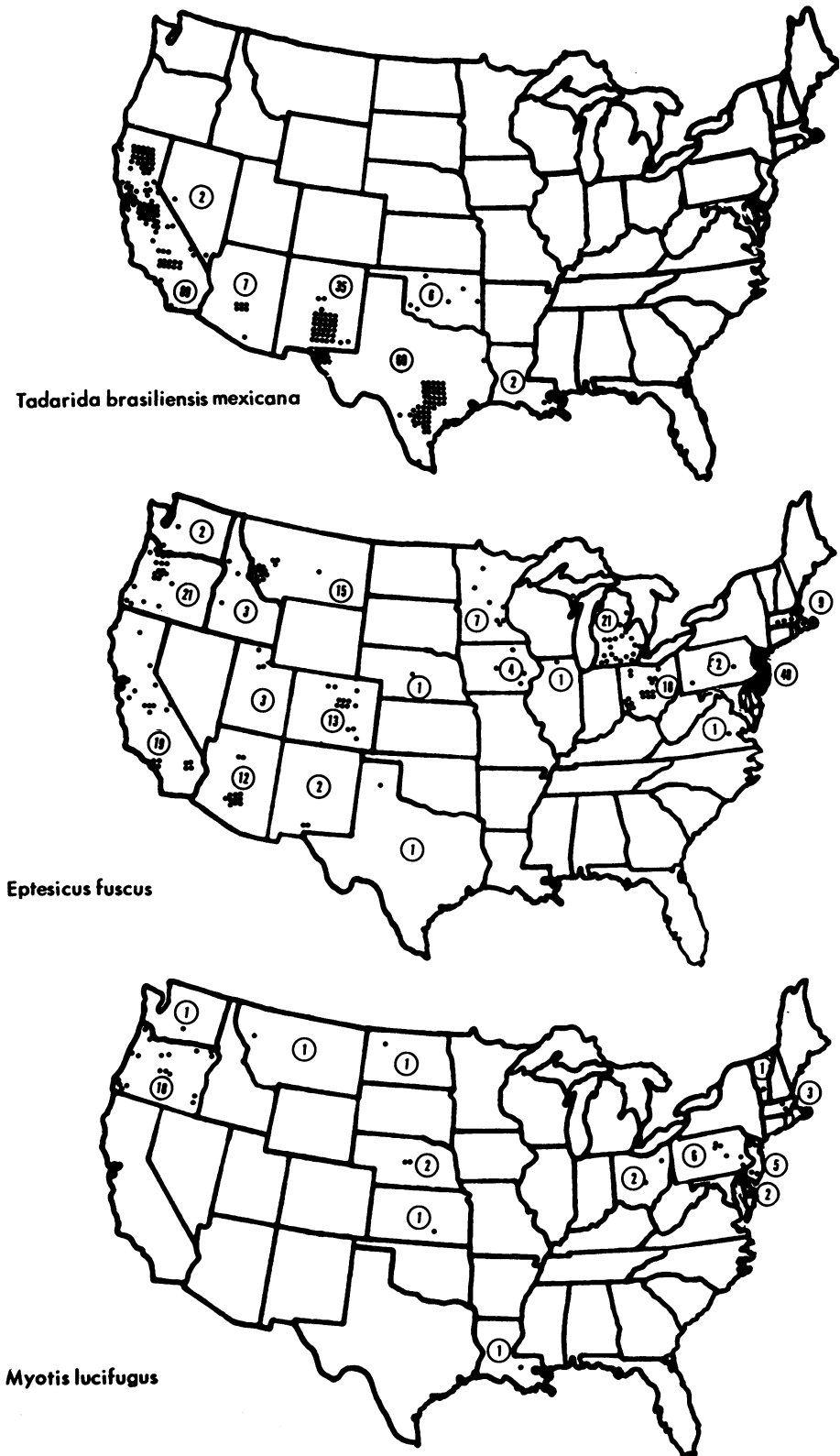
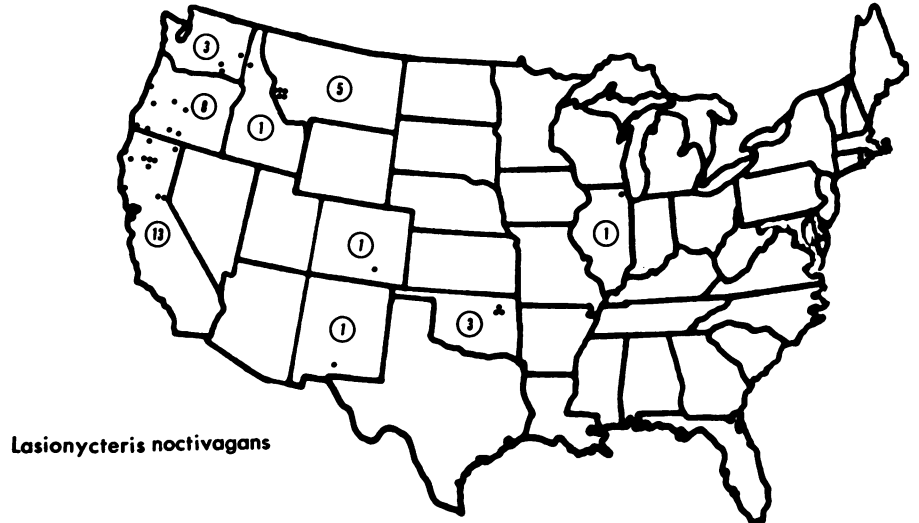
