Reprinted from The American Journal of Tropical Medicine and Hygiene
Vol. 25, No. 3, May 1976
p. 407–409
Printed in United States of America

TRYPANOSOME INFECTIONS IN THE MARMOSET (*SAGUINUS GEOFFROYI*) FROM THE PANAMA CANAL ZONE*

OCTAVIO E. SOUSA AND GARY A. DAWSON†
Gorgas Memorial Laboratory, P.O. Box 2016, Balboa Heights, Canal Zone

Abstract. From August 1973 through May 1974 a total of 148 marmosets (*Saguinus geoffroyi*) were examined for blood parasites. Parasites were detected in 93.2% of the monkeys. Direct examination of blood revealed 82.4% infected with trypanosomes; *Trypanosoma cruzi* was seen in 1.3% of the animals examined, *T. minasense* in 52.7% and *T. rangeli* in 25%. However, the use of several diagnostic tests (direct microscopic examination, hemoculture, xenodiagnosis, and animal inoculation) in 15 marmosets revealed *T. cruzi* in 40%, *T. rangeli* in 93%, and *T. minasense* in 87%. The high rate of infection among marmosets suggests that they are important natural hosts of *T. cruzi* and *T. rangeli* in the Panama Canal Zone.

Previous reports on the blood parasites of titi marmosets (*Saguinus geoffroyi*) collected in the Republic of Panama have indicated that a high percentage of these primates are infected with trypanosomes and microfilariae.[1,2] Sousa et al.,[3] employing hemoculture techniques, found *Trypanosoma cruzi* in 12.2% of 408 marmosets collected at various localities in Panama and Colon provinces. *Trypanosoma rangeli* was detected in 55.8% of the marmosets studied. Prior to the present investigation, only one marmoset from the Canal Zone had been examined.

The only known vector of *T. rangeli* in Panama is *Rhodnius pallescens*. The relationship of the marmoset with this triatomine in the forest habitat, and its significance in the epidemiology of human trypanosomiasis, have not been defined. Marmosets are frequently kept as house pets in rural areas of Panama, and they are known to move as groups to the peridomiciliary areas of suburban communities, particularly when attracted by backyard fruit trees.

The purpose of this paper is to report the prevalence of *T. cruzi* and *T. rangeli* in *S. geoffroyi* from the Panama Canal Zone. This is part of a study on the ecology and behavior of the marmoset, which may serve to delineate the epidemiological factors concerned in the transmission of trypanosomes among monkeys, and ascertain the marmoset's significance as a reservoir host of human trypanosomiasis.

MATERIALS AND METHODS

The marmosets examined came from two sources: 1) the Rodman area, a 1,015 hectare reserve administered by Gorgas Memorial Laboratory for biomedical field studies. This area is located approximately 6 km west of Balboa, Canal Zone. All marmosets from Rodman were live animals which had been trapped for radiolocation telemetry and behavioral studies; 2) a collection of 131 marmosets obtained at the rate of five animals biweekly from areas peripheral to Rodman. The exact collecting locality was that area of the Canal Zone west of the Panama Canal and south of a line extending due west from Paraiso, Canal Zone, to the boundary with the Republic of Panama. The collecting area is adjacent to three military posts and several small communities.

Blood samples were obtained from a vein, ear lobe, or foot pad. Giemsa-stained, thick and thin blood smears plus blood samples in microhematocrit capillary tubes, were examined microscopically for blood parasites. To determine the characteristics of the trypanosomes found in the marmoset, 15 live animals were taken to the laboratory where they underwent a parasitological examination involving direct observations, hemoculture, xenodiagnosis, and mouse inoculation. The techniques and criteria used for the identification of the trypanosomes have been reported previously.[3]

RESULTS AND DISCUSSION

From August 1973 through May 1974 a total of 148 *S. geoffroyi* were examined for trypano-

Accepted 8 November 1975.

* This work was supported in part by Grant No. HE 10689 from the National Heart and Lung Institute, National Institutes of Health, Bethesda, Maryland.

† Present address: Michigan State University, The Museum, East Lansing, Michigan 48824.

TABLE 1

Blood parasites of 148 marmosets (Saguinus geoffroyi) *collected on the Pacific slope of the Panama Canal Zone, 1973–1974*

Parasites	Animals infected	
	Number	Percent
Total positive*	138	93.2
Trypanosomes	122	82.4
Microfilariae	108	73.0
Mixed infections	93	62.8
Trypanosoma minasense	78	52.7
T. rangeli	37	25.0
T. cruzi	2	1.3
T. cruzi and *T. rangeli*	1	0.7
T. rangeli and *T. minasense*	2	1.3
Trypanosoma sp.	8	5.4

* As determined by direct microscopic examination of blood films (thick and thin smears).

TABLE 2

Results of diagnostic procedures for the trypanosomes of Saguinus geoffroyi

Type of test	No. animals infected with		
	T. cruzi	*T. rangeli*	*T. minasense*
Direct blood examination	0	8 (57.1)*	13 (100.0)
Animal inoculation	1 (16.6)	0	0
Hemoculture	2 (33.3)	12 (87.8)	0
Xenodiagnosis	6 (100.0)	13 (92.8)	0
Infections detected	6	14	13
Total animals examined	15	15	15
Percent positive	40.0	93.3	86.7

* Number in parentheses indicates percent effectiveness of test in demonstrating natural infections in the 15 animals studied.

somes and microfilariae. Blood parasites were detected in 93.2% of the marmosets, trypanosomes were found in 82.4%, and microfilariae in 73.0% (Table 1). The infection rate with *T. cruzi*, as determined through direct blood examination, was only 1.3%, while *T. rangeli* was detected in 25.0% of the marmosets. Most of the trypanosomes in smears and capillary tubes were identified as *T. minasense*.

