Bat Rabies in Georgia, 1956–65

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THE first laboratory-confirmed infection of rabies in an insectivorous bat was reported by Pawan (*1*) in a white bat, *Diclidurus alba*, in 1936. This white bat was among a group of insect-eating, fruit-eating, and blood-lapping species examined during the investigation of an outbreak of rabies in cattle and humans in Trinidad in 1932.

Rabies infection in an insectivorous bat from North America was first reported by Venters and associates (*2*) in a yellow bat, *Dasypterus floridanus*, killed near Tampa, Fla., in 1953. In the 13 years following (1953–65) rabies was diagnosed in one or more species of insectivorous bats from 47 States (personal communication, Dr. R. K. Sikes, Communicable Disease Center, 1966) and from two Provinces of Canada (*3*, *4*).

Rabies infection in an insectivorous bat from Georgia was first reported in a Seminole bat, *Lasiurus seminolus*, found dead on a street in Thomas County, by personnel of the Public Health Service's Newton Field Station in 1956 (personal communication, Dr. Douglas Hawkins, Newton Field Station, 1956).

In the 10 years following (1956–65) rabies was diagnosed in six species of bats and from 18 counties in the State.

This paper reviews the 36 cases of laboratory-confirmed rabies in 531 insectivorous bats examined in Georgia during the 1956–65 period.

Materials and Methods

The 531 bats examined came from two primary sources. Residents of Georgia submitted 313 bats through routine diagnostic facilities. All of the 36 bats eventually diagnosed as rabid were obtained this way. Two of these were initially taken to the Tennessee Department of Public Health Regional Laboratory in Chattanooga where the diagnosis was made. The carcasses were then forwarded to Atlanta for species identification and salivary gland examination (personal communication, L. V. Smith, Chattanooga Regional Laboratory, Tennessee Department of Public Health, 1965).

Field personnel collected the remaining 218 bats examined. Collections, confined almost exclusively to colonial species, were often prompted by complaints of bats inhabiting buildings, human exposures to bats, and discovery of infected bats in a county in which rabies had not previously been reported in these species.

Laboratory procedures. The initial rabies diagnostic procedure employed was microscopic examination of whole brain cross section impressions stained by Sellers' method. Negri-positive brain tissues were often injected intracerebrally into mice for additional diagnostic confirmation. Negri-negative brain tissues from bats that had bitten humans or had clinical signs suggestive of rabies were also selectively subjected to mouse inoculation tests.

When brain tissues of bats collected by field personnel between 1956 and 1960 proved to be Negri-negative, the tissues were often pooled (3–5 brains in each pool) for mouse inoculation tests. Since 1961 the fluorescent rabies

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antibody test has been used routinely in conjunction with microscopic examination and mouse inoculation of individual bat brain tissues in the diagnosis of rabies.

Intracerebral inoculation of mice was also used to demonstrate the presence of rabies virus in the salivary glands of selected specimens. No attempt was made to quantitate rabies virus in the brains or salivary glands of infected bats or to examine brown fat and other tissues for virus.

Species identification. Species identification of individual bats was based on gross physical characteristics including color, length, and distribution of pelage; relationship of tail and interfemoral membrane; dentition; and geographic distribution (*5–8*).

Bats whose size and dentition were within specified adult limits were designated as mature. Other specimens were designated as immature.

Results

A wide range of behavior was reported for the 36 rabid bats. Nineteen were found alive on the ground, apparently incapable of flight. These grounded bats were often aggressive, or perhaps defensive, when approached or manipulated. Six of the rabid bats were found dead on the ground; eight were either captured alive or brought dead into the yard by pet dogs or cats, and two made aggressive flying attacks on humans although no actual bites or contacts occurred. Two bats, a male and a female, were observed fighting in mid-air, captured after falling to the ground, and submitted for laboratory examination. Only the female was rabid.

