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HOST FEEDING PROFILES OF *RHODNIUS PALLESCENS* (HEMIPTERA: REDUVIIDAE) IN RURAL VILLAGES OF CENTRAL PANAMA*

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Abstract. *Rhodnius pallescens*, reported to be the principal vector of Chagas' disease in central Panama, has been shown to feed on opossums, anteaters, sloths, rodents, birds and, rarely, lizards in sylvatic habitats in this country; however, the extent of its anthropophagic affinities in rural areas has never been determined. The host selections of 1,340 *R. pallescens* from domestic and peridomestic habitats of three Panamanian villages were determined by microcapillary precipitin tests. Slightly more than half of the triatomines collected in houses and nearby palm trees and bird nests had fed on humans. Opossums, which are important reservoirs of *Trypanosoma cruzi* in Panama, were the second most frequently selected host. The importance for the transmission of Chagas' disease to humans of the close relationship between the principal vector and reservoir in sylvatic and peridomestic environments and the anthropophagy of the former is discussed. Pigeons and chickens were the dominant bloodmeal sources of triatomines collected in their respective shelters. The roof rat, *Rattus rattus*, was the third most common mammalian host, and may represent an ancillary reservoir in the transmission of Chagas' disease in rural areas of Panama.

The close association between the triatomine *Rhodnius pallescens*, the principal vector of Chagas' disease in Panama, and the corozo palm tree, *Scheelea zonensis* in sylvatic environments of the former Canal Zone has been reported.[1] The blood meals of engorged specimens from the same study, as determined by microcapillary precipitin tests, showed that opossums were the principal hosts, followed by anteaters, sloths, spiny rats, squirrels, cracid birds, and lizards.[2] Corozo palms are prevalent not only in primary tropical forests, but also in secondary forests, savannahs, grasslands and agricultural lands throughout much of Panama. The present study was designed to determine the degree of anthropophagy exhibited by *R. pallescens* in populated rural areas of the country, and thereby corroborate the work of others implicating this triatomine as the principal vector of *Trypanosoma cruzi* among humans.[3–5] Additionally, we were interested in potential reservoirs responsible for the maintenance of the disease in domestic environments. To investigate these epidemiological parameters domestic and peridomestic habitats in three rural villages in central Panama were selected for study.

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MATERIALS AND METHODS

Study sites

The three villages, El Aguacate, Cauchal and Filipina, Panama Province, are within a radius of about 10 km of each other, and typify the homestead type of settlements of 100–400 inhabitants in the country's interior. The communities are approximately 50 km west of Panama City and 25 km inland from the Pacific Ocean. Common to all villages were houses with cane walls, palm thatch roofs and dirt floors (Fig. 1). Domestic animals included dogs, cats, horses, chickens, pigeons, and a few pigs. Many of the surrounding hillsides are tilled and planted with corn, rice, tomatoes and other crops. A number of large secondary forest trees have been left uncut to provide shade for coffee plants. Citrus trees are also plentiful in the settlements. Corozo palms are common, often within a meter or two of the houses.

Triatomine collections

Specimens were collected routinely by hand from the following habitats January through April 1979: thatched roofs and cane walls of houses,

FIGURE 1. A house in El Aguacate, Panama from which triatomines were collected for bloodmeal analyses.

thatched roofs and nests in chicken and pigeon coops, and the bases of palm tree fronds. The field work was conducted by a three-man team of professional animal and arthropod collectors who have been associated with Gorgas Memorial Laboratory (GML) for 10 years. Additional collections were made on several occasions from an abandoned house, a tree hole and the trunk of a rotting tree. All collections were made within 100 m of an occupied house. The triatomines were placed individually in small screw-capped vials and labeled with the village name, date and habitat at the time of collection. Each week the collections were sent to GML where the triatomines were identified and stored at −15°C until being processed for bloodmeal determinations.