Due to the low sensitivity of the direct blood examination technique for the detection of *T. cruzi* and *T. rangeli*, the trypanosomes of 15 animals were intensively studied in the laboratory. The results of xenodiagnosis, hemocultures, and animal inoculation in each animal showed that 6 marmosets (40%) were infected with *T. cruzi*, 14 (93.3%) carried *T. rangeli*, and 13 (86.7%) were positive for *T. minasense*. The animals examined included 11 males (5 adults, 6 juveniles) and 4 females (3 adults and 1 juvenile). Three procedures were useful to differentiate the trypanosomes, and the sensitivity of the technique varied according to the species involved. Xenodiagnosis using *Rhodnius prolixus*, *R. pallescens*, or *R. neglectus* proved to be most practical for the detection of *T. cruzi* and *T. rangeli* (Table 2). Hemocultures were highly effective for the isolation of *T. rangeli*, but less so in the case of *T. cruzi* (33.3% of positives). Neither xenodiagnosis or hemoculture was of value in the diagnosis of *T. minasense*, which was seen only by direct blood examination.

These results further support the proposition that the titi marmoset is an important host of *T. cruzi* and *T. rangeli* in Panama, including the Canal Zone. The fact that 40% of the monkeys were found positive for *T. cruzi* through xenodiagnosis should be considered significant in the evaluation of the marmoset as a primary reservoir host of Chagas' disease in certain areas of Panama. The presence of *T. rangeli* in 93.3% of the marmosets, determined by xenodiagnosis and hemoculture, strongly suggests a close association between marmosets and *R. pallescens*.

The actual vector-host relationship, and transmission of *T. rangeli* among marmosets, need clarification. All blood culture isolates of *T. rangeli* developed metacyclic trypomastigotes in the salivary glands of *R. pallescens*, but not in *Triatoma infestans* and *R. neglectus*, in which infections progressed only into the hemolymph. The course of development of *T. rangeli* in the sylvatic triatomines of Panama must be elucidated to evaluate their possible role as local vectors.

Rhodnius pallescens, the only known naturally-occurring vector of *T. rangeli* in Panama, is also the most important vector of Chagas' disease in rural areas of Central Panama.[1-4] Since *R. pallescens* is not well adapted to domiciliary conditions, it is likely that human infections are the result of contact with triatomines infected from sylvatic or peridomiciliary hosts, e.g., the marmoset and other wild animals. Under these conditions, noncommensal reservoir hosts may be more important sources of infection for man and his domestic animals than the house rat (*Rattus rattus*), a species which lives in rural Panamanian

houses and which exhibits a high incidence of parasitism by *T. cruzi*.[5]

The hypothesis that ingestion of infected triatomines by marmosets may be responsible for the high incidence of *T. cruzi* infection in the latter was tested through the examination of dietary evidence. In examining the stomach and intestinal contents of 131 *S. geoffroyi*, not one triatomine was found. In fact, only five tamarins in the sample had eaten hemipterans of any type. Three were reduviids; the other two were not identifiable. Hemipterans formed only 0.1% of the volume of insects taken by marmosets, and occurred in only 3.8% of the sample. They are common in the thick foliage favored by marmosets, particularly during the dry season, when they are one of the three most abundant insect orders found in the vegetation.[6] It would appear then, when comparing usage to availability, that marmosets avoid eating hemipterans. It thus seems unlikely that ingestion of triatomines is a significant method of *T. cruzi* transmission among marmosets in Panama.

REFERENCES

1. Pipkin, A. C., 1968. Domiciliary reduviid bugs and the epidemiology of Chagas' disease in Panama (Hemiptera: Reduviidae: Triatominae). *J. Med. Entomol., 5:* 107–124.
2. Sousa, O. E., 1972. Anotaciones sobre la enfermedad de Chagas en Panamá. Frecuencia y distribución de *Trypanosoma cruzi* y *Trypanosoma rangeli*. *Rev. Biol. Trop., 20:* 167–179.
3. Sousa, O. E., Rossan, R. N., and Berg, D. C., 1974. The prevalence of trypanosomes and microfilariae in Panamanian monkeys. *Am. J. Trop. Med. Hyg., 23:* 862–868.
4. Sousa, O. E., and Johnson, C. M., 1973. Prevalence of *Trypanosoma cruzi* and *Trypanosoma rangeli* in triatomines (Hemiptera: Reduviidae) collected in the Republic of Panama. *Am. J. Trop. Med. Hyg., 22:* 18–23.
5. Edgcomb, J., and Johnson, C. M., 1970. Natural infection of *Rattus rattus* by *Trypanosoma cruzi* in Panama. *Am. J. Trop. Med. Hyg., 19:* 767–769.
6. Janzen, D. H., and Schoener, T. W., 1968. Differences in insect abundance and diversity between wetter and drier sites during a tropical dry season. *Ecology, 49:* 98–110.