Table 1. Species distribution of rabies infection in 531 bats examined in Georgia, 1956–65

Species	Number examined	Number rabid	Percent rabid
Colonial bats	303	4	1.3
Nycticeius humeralis (twilight bat)	172	2	1.2
Tadarida cynocephala (eastern free tailed bat)	81	1	1.3
Eptesicus fuscus (big brown bat)	32	0	0
Pipistrellus subflavus (southeastern pipistrelle bat)	7	0	0
Myotis austroriparius (southeastern Myotis)	6	1	16.6
Myotis grisescens (gray Myotis)	3	0	0
Myotis keenii (Keen's Myotis)	1	0	0
Myotis species	1	0	0
Noncolonial bats	228	32	14
Lasiurus borealis (red bat)	173	26	15
Lasiurus seminolus (Seminole bat)	27	3	11
Lasiurus cinereus (hoary bat)	15	3	20
Lasionycterus noctivagans (silver haired bat)	11	0	0
Corynorhinus macrotis (eastern big eared bat)	2	0	0
Total	531	36	6.7

The incidence of rabies, by species, in the 531 bats examined is given in table 1. The five colonial species accounted for 57 percent of the total examinations. However, the infection rate of the noncolonial bats was more than 10 times higher than that of the colonial bats.

Table 2. Rabies infection in 36 bats in Georgia by species, sex, and estimated stage of maturity, 1956–65

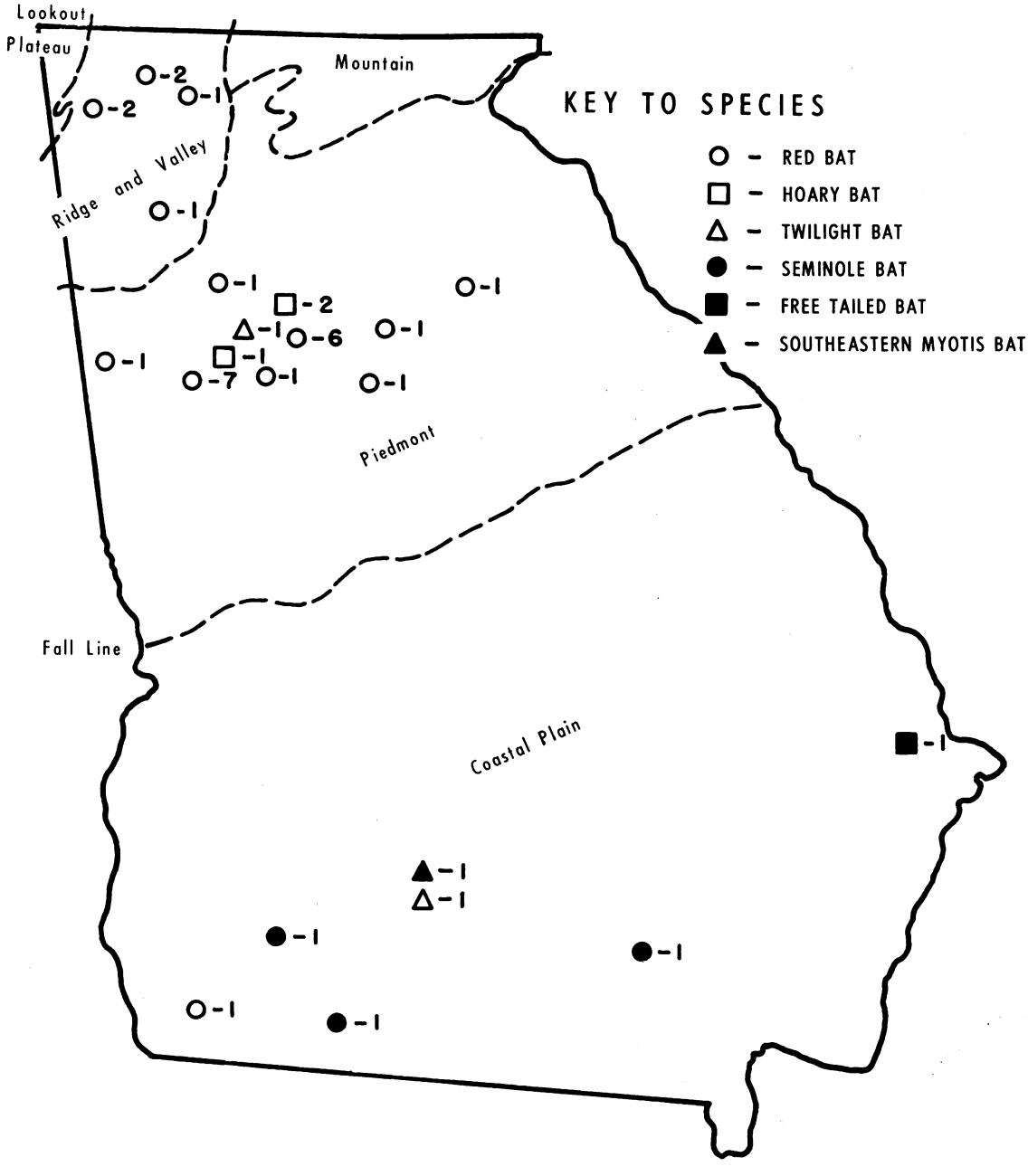
Species	Male		Female		Total
	Mature	Immature	Mature	Immature	
Lasiurus borealis	10	3	12	1	26
Lasiurus cinereus	1	----	2	----	3
Lasiurus seminolus	----	----	2	----	[1] 3
Nycticeius humeralis	1	----	1	----	2
Tadarida cynocephala	1	----	----	----	1
Myotis austroriparius	1	----	----	----	1
Total	14	3	17	1	36