Processing of bloodmeals

The abdomens of the triatomines were separated from the thorax with tweezers, placed in 12 × 75 mm test tubes containing 1–2 ml of buffered 0.85% saline and refrigerated overnight. The following morning the bloodmeals were expressed from the abdomens with applicator sticks and centrifuged at 500 × g for 30 min. The antigens in the supernatant were then screened by class, order and family with specific antisera via a microcapillary precipitin method developed by Tempelis and Lofy.[5] Turbidity, present in the supernatant of about 10% of the cases, was removed by passing the fluid through a 0.22-μm disposable millipore filter.

Preparation of antisera

All antisera were produced in rabbits except anti-Leporidae which was prepared in roosters. Four class-specific antisera, against mammals, birds, reptiles and amphibians respectively, each were prepared by injecting 2.0 ml of inoculum (including 0.25 ml serum from each of four species of different orders in the same class and 1.0 ml of Freund's complete adjuvant) into the axillary and inguinal lymph nodes of a rabbit (0.5 ml per node). The rabbit received a booster after 3 weeks and again on the 4th week with the same sera and Freund's incomplete adjuvant. On the 5th week the rabbit was bled and the antisera were titered and tested against sera diluted 1:1,000 from one species of each order within the homologous class and two species from heterologous classes.

Order- and family-specific antisera were prepared in a similar way, but with a briefer immunization period using animals within the order or family group desired. Two injections were given 1 week apart, using Freund's complete adjuvant in both inoculations. Antisera were harvested 8 days later and tested against homologous and heterologous sera diluted 1:1,000 from 42 species of mammals, 35 species of birds, or five species of reptiles, depending on the class association. Amphibian antisera were prepared only at the class level of specificity. Titers of the antisera ranged from 1:10,000 to 1:80,000.

Antisera which cross-reacted with sera diluted 1:1,000 from heterologous orders or families were mixed with undiluted sera from the cross-reacting species in a proportion of 1 volume of serum to 100 volumes of antiserum, refrigerated overnight, and centrifuged the following day to remove the precipitated reactants. Antisera titers which decreased to less than 1:10,000 as a result of this absorption process were discarded. Four to six unknown sera diluted 1:1,000 from species within the four classes were included as controls in daily precipitin tests. The antisera in each instance of double feeding detections were checked for specificity against the reacting serum at dilutions of 1:1,000.

RESULTS

A total of 1,978 *R. pallescens* (439 adults and 1,539 nymphs) were collected and processed. Of these, 1,340 (67.7%) contained sufficient blood for host identification. Table 1 outlines the feeding

TABLE 1

Hosts of Rhodnius pallescens *identified by microcapillary precipitin tests from domestic and peridomestic habitat of three Panamanian rural villages*

Hosts	No. of bloodmeals	% of order	% of class	% of total
Mammalian	1,111	—	100	85.3
Primates	674	100	60.7	51.7
Hominidae (humans)	673	99.9	60.6	51.6
Cebidae (monkeys)	1	0.1	0.1	0.1
Marsupialia				
Didelphidae (Opossums)	354	100	31.9	27.2
Rodentia	36	100	3.2	2.8
Muridae (roof rats)	31	86.1	2.8	2.4
Echimyidae (spiny rats)	3	8.3	0.3	0.2
Dasyproctidae (agoutis)	1	2.8	0.1	0.1
Cricetidae (rice rats)	1	2.8	0.1	0.1
Carnivora	39	100	3.5	3.0
Canidae (dogs)	28	71.8	2.5	2.1
Felidae (cats)	11	28.2	1.0	0.8
Lagomorpha				
Leporidae (rabbits)	3	100	0.3	0.2
Artiodactyla				
Suidae (pigs)	2	100	0.2	0.2
Unidentified	3	—	0.3	0.2
Aves	187	—	100	14.4
Columbiformes				
Columbidae (pigeons)	121	100	64.7	9.3
Galliformes	58	100	31.0	4.5
Phasianidae (chickens)	52	89.7	27.8	4.0
Cracidae (guans)	6	10.3	3.2	0.5
Strigiformes				
Strigidae (owls)	2	100	1.1	0.2
Psittaciformes				
Psittacidae (parrots)	4	100	2.1	0.3
Gruiformes				
Rallidae (rails)	1	100	0.5	0.1
Unidentified	1	—	0.5	0.1
Reptilia				
Sauria (lizards)	3	100	100	0.2
Amphibia	2	—	100	0.2