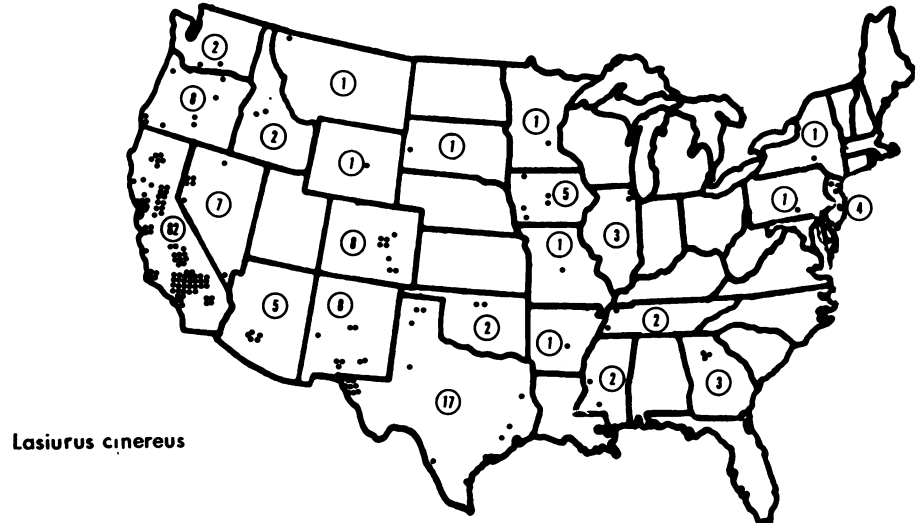
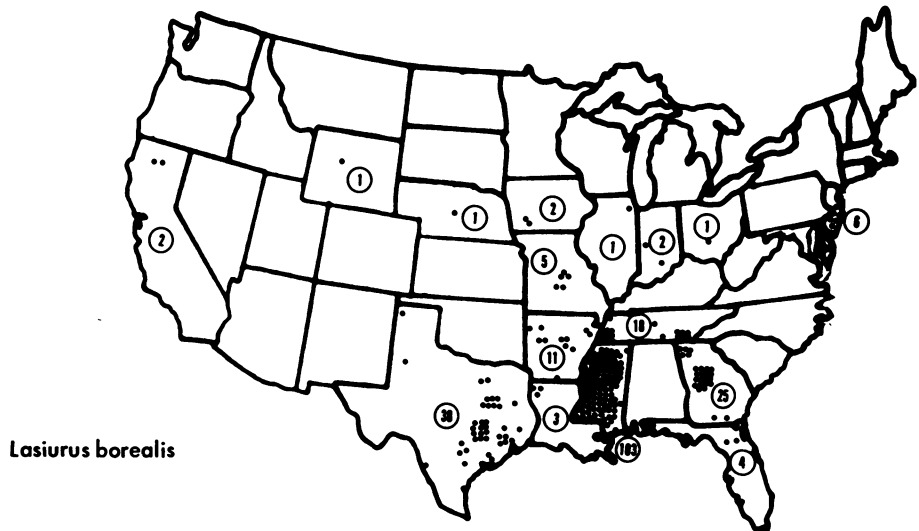