[1] Includes 1 specimen with no data concerning sex or maturity.

The species, sex, and estimated stage of maturity of each of the 36 rabid bats is given in table 2. Noncolonial bats of the genus *Lasiurus* accounted for 32 (89 percent) of the 36 confirmed infections. Within the lasiurine group the red bat, *Lasiurus borealis*, was found to be the species most frequently infected with rabies. Twenty-six (64 percent) of the rabid bats were red bats. Rabies infection was equally distributed among male and female bats. Thirty-one of the 35 bats for which maturity data were available were mature specimens.

Golley (*7*) lists 9 genera and 15 species under the order *Chiroptera* reported to occur naturally in Georgia. Representatives of 12 of these 15 species were examined for rabies during the 10-year study period. Rabies was diagnosed

Figure 1. Geographic distribution of 36 cases of bat rabies in Georgia, 1956–65



in one or more individuals of 6 of these 12 species examined.

The geographic distribution of rabid bats is shown by species and county in figure 1. Approximately half of the cases were reported from the Metropolitan Atlanta area which consists in part of Clayton, Cobb, De Kalb, and Fulton Counties. The remaining cases were sporadically distributed in the Coastal Plain, Piedmont, and Ridge and Valley Provinces.

The monthly distribution of the 36 cases is shown in figure 2. On a calendar year basis the earliest reported case of bat rabies was on March 27 and the latest on November 5. More than 60 percent of the cases were reported during the 4-month period of July to October. A secondary peak of reported cases occurred in the spring.

The annual incidence of bat rabies showed considerable variation and was apparently influenced by both the species and number of bats examined in a given year. Reported cases ranged from a low of 1 rabid bat in 10 examined in 1959 to a high of 15 rabid bats in 159 examined in 1965.

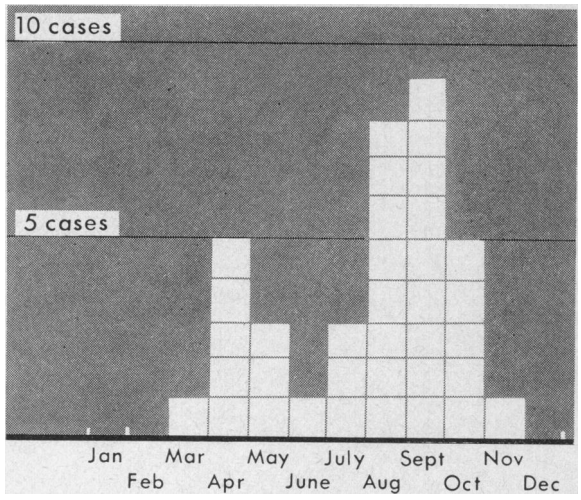
Table 3 summarizes the results obtained in the laboratory examination of brain tissues and salivary glands of rabid bats by the applicable diagnostic procedure. Negri bodies were observed in 33 (94 percent) of the 35 brain tissues examined by Sellers' method. During the same 10-year period, Negri bodies were demonstrated in brain tissues of 323 (89 percent) of the 362 rabid dogs examined by Sellers' method.

