SHORT COMMUNICATION

Observations on the Domestic Ecology of *Rhodnius ecuadoriensis* (Triatominae)

F Abad-Franch/*/+, HM Aguilar V*/**, A Paucar C*, ES Lorosa***, F Noireau***/****

Pathogen Molecular Biology and Biochemistry Unit, Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, Keppel St., London WC1E 7HT, UK *Unidad de Medicina Tropical, Instituto 'Juan César García', Quito, Ecuador **Instituto Nacional de Higiene y Medicina Tropical 'Leopoldo Izquieta Pérez', Quito, Ecuador ***Laboratório Nacional e Internacional de Referência em Taxonomia de Triatomíneos, Departamento de Entomologia, Instituto Oswaldo Cruz-Fiocruz, Rio de Janeiro, RJ, Brazil ****Institut de Recherche pour le Développement, UR016, France

Rhodnius ecuadoriensis *infests peridomiciles and colonises houses in rural southern Ecuador. Six out of 84 dwellings (7%) surveyed in a rural village were infested (78 bugs/infested domicile; 279 bugs were collected in a single dwelling). Precipitin tests revealed* R. ecuadoriensis *fed on birds (65%), rodents (31%), marsupials (8%), and humans (15%) – mixed bloodmeals detected in 37.5% of individual samples.* Trypanosoma cruzi *from opossums and rodents may thus be introduced into the domestic cycle. Wasp parasitoidism was detected in 6.5% of 995* R. ecuadoriensis *eggs (only in peridomestic habitats). Control strategies should integrate insecticide spraying (indoors and peridomestic), better management of poultry, and housing improvements. A possible inefficacy of Malathion is reported.*

Key words: *Rhodnius ecuadoriensis* - ecology - feeding - Chagas disease - control - Ecuador

Chagas disease, caused by *Trypanosoma cruzi*, is a major public health challenge in Latin America. Since the early 90s (when ~18 million people were estimated to be infected), control interventions (elimination of domestic vectors plus blood bank control) have reduced incidence by ~70% in the Southern Cone countries (WHO 1991, Dias & Schofield 1999, Moncayo 1999, WHO/CTD 2001). Aguilar et al. (1999) estimated some 150,000 people may be infected by *T. cruzi* in Ecuador, with ~3 million living at risk. Epidemiological evidence indicates that *Rhodnius ecuadoriensis* is a significant disease vector in southern Ecuador (with reported prevalence rates up to 17%, including 9% at the blood bank of Machala) and northern Peru, where control interventions are being designed; however, very few studies on the ecology and behaviour of the species have been published (see Aguilar et al. 1999, Guevara et al. 1999, Abad-Franch et al. 2001, Cuba Cuba et al. this vol., p. 175-183). It colonises human habitats, and sylvatic populations breed in *Phytelephas aequatorialis* palms in western Ecuador (Lent & Wygodzinsky 1979, Lazo 1985, Barrett 1991, Schofield 1994, Abad-Franch et al. 2000, 2001). Aiming to understand better the domestic-peridomestic ecology of this species, we studied the situation in a rural area of southern Ecuador, and present here some preliminary results.

The locality of El Lucero (~1,400 m altitude, 79°30'W 4°10'S) belongs to the province of Loja, where Chagas disease is endemic (cf. Aguilar et al. 1999). The original dry premontane forest has been widely replaced by agriculture and livestock farms. No wild palm trees were observed in the area. We inspected 84 dwellings (sample representative for 2% expected infestation) and found 7.1% to be infested. Bugs were breeding mainly in peridomestic chicken coops and (in smaller numbers) inside bedrooms; 469 bugs of all stages (an average of 78.2 bugs/infested house) and 995 eggs were collected in the locality (Abad-Franch 2000). Eggs were inspected to detect parasitoidism by Hymenoptera (see Coscarón et al. 1999).