Figure 2. Rabies in three species of free-living bats, United States, 1953-65



of the problem. It should be emphasized that increased interest in bat rabies in certain areas (through the activities of research institutes, surveys, and publicity) often results in the discovery and reporting of more than the "usual" number of cases. Surveys have shown that rabid bats can be found throughout the country, in widely separated geographic areas, and that the disease occurs in many colonial and free-living species.

Interestingly, despite the comparatively large numbers of colonial bats—it has been estimated, for instance, that at least 60 million Mexican free-tailed bats can be found in Texas each year (12)—only 59 percent of the identified rabid bats in 1953–65 were of colonial species, while 41 percent were free living. An early Florida report (17) states: "There is the paradoxical situation that the lowest infection rate is in bats living in intimate contact in colonies where it would be assumed that the spread of infection would be facilitated; in contrast, the highest infection rate was in the free-living bats dispersed in nature." It should be noted that in the Florida study the free-living bats were submitted because of abnormal behavior.

In numerous field surveys a comparatively low prevalence of rabies infection has been noted in Mexican freetails, with a concurrent high prevalence of rabies serum-neutralizing antibody (5, 18, 19). This phenomenon has not been noted among terrestrial species (20). The relative resistance of the Mexican freetail to experimental rabies infection, moreover, has been seen in several studies (21–23). Violence was seldom noted after experimental infection by other than the intracerebral route (21), and aberrant behavior and aggressiveness are also apparently unusual in the field (12), although such behavior has been reported occasionally (24). Rabies appears to be enzootic in this species, perhaps because of a combination of factors, including population density, relative host resistance, and possible infection early in life by aerosol, bites, licking by mothers, or contact via urine or milk.

The geographic distribution of cases differed among at least some colonial and free-living species. Most rabid Mexican freetails were discovered in or near large urban centers (fig. 1), but rabid free-living red, hoary, and silver-

haired bats, although also often found in population centers (fig. 2), were distributed over a wider area within each involved State. There were 223 cases of rabies in the red bat, more than in any other species; an epizootic apparently occurred in this species in Mississippi during 1964 and 1965 (10), with most of the 103 cases in that State occurring from July through October. Violent biting among red bats has been observed (8, 25) and "may be suggestive of the manner in which rabies infection is transmitted from bat to bat in nature" (25).

Definite aberrant behavior and violent attacks on human beings have been noted with a free-living hoary bat (26), red bats (25), and yellow bats (1, 27). It is more common, however, for human beings to be exposed when they attempt to handle partially paralyzed or sick bats than by direct attack. The death of a woman resulting from exposure to a rabid silver-haired bat in 1958 (28) did not stem from an attack but occurred because she unnecessarily picked up a bat that was behaving abnormally.

There are indications that bats may not be an important source of rabies infection for terrestrial wildlife species. Many States have reported rabies in bats (29) without accompanying cases in terrestrial wildlife. The definitive answer as to whether rabies is transmitted from bats to terrestrial animals will probably be delayed until rabies in terrestrial wildlife has been drastically reduced.

Summary

Of the 1,869 rabid insectivorous bats reported from 47 States from 1953 through 1965, 65 percent were identified as to species. There was a notable concentration of rabid bats from May to October; 88.2 percent of rabid bats were reported during these months.

Of the identified bats, 59 percent were recorded in 20 colonial species, and the remaining 41 percent in five free-living species. The species with the widest geographic distribution was the free-living hoary bats, *Lasiurus cinereus*; cases were reported by 24 States. There were more cases (223) of rabies in the free-living red bat, *Lasiurus borealis*, than in any other species.

In the colonial Mexican freetail a comparatively low prevalence of rabies infection has been noted, together with a concurrent high

prevalence of rabies antibody; violence is rare in this species. Violence has, however, been observed in three free-living species—the hoary bat, the red bat, and *Lasiurus intermedius floridanus*, the yellow bat.