profiles of 1,303 *R. pallescens* from all habitats in which single bloodmeal sources were identified. Mammalian feedings accounted for 85.3%, birds for 14.4%, and reptiles and amphibians for less than 1% of the total. Members of 17 mammalian and avian families of 11 orders, as well as reptiles and amphibians, were host for *R. pallescens* in the domestic and peridomestic environments. Slightly more than half of the triatomines had fed on humans, who represented the principal host of bugs collected in houses (Table 2), palm trees (Table 3), and birds nests. In all of these habitats opossums were the second most frequently fed upon host. Common opossums, *Didelphis marsupialis*, were encountered occasionally resting in the corozo palm trees at the time of collections.

The bloodmeal sources of 123 triatomines recovered from bird nests, all of which were abandoned, were identified as human 98 (79.7%), opossum 14 (11.4%), roof rat six (4.9%), as well as one each from dog, cat, pig, psittacid and columbid birds.

Pigeons and chickens were maintained in shelters adjacent but unattached to the houses. While

TABLE 2

Hosts of Rhodnius pallescens *identified by microcapillary precipitin tests from houses of three Panamanian rural villages*

Hosts	No. of bloodmeals	% of order	% of class	% of total
Mammalian	288	—	100	86.5
Primates				
Hominidae (humans)	196	100	68.1	58.9
Marsupialia				
Didelphidae (opossums)	58	100	20.1	17.4
Carnivora	22	100	7.6	6.6
Canidae (dogs)	13	59.1	4.5	3.9
Felidae (cats)	9	40.9	3.1	2.7
Rodentia	9	100	3.1	2.7
Muridae (roof rats)	6	66.7	2.1	1.8
Echimyidae (spiny rats)	2	22.2	0.7	0.6
Dasyproctidae (agoutis)	1	11.1	0.3	0.3
Lagomorpha				
Leporidae (rabbits)	2	100	0.7	0.6
Unidentified	1	—	0.3	0.3
Aves	44	—	100	13.2
Columbiformes				
Columbidae (pigeons)	19	100	43.2	5.7
Galliformes	21	100	47.8	6.3
Phasianidae (chickens)	16	76.2	36.4	4.8
Cracidae (guans)	5	23.8	11.4	1.5
Psittaciformes				
Psittacidae (parrots)	3	100	6.8	0.9
Unidentified	1	—	2.3	0.3
Amphibia	1	—	100	0.3

these domestic birds were the principal bloodmeal sources of the triatomines collected from their individual shelters, humans and opossums, respectively, were the second and third most frequent hosts. The feeding patterns of 118 *R. pallescens* collected from pigeon shelters showed the following host frequencies: pigeons 85 (72.0%), humans 17 (14.4%) and opossums 13 (11.0%). In addition, two specimens had fed on chickens and one each on a roof rat and a monkey. The host profiles of 30 *R. pallescens* recovered from chicken coops showed, chickens 19 (63.3%), humans five (16.7%), opossums three (10.0%), and one each feeding on a pigeon and a rallid bird. In the abandoned house, 26 bugs had fed on opossums and one each on a murid rodent and a chicken. Of a dozen bugs collected from the tree hole, eight had fed on opossums, three on humans and one on a murid rodent. The dead tree trunk yielded six triatomines, five of which had fed upon opossums and one on a lizard.

