# Mongoose Rabies in Puerto Rico

By ERNEST S. TIERKEL, D.V.M., M.P.H., GUILLERMO ARBONA, M.D., M.P.H., ALFONSO RIVERA, D.V.M., and ABEL de JUAN, M.D., M.P.H.

Rabies has been classified into two epidemiological types, the sylvatic or campestral type in wildlife and the disease as it is found in domestic dogs (*1*). In certain rural areas where rabies is enzootic, this epidemiological differentiation may not always be so discrete. The factors which influence the presence of both types simultaneously in a given area are the amount of contact between wild species and domestic dogs, the relative population sizes of both groups, and the immunity level of the domestic dog population.

Although the disease in dogs is still the principal rabies problem in most countries of the world today, mass canine immunization practices and other effective measures have brought about increasing control and eradication. Success with dogs has focused attention on the importance of various species of wild fauna in the spread and transmission of the disease.

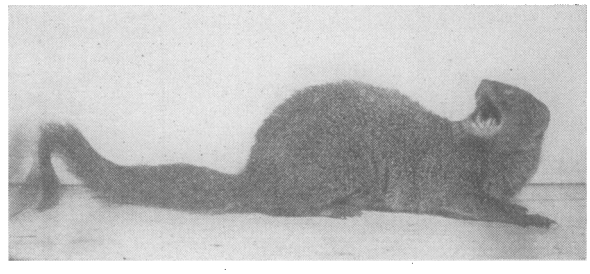
In the Americas, rabies has been diagnosed sporadically in practically every kind of susceptible wild animal. In the United States, the principal large-scale sylvatic vectors of the disease have been the fox, genus *Vrocyon;* the skunk, genus *Mephitis* and genus *Spilogale;* and the coyote, *Canis latrans.* In South America, Central America, Trinidad, and Mexico, the vampire bat, *Desmodus rotundus*, is an important transmitter of rabies.

The first major outbreak of rabies in an area of the Western Hemisphere, attributed to the Indian mongoose, *Herpestes javanicus*, is presented in this report.

*Dr. Tierkel is from the veterinary public health branch of the Communicable Disease Center, Public Health Service, Atlanta, Ga. Dr. Arbona and Dr. de Juan are from the Puerto Rico Health Department's division of public health and Dr. Rivera, from the veterinary division of the Puerto Rico Department of Agriculture, San Juan, P. R.*

## History of Rabies in Puerto Rico

Information on the early history of rabies in Puerto Rico is restricted, for the most part, to the laws for controlling the disease. The first edict, issued in 1841, ordered owners to kill immediately any animals showing signs of hydrophobia or any other contagious disease (*2–4*). This law was reprinted in 1874 after an outbreak of rabies in Bayamon, and in 1875



**The Indian mongoose,** *Herpestes javanicus* **(family Viverridae), is a small carnivore, with a body 14 to 17 inches long and a tail 11 to 13 inches long. It averages about 1.5 pounds in weight. Its hair coat varies from brindle to tan-gray in color. An extraordinarily wily animal, its ferocity is matched only by its speed of movement, and it is famous for its ability to attack and overcome snakes, even the poisonous cobra in its native India. Mongooses are largely migratory in habit and have no specific home range. The average daily foraging range is estimated to be one-eighth to one-fourth of a mile (*11*). In its daily movements it prefers natural runs which are fairly well covered by overgrown brush.**

after several cases were found at different places on the island.

In 1896, the occurrence of two human cases of rabies motivated the establishment of a histochemical-bacteriological institute at the city of Mayaguez (*5*). After the American occupation, general order No. 221, dated December 19, 1899, contained the following: "Any animal suspected of having hydrophobia should be killed instantly and burned or buried in a deep grave" (*2*).

From 1910 to 1949, 21 cases of rabies diagnosed by laboratory examination of suspected specimens (table 1) were reported by the Puerto Rico Department of Health and 1 case by the School of Tropical Medicine (*6*).

Although details regarding types of affected animals are not available for all the years, the only species mentioned in the literature are dogs and various types of farm animals. Until the present outbreak, Puerto Rico had been considered as one of the world's rabies-free areas, no case of rabies having been reported on the island since 1933.

