

A SURVEY OF THE *Anopheles* MOSQUITOES (DIPTERA: CULICIDAE) ALONG THE ACRE AND PURUS RIVERS, AMAZON BASIN, BRAZIL

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ABSTRACT — From January 19 to February 25, 1997 an entomological survey of the seringais and larger towns along the Acre and Purus rivers was made as part of the project "Revisitando a Amazônia de Carlos Chagas; da Borracha a Biodiversidade". Eleven anopheline species and 1285 specimens were collected landing on human baits. The four most abundant species were *Anopheles albittarsis* s.l. (n=778), *A. darlingi* (n=359), *A. rangeli* (n=69) and *A. oswaldoi* (n=60). A total of 252 larvae were collected of which 10 anopheline species were identified. The most abundant species collected were *A. albittarsis* s.l. (n=88), *A. deaneorum* (n=45) and *A. triannulatus* (n=40). The low numbers of *Anopheles* collected and the absence of the principal malaria vector *A. darlingi* at the seringais sites suggests that they are not high risk malarious areas. Other Diptera collected were *Culex* sp., *Mansonia titillans*, *Mansonia pseudotitillans*, *Psorophora ciliata*, *Psorophora* sp., *Coquillettidia (Rhynchoetaenia)* sp., *Simulium amazonicum* and *S. sanguineum*.

Keywords: *Anopheles*, Malaria, Amazon

Levantamento dos Mosquitos *Anopheles* (Diptera: Culicidae) ao Longo dos Rios Acre e Purus, na Bacia Amazonica, Brasil.