Rabies virus was demonstrated, by mouse inoculation tests, in the salivary glands of 12 (57 percent) of the 21 rabid bats examined. Rabies antigen was demonstrated in all of the 25 rabid bats examined by the fluorescent rabies antibody procedure since 1961.

Table 3. Results of laboratory examinations of tissues from 36 rabid bats in Georgia, 1956–65

Diagnostic procedure	Tissue examined	Number examined	Number positive for rabies
Microscopic examination.	Brain	35	33
Fluorescent rabies antibody.	do	25	25
Mouse inoculation	do	23	23
Do	Salivary glands.	21	12

Figure 2. Monthly distribution of 36 cases of bat rabies in Georgia, 1956–65



Discussion

Although the number of specimens described in this 10-year summary is limited, certain trends are apparent. Bat rabies in Georgia seems to be primarily associated with noncolonial adult lasiurine bats during the milder seasons of the year. This period of highest recognized incidence coincides with a period of relatively vigorous activity for most bats. In the early summer the rapidly developing young are weaned and become self-sufficient fliers and feeders. Late summer is associated with breeding activities, premigration wanderings, and migration in many species.

Reporting of bat rabies seems to be strongly influenced by the availability of interested observers. The large number of cases reported from urban areas suggests that the density of the human population may increase the opportunity of seeing a bat acting unusually. Announcement of cases in public media also increases general awareness and interest in bat rabies and stimulates the submission of specimens to the laboratory.

Rabies is thought to be transmitted in nature primarily by the bite of an infected animal.

The relatively high population density of colonial bats as compared to noncolonial bats should increase the opportunity for transmission of rabies by bite and nonbite (*9*) routes. The findings of this review and of previous investigations in Florida (*10*) do not corroborate this assumption. The rabies infection rate in noncolonial bats was found to be more than 10 times higher than in colonial bats in Georgia and more than 7 times higher in Florida.

Bat rabies in Georgia has occurred predominantly in counties that were free of reported rabies in terrestrial mammals. Only 7 of the 36 cases occurred in counties with rabies diagnosed in other animals during the same calendar year. No epidemiologic evidence exists to date which suggests the transmission of rabies by bats to other animals in Georgia.

The historical references cited by Pawan (*1*) indicate that vampire bats were associated with disease and death in South and Central America at the time of the Spanish colonization in the 18th century. The recently recognized and widespread distribution of rabid insectivorous bats in the United States is perhaps suggestive of a new ecological facet of the disease.

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Experimental Vaccine Against Pneumonia

An experimental vaccine against primary atypical pneumonia that has given significant protection against experimentally produced illness has been tested by Dr. Charles B. Smith, Dr. William Friedewald, Dr. Robert Alford, and Dr. Robert M. Chanock of the National Institute of Allergy and Infectious Diseases (NIAID), Public Health Service. Results of the early trials were reported at the New York Academy of Science Conference on Mycoplasma, May 10–13, 1966.

The vaccine, which consists of a formalin-inactivated suspension of *Mycoplasma pneumoniae* organisms, was given to 19 volunteers who lacked prior antibody to the organism. Ten developed antibody and when these 10 were later experimentally infected with *M. pneumoniae*, only 1 became ill. Illness occurred in 10 of 13 control subjects who had not received the vaccine.

The killed vaccine, prepared by Chas. Pfizer & Co., Inc., is currently being tested on a larger scale in military populations under the sponsorship of NIAID's collaborative vaccine development program. The research group is also doing studies directed toward development of a live vaccine. *M. pneumoniae* infections are one of the greatest health problems in the armed services and are the cause of up to 50 percent of pneumonia cases in the 20–30 year age group in the general population.

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