In addition to single host feedings detected in this study, 36 (2.7%) of the triatomines had fed upon members of two families; the bloodmeals of human, chicken and a ciconiiform bird, were identified from one *R. pallescens*. Four animal classes, Mammalia, Aves, Reptilia and Amphibia, with members from 12 families identified, were involved in the double feedings. Humans were involved in more than a third of all double feedings which also frequently involved domestic animals, dogs, cats and chickens. Members of the following families were involved in double feedings: Hominidae (34.7%), Felidae (12.5%), Phasianidae (11.1%), Muridae (9.7%), Canidae (5.6%), Bradypodidae (5.6%), Didelphidae (4.2%), Columbidae (4.2%), Leporidae (2.8%), unidentified birds (2.8%), and (1.4%) each of Echimyidae, Suidae, Psittacidae, Reptilia, and Amphibia.

DISCUSSION

Anthropophagy is an essential requisite for triatomines involved in the epidemiology of Chagas'

TABLE 3

Hosts of Rhodnius pallescens *identified by microcapillary precipitin tests from corozo palm trees within 100 m of houses in three Panamanian rural villages*

Hosts	No. of blood meals	% of order	% of class	% of total
Mammalia	618	—	100	94.6
Primates				
Hominidae (humans)	355	100	57.4	54.3
Marsupialia				
Didelphidae (opossums)	227	100	36.7	34.7
Rodentia	18	100	2.9	2.8
Muridae (roof rats)	16	88.9	2.5	2.4
Echimyidae (spiny rats)	1	5.6	0.2	0.2
Cricetidae (rice rats)	1	5.6	0.2	0.2
Carnivora	15	100	2.4	2.3
Canidae (dogs)	14	93.3	2.2	2.1
Felidae (cats)	1	6.7	0.2	0.2
Artiodactyla				
Suidae (pigs)	1	100	0.2	0.2
Lagomorpha				
Leporidae (rabbits)	1	100	0.2	0.2
Unidentified	1	—	0.2	0.2
Aves	32	—	100	4.9
Columbiformes				
Columbidae (pigeons)	15	100	46.9	2.3
Galliformes	15	100	46.9	2.3
Phasianidae (chickens)	14	93.3	43.8	2.1
Cracidae (guans)	1	6.7	3.1	0.2
Strigiformes				
Strigidae (owls)	2	100	6.2	0.3
Reptilia				
Sauria (lizards)	2	100	100	0.3
Amphibia	1	—	100	0.2

disease in the Americas. The present study has shown that humans were the principal hosts of *R. pallescens* in the domestic and peridomestic habitats of the three villages investigated, thus supporting reports by other workers that this triatomine species is the principal vector of *T. cruzi* in central Panama.[3,4] Another salient feature revealed by our investigations was the large number of feedings on opossums. We were aware, from our previous work,[2] that the opossum was the principal host of *R. pallescens* in the sylvatic ecotope. In the domestic and peridomestic environment it appears to be the host of selection second only to humans. Recent studies have implicated *D. marsupialis* as one of the most important reservoirs of *T. cruzi* in Panama.[6] This animal appears to be equally well adapted to sylvatic and rural populated areas in this country, and is one of the most common mammals found resting in corozo palm trees.

Rattus rattus, the roof rat, represents the only member of the family Muridae in the rural areas studied. Our results show that this animal was the third most frequent mammalian host of *R. pallescens*. It may also represent an ancillary reservoir in the transmission of *T. cruzi* to man since Edgecomb and Johnson reported an infection rate of 57% in these rodents captured in rural areas of central Panama.[7]

The discovery of *R. pallescens* with bloodmeals of hosts not associated with particular habitats (e.g., humans and palm trees, opossums and houses, chickens and pigeon coops, etc.) emphasizes the highly migratory behavior of flightless nymphs, which comprised 77.8% of triatomines collected, as well as adults.

The habitation of sylvatic and peridomestic environments by *R. pallescens* and *D. marsupialis*, in addition to the feeding habits of the former, fulfill requisite epidemiological parameters essen-

tial to the transmission of Chagas' disease between wild animals and man.

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