We studied in depth one house presenting heavy infestation, where two adults and four children lived by subsistence farming. The general condition of the dwelling was very poor (mud-stick, non-plastered walls; roof made of tiles, bamboo, and trunks; and earthen floor). All six people shared two beds in a 6.3m²-room; 36 chickens, 3 dogs, 6 pigs, 4 sheep, a donkey, and a goat were kept in the peridomicile. The house was surrounded by cropland and patches of modified dry premontane forest. Both adults answered a brief questionnaire on Chagas disease and its vectors. A four hour-search for bugs was conducted in and around the domicile (4 inspectors); beds and two chicken nests were systematically dismantled. Precipitin bloodmeal tests were performed on 26 bug faecal samples collected on filter paper. Eight individual bugs and the papers placed in containers used for bug collection, stained by bug faeces, were analysed (the latter results, although not individual-specific, reveal the feeding preferences of the colonies). A 17-antiserum battery was used (human 1:15,000, bird 1:10,000, opossum 1:15,000,

rodent 1:17,000, dog 1:15,000, cat 1:12,000, sheep 1:8,000, goat 1:14,000, pig 1:10,000, horse 1:16,000, ox 1:15,000, coati 1:13,000, tamandua 1:12,000, capybara 1:14,000, armadillo 1:15,000, toad 1:16,000, lizard 1:16,000).

Adults and nymphs of *R. ecuadoriensis* (but no other species) were readily recognised by the inhabitants, who said that bugs were common during all seasons. They had never heard before about Chagas disease, but other conditions were thought to be caused by bug bites ("allergy, itch, anaemia"). They knew that bugs live in mud wall crevices, beds, and chicken nests, and that they "eat blood" from people and poultry. The presence of triatomines inside the house was described as a daily major nuisance. Peridomestic colonies were also considered an important pest, as they suck blood from hens, reducing the production of eggs – hence contributing to malnutrition of children. Bednets were said to be ineffective against triatomines, as bugs "hide *within* the beds". The householders avoided using chemical insecticides inside the house, as they were deemed harmful for the children. A Malathion product used in chicken nests proved quite ineffective – two nests recently treated were infested. Bugs hiding in wall cracks within the house were regularly killed with needles, and boiling water was spread sporadically on infested walls and chicken nests – which were made of dry branches of *Dodonaea viscosa* ("chamana") and grass.

Forty-one *R. ecuadoriensis* adults and over 230 nymphs were captured in this dwelling. Beds, bedroom walls, chicken nests, and a peridomestic hollow tree (where two hens were nesting) were infested. Twenty bugs (all stages) were collected from the two beds; they took shelter in clefts between wood planks or among vegetal fibres used to tie up different parts of beds. Eggs were systematically collected from beds (239 eggs found). A few adult bugs were observed to hide in wall crevices beside the beds. Exuviae and eggs were found in nests, beds, and behind objects hanging on walls. 221 bugs of all stages were found in a nest occupied by a hen, but only three in an adjacent empty nest. Finally, 35 bugs were found in two chicken nests (recently treated with Malathion) located upon a hollow tree near the house; adults and nymphs were also found in the tree itself (Table I).

These triatomines proved rather eclectic in relation to their feeding habits (Table II). They appear to be mainly ornithophilic (65.4% of samples contained bird blood), but rodents (30.8%), humans (15.4%), and opossums (7.7%) are also hosts; 37.5% of individual samples were positive for more than one type of blood. Bugs fed on birds, opossums, and rodents were collected from beds, indicating that bugs circulate from the peridomestic environment to the house (where no birds or opossums were present) and pointing out the risk of introduction of parasites from opossums and rodents into the domestic cycle.

Only 6.5% out of 995 *R. ecuadoriensis* eggs collected in the study locality presented evidence of parasitoidism by Hymenoptera (probably Scelionidae) (Table III). All of them were found in peridomiciles, suggesting that parasitoid wasps do not reach triatomine eggs inside dwellings; the impact of parasitoidism in the demography of *R. ecuadoriensis* in the area is probably insignificant.