**Table 1. Laboratory examinations for rabies and reports of positive diagnosis by the Puerto Rico Department of Health**

| Fiscal year | Total specimens examined | Rabies positive |
|---|---|---|
| 1910–11 | (1) | (1) |
| 1911–12 | 9 | 4 |
| 1912–13 | 17 | 2 |
| 1913–14 | 25 | 1 |
| 1914–15 | (2) | (2) |
| 1915–16 | (1) | (1) |
| 1916–17 | (1) | (1) |
| 1917–18 | 12 | 4 |
| 1918–19 | 12 | 3 |
| 1919–20 | (1) | (1) |
| 1920–21 | (1) | (1) |
| 1921–22 | 6 | 1 |
| 1922–23 | (2) | (2) |
| 1923–24 | (2) | (2) |
| 1924–25 | 5 | 1 |
| 1925–26 | 5 | 1 |
| 1926–27 | (2) | (2) |
| 1927–28 | (2) | (2) |
| 1928–29 | 7 | 4 |
| 1929–30 | 9 | 0 |
| 1930–31 | 9 | 0 |
| 1931–32 | 7 | 0 |
| 1932–33 | (2) | (2) |
| 1933–34 [3] | 1 | 1 |
| 1934–35 | (1) | (1) |
| 1935–36 | (1) | (1) |
| 1936–37 | (1) | (1) |
| 1937–38 | 3 | 0 |
| 1938–39 | 2 | 0 |
| 1939–40 | 3 | 0 |
| 1940–41 | (1) | (1) |
| 1941–42 | (1) | (1) |
| 1942–43 | (1) | (1) |
| 1943–44 | (1) | (1) |
| 1944–45 | (1) | (1) |
| 1945–46 | (1) | (1) |
| 1946–47 | (1) | (1) |
| 1947–48 | 15 | 0 |
| 1948–49 | 25 | 0 |
| Total | 172 | 22 |

[1] None recorded.
[2] Data not available.
[3] Examination performed at School of Tropical Medicine, San Juan.

## The Present Outbreak

The first known case of the present outbreak was diagnosed in a dog March 22, 1950, on a small farm in Barrio Monacillo of the municipality of Rio Piedras. The animal had shown typical clinical symptoms and had bitten several persons and animals on the farm. A hog, bitten by this first rabid dog, subsequently died of rabies. All persons bitten received the complete series of Semple antirabic vaccinations. The next 3 months marked the occurrence of seven cases: four dogs, one hog, one calf, and one cat. The bizarre geographic distribution involved five widely scattered foci of infection including two barrios in Rio Piedras and one each in Ciales, Toa Alta, and Ponce. The diagnosis of these initial cases was confirmed by the Communicable Disease Center laboratory at Montgomery, Ala., and the School of Tropical Medicine, San Juan, P. R.

Thorough investigation revealed that all of the cases were rural and in no instance was there evidence that the involved foci had as a source of infection any one animal contact which was common to all. Nor was there any evidence to support the hypothesis that any one or several of the cases had stemmed from a recent importation of infected pet animals. The striking fact about the investigation was that all of the originally infected dogs and the cat in the five foci had fought with mongooses within a period varying from 2 weeks to 2 months before clinical illness. This was the first epidemiological suggestion that rabies might be present in the mongoose population and that it possibly was being transmitted from the mongoose to domestic animals.

Several mongooses were trapped and exposed to experimental infection in order to determine

**Table 2. Rabies cases in Puerto Rico diagnosed by laboratory examination, March 22, 1950, to September 18, 1951**

| Animals | 1950 | | | | | | | | | | 1951 | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | March | April | May | June | July | August | September | October | November | December | January | February | March | April | May | June | July | August | September | |
| Mongoose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 2 | 5 | 0 | 2 | 1 | 8 | 2 | 4 | 1 | 37 |
| Dog | 1 | 1 | 1 | 1 | 0 | 0 | 3 | 2 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 18 |
| Other [1] | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 0 | 1 | 0 | 2 | 3 | 3 | 3 | 2 | 1 | 23 |
| Total | 1 | 2 | 3 | 1 | 0 | 0 | 3 | 8 | 6 | 6 | 6 | 6 | 0 | 4 | 4 | 11 | 8 | 6 | 3 | 78 |

[1] Cats, cattle, horses, goats, swine.

their relative susceptibility and to study the clinical pattern of rabies in these animals. Infected brain suspensions were inoculated intramuscularly (total dose of 0.4 cc., 10-percent suspension, intramasseter) with several of the Puerto Rican strains of virus obtained from the original cases. Two of four inoculated mongooses became infected after incubation periods of 22 and 23 days, respectively. They exhibited progressively typical, if exaggerated, symptoms of furious rabies which lasted 4 and 6 days, respectively, until death.