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Tearsheet Requests

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Bibliography on Suicide and Suicide Prevention. *PHS Publication No. 1799; 1969; by Norman L. Farberow; 203 pages; \$1.75.* Published by the National Clearinghouse for Mental Health Information, National Institute of Mental Health. Covers the years 1897 through 1967, arranged in two periods. The first period incorporates and expands the bibliography originally published in "The Cry for Help" (McGraw-Hill, Inc., 1961), 1897 through 1957. The second period covers works from 1958 through 1967. Includes an author and subject index for each section of the bibliography.

Macroeconomic Effects of Social Insurance on Aggregate Demand. *Social Security Administration, Office of Research and Statistics, Staff Paper No. 2. July 1969; By Wayne G. Vroman; 95 pages.* Presents a study adopted from the author's 1967 dissertation at the University of Michigan. Focuses on the macroeconomic aspects of the Old Age, Survivors, Disability, and Health Insurance (OASDHI) and State Unemployment Insurance. It assesses how changes in contribution rates, the taxable maximum per employee, and the level of benefits affect the level and stability of aggregate demand.

Health Manpower Source Book. Section 2. Nursing personnel. *PHS Publication No. 263; revised 1969; 144 pages; \$1.50.* Presents the most recent data available for the States and the nation in early 1969. Continues the time series that are not included in other publications and eliminates less pertinent information. Text is revised where necessary to discuss new definitions and new trends; similarities, differences, and limitations of nurse manpower surveys; and preliminary effects of legislation on nurse education and supply. Part V reflects the growth of practical nursing throughout the

country and part VI includes all nursing personnel who serve patients in hospitals. Part VII discusses the characteristics of nurses in public health and in occupational health and the growth of home care services. Part VIII presents new projections of need and supply of registered nurses, emphasizing the varying factors that affect these determinations, and discusses methodology for estimating both.

Statistics From the National Health Survey

PERSONS INJURED AND DISABILITY DAYS DUE TO INJURY, United States, July 1965-June 1967. *PHS Publication No. 1000, Series 10, No. 58; March 1970; 72 pages; 70 cents.*

BLOOD PRESSURE AS IT RELATES TO PHYSIQUE, BLOOD GLUCOSE, AND SERUM CHOLESTEROL, United States, 1960-1962. *PHS Publication No. 1000, Series 11, No. 34; October 1969; 29 pages; 40 cents.*

NEED FOR DENTAL CARE AMONG ADULTS, United States, 1960-1962. *PHS Publication No. 1000, Series 11; No. 36; March 1970; 22 pages; 35 cents.*

VISUAL ACUITY OF CHILDREN, United States. *PHS Publication No. 1000, Series 11, No. 101; February 1970; 35 pages; 45 cents.*

HEARING LEVELS OF CHILDREN, by Age and Sex, United States. *PHS Publication No. 1000, Series 11, No. 102; February 1970; 51 pages; 55 cents.*

ARRANGEMENTS FOR PHYSICIAN SERVICES TO RESIDENTS IN NURSING AND PERSONAL CARE HOMES, United States, May-June 1964. *PHS Publication No. 1000, Series 12, No. 13; February 1970; 42 pages; 50 cents.*

A STUDY OF INFANT MORTALITY FROM LINKED RECORDS: Method of study and registration aspects,

United States. PHS Publication No. 1000, Series 20, No. 7; February 1970; 44 pages; 50 cents.

CHILDREN OF DIVORCED COUPLES: United States, Selected years. *PHS Publication No. 1000, Series 21, No. 8; February 1970; 40 pages; 50 cents.*

Activities Supervisor's Guide. A handbook for activities supervisors in long-term care facilities. *PHS Publication No. 2021; 1970; 64 pages; \$1.* Covers, with illustrations, all aspects of patient activities, from the rationale for such programs to instructions for selected activities. Discusses such practical aspects of the activities supervisor's work as qualifications for this position, group and individual activities, and community and other resources. Appendix A deals with common health problems requiring long-term care, and appendix B lists pertinent books and periodicals. Manual should be useful as a reference for all professional personnel engaged in the rapidly growing field of long-term medical care.

The Dietitian and Continuity of Patient Care. 1970; 2-fold flyer. Published by the Community Health Service, Health Services and Mental Health Administration. Lists specific ways in which dietitians and public health nutritionists, with other team members, can contribute to continuous health care for the patient, emphasizing the importance of discharge planning. Includes a true-false quiz on continuity of patient care.

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