This example describes some little-known aspects of the ecology of *R. ecuadoriensis* in human environments (trophic resources, population age structure, preferred microhabitat, impact of parasitoidism), providing valuable data for improved control strategies – currently being planned in the context of the Andean Countries initiative (WHO/TDR 1997). The strong synanthropic behaviour of the species and the virtual absence of palm trees in southern Ecuador and northern Peru suggest that *R. ecuadoriensis* might have spread there in association with humans; if this is confirmed, local eradication might be attainable (Abad-Franch et al. 2001). The combination of an adequate substrate (dwelling in poor condition, abundant domestic birds around houses) with the lack of effective control measures makes human environments likely to become infested by *R. ecuadoriensis*. This species can establish large colonies associated with poultry and has proven able to migrate from peridomiciles into houses, feeding both on mammals and birds. Combined, these features result in a good capacity for house infestation from peridomestic colonies; *T. cruzi* strains from wild and peridomestic mammals may thus be introduced into the domestic cycle. Knowledge, beliefs and customs of inhabitants regarding triatomines are central to health education in community-based surveillance systems; although we found some to be wrong, most of them may be beneficial if slightly modified. Control of the species in the area should integrate residual insecticide spraying (both indoors and peridomestic) with an improved man-

TABLE I

Rhodnius ecuadoriensis domestic and peridomestic colonies in a heavily infested dwelling (El Lucero, Loja, Ecuador)

Site of capture	Eggs			Nymphs (instars)					Adults	Total
	Hatched	Not hatched		I	II	III	IV	V		
		Alive	Dead							
Beds	221	10	8	5	4	3	2	2	4	20 bugs/239 eggs
Chicken nests 1[a]	nr	nr	nr	35	72	77	7	6	27	224 bugs
Chicken nests 2 [b]	nr	nr	nr	2	4	2	4	13	10	35 bugs
Total	221	10	8	42	80	82	13	21	41	279 bugs/239 eggs

nr: not recorded; *a*: two adjacent chicken nests dissected on white cardboard; *b*: bugs from two chicken nests and the hollow tree where these nests were located.

TABLE II

Feeding profiles of *Rhodnius ecuadoriensis* collected in a heavily infested dwelling (El Lucero, Loja, Ecuador), tested by immunoprecipitation

Sample	Place of capture	Results
01-individual (G)	Hollow tree with chicken nests	Bird
02-individual (nymph V)	Hollow tree with chicken nests	Bird
03-individual (nymph V)	Hollow tree with chicken nests	Opossum – Bird
04-individual (E)	Chicken nest	Bird – Rodent
05-individual (nymph V)	Chicken nest	Bird
06-individual (E)	Bed	Human
07-individual (E)	Bed	Opossum – Bird
08-individual (nymph V)	Bed	Rodent
09 to 11-colony 1[a]	Hollow tree with chicken nests	Bird – Rodent
12 to 20-colony 2[b]	Chicken nest	Bird – Rodent
21 to 26-colony 3[c]	Bed	Human – Bird – Rodent

a: colony 1: 35 bugs collected in two chicken nests and the hollow tree where these nests were located; *b*: colony 2: 224 bugs collected in two chicken nests dissected; *c*: colony 3: 20 bugs collected in two beds.

TABLE III

Eggs of *Rhodnius ecuadoriensis* collected in El Lucero (Loja, Ecuador)

Site of collection	Hatched	Not hatched			Dubious [a]	Total (%)
		Viable	Not viable			
			P+	P–		
Intra-domiciliary	434	14	0	13	3	464 (46.6)
Peridomestic	414	15	65	28	9	531 (53.4)
Total (%)	848 (85.2)	29 (2.9)	65 (6.5)	41 (4.1)	12 (1.2)	995

P+: eggs with evident signs of parasitoidism by Hymenoptera (larvae inside eggs or egg corium presenting a circular orifice left by the emerging wasp); *P*–: eggs with no evident sign of parasitoidism; *a*: apparently alive when collected, but producing no nymphs.

agement of domestic and peridomestic environments (burning/replacement of hen nests each 15-30 days, and better domestic hygiene), and community-based surveillance. The possible resistance of *R. ecuadoriensis* to Malathion preparations should be investigated, as this insecticide has been extensively used for malaria control in Ecuador.

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