Like most other wild animals, the normal mongoose has a natural fear of man and many other animals. When it is cornered or caged, however, it becomes extremely vicious. At the height of clinical rabies, it exhibits extraordinary symptoms of hyperexcitability and ferocity. Both of the infected animals suffered broken teeth, lacerated muzzles, and severe oral trauma from biting at the wire and frame walls of their cages. The terminal paralysis which ensued was swift and overwhelming. Negri bodies were demonstrated upon direct microscopic examination, and virus was isolated from the brains and salivary glands of both animals.

Pilot trapping operations were then set up in and around the reported infected areas. The first two naturally infected mongooses were found October 18 and 20, 1950, at Fort Buchanan in the municipality of Bayamon. These had been captured after unprovoked attacks on personnel and animals on the military reservation.

Stimulated by a campaign of public information, increasing reports of clinically rabid mongooses that exhibited signs of unusual bravado and ferocity began to come into the health department. Corresponding increases in the number of mongoose brains submitted to the laboratory followed. From the onset of the outbreak March 22, 1950, to September 18, 1951, a total of 78 cases of rabies was confirmed by laboratory examination. These included 37 cases in mongooses, 18 cases in dogs, and 23 cases in cats and livestock (table 2). All of the cases were restricted to rural areas and were distributed throughout the island with no significant geographic pattern. Since the beginning of the outbreak, 104 treatments of Semple human antirabic vaccinations have been administered by the health department. The chain of events with regard to the occurrence and spread of the infection established it as primarily an epizootic of rabies in the mongoose population with secondary transmission to dogs and other domestic animals. There is no evidence that the disease has, as yet, become entrenched in the canine population with urban involvement and significant dog-to-dog transmission. Most of the livestock cases which were investigated were caused by exposure from rabid mongooses.

Immediately after the outbreak, emergency control measures were put into effect to prevent the spread of the disease in the large and susceptible dog population. These programs included a thorough census of all dogs, the collection, impoundment, and humane destruction of all ownerless and stray dogs, and the vaccination of all other dogs in the original zones of infection which included an area covering a radius of 3 to 5 kilometers from the focal case. Since Rio Piedras and San Juan were not far

from this area, a similar campaign was carried out in these cities.

As the reports of cases began to come in from other parts of the island, the same intensified control, with emphasis on dog vaccination, was extended to all affected areas. Although mongoose and livestock cases continued to occur in some of the previously infected areas, in no instances were there any cases in dogs in areas where a canine rabies-control program had been conducted. Further evidence of the effectiveness of measures to prevent the disease from becoming established in the dog population is demonstrated by the fact that from January 29 to July 5, 1951, there were no cases reported in dogs, while there were 17 cases in mongooses, 3 in cattle, 4 in horses, and 2 in goats.

Plans were drawn to control the disease in the mongooses of the island by a mongoose trapping program. Two types of traps were put into use, one made of wood and hardware cloth and the other, of simpler design, entirely of wood. Both types employ the principle of placing an attractive bait on a device inside the trap which, when disturbed, springs a trap door shut. Approximately 3,000 traps have been constructed as models and distributed to centers throughout the island. An island-wide program now in operation consists primarily of the training and education of the public for the trapping of mongooses in rural areas of the island. Training centers have been established and training carried out by local health units, 4-H clubs, and agricultural extension services.

## Characteristics and Habitat

The mongoose is not native to Puerto Rico or to the other islands of the Carribean. It was imported from India to Jamaica during the middle of the nineteenth century by sugar planters to destroy the rats which were causing large economic losses in the cane fields. Jamaica apparently served as a distributing point for far-flung exportation. They were introduced into Puerto Rico between 1870 and 1877 (*7*) and into Hawaii about 1883 (*8*).

The mongoose has been of little or no value as a biological means of rat control, Spencer points out in his studies in the Territory of Hawaii. In comparing the rat populations of the principal islands on which the mongooses were introduced with those of the islands of Lanai and Kauai where they were not released, he shows that the over-all rat population densities remained the same. This species of mongoose is diurnal in habit while the rat is nocturnal. Their paths rarely cross. Furthermore, Spencer says, the mongoose is as much of a scavenger as a predator, has no aversion to feeding on carrion, and will try to obtain his food in the easiest way possible (*9*).

The experience in the West Indies has been much the same, and over the years it was found that the mongoose, rather than being an asset, has been a liability. It has greatly reduced, and even exterminated, most species of ground-nesting birds by preying on eggs, nestling birds, and adults. It has also reduced great numbers of beneficial insectivorous lizards and toads and has been a serious pest of poultry by decimating young chicks and eggs. As a result, most of the islands have, from time to time, attempted to initiate mongoose reduction programs, usually by some kind of bounty scheme, with varying degrees of success (*10*). Now that the animal has been proved an important disease vector, interest in devising effective reduction programs has been revived.

Although this species abounds in India, it has not been listed as an important vector of rabies in that country, where the jackal is the principal wild host and transmitter of the disease (*12*). However, in South Africa, other species of the family Viverridae are described as important vectors of rabies. These veld carnivora include the yellow mongoose, *Cynicits penicillata;* the suricate, *Suricata suricatta;* the small gray mongoose, *Myonax pulverulentus;* and the genet cat, *Geneta felina.* The first two are burrowing animals while the latter two are not (*13–15*). The South African types of mongooses often are referred to as meercats.

## Summary

1. Puerto Rico is experiencing an outbreak of rabies which began with the first reported case March 22, 1950.

2. This was the first case of rabies reported

since October 15, 1933, with only sporadic cases having been diagnosed in the years before that time.

3. A thorough study of the outbreak has established it as primarily an epizootic of rabies in the mongoose population of the island with secondary transmission to dogs and other animals.

4. This is the first major outbreak of rabies in the Western Hemisphere attributed to the Indian mongoose, *Herpestes javanicus.*


#### ACKNOWLEDGMENTS

The authors express their appreciation to Health Commissioner Juan A. Pons for making this study possible; to Martha Eidson, Dr. Enrique Koppisch, Manuel Betances, and Antonio Puras for their assistance in the diagnostic phases of this work; to Dr. Enrique Toro, Jr., Dr. Aurelio Malaga Alba, and William Buren for their active participation in the control activities; to George A. Seaman, Nelson Biaggi, Luis Hernandez Aquino, José Ramos, and Dr. Virgilio Biaggi for supplying important sources of historical and scientific information.


#### REFERENCES


(*1*) Johnson, Harald N.: Methods of rabies control. Proc. 4th Internat. Cong. Trop. Med. 1: 587–594 (1948).

(*2*) Bagué, Jaime: Personal communication.

(*3*) Bando de Policia y Buen Gobierno de la Isla de Puerto Rico 1841, art. 83.

(*4*) Bando de Policia y Buen Gobierno de la Isla de Puerto Rico No. 76 de 1849, art. 196.

(*5*) Costa-Mandry, O.: El laboratorio biologico como factor de progreso medico en Puerto Rico. Bol. Asoc. mèd. de Puerto Rico 24: 425–449 (1932).

(*6*) Reports of the commissioner of health to the governor of Puerto Rico, 1910–11 through 1948–49.

(*7*) Archives of the assistant engineer, Porto Rico district, San Juan, P. R., 1912.

(*8*) Doty, R. E.: Rat control on Hawaiian sugar cane plantations. Hawaiian Sugar Planters' Record 49: 71–239 (1945).

(*9*) Spencer, H. J.: Unpublished report on Hawaiian rat control project, U. S. Fish and Wildlife Service, Dec. 1935–June 1938.

(*10*) Myers, J. G., and Urich, F. W.: The mongoose. Trop. Agriculture 8: 94–97 (1931).

(*11*) Spencer, H. J.: Mongoose control research project. Unpublished report. U. S. Fish and Wildlife Service, Virgin Islands, October–November 1950.

(*12*) Fagan, Raymond: Rabies in animals other than dogs. CDC Bull. 9: 10, 11 (Oct. 1950).

(*13*) Snyman, P. S., and Thomas, A. D.: The carriers of rabies in South Africa. *In* Congrès International de médicine tropicale et d'Hygiène, 3d, Amsterdam, 1938. Acta Conventus Tertii de Tropicis Atgue Malariae Morbis, pars. I, pp. 616–638.

(*14*) Neitz, W. D., and Marais, I. P.: Rabies as it occurs in the Union of South Africa. 18th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, 1932.

(*15*) Snyman, P. S.: The study and control of the vectors of rabies in South Africa. Onderstepoort. J. Vet. Sc. & Animal Indust. 15: 9–140 (1940).


## Heart Center for Children

Plans for a new center to serve children with congenital heart malformations have been approved by the Children's Bureau, Federal Security Agency. This center, the second regional heart program of its kind, will be located in California and will serve children in that State, Arizona, Idaho, Nevada, Alaska, and Hawaii.

According to arrangements completed with the California State Department of Public Health, the center will use four hospitals, three in San Francisco, the Mt. Zion, Stanford, and University of California, and the Children's Hospital in Los Angeles.

The first heart center, approved last August, is in Connecticut and serves children from Connecticut and Rhode Island. Studies are now being made to determine the best locations for centers in the South, East, Midwest, and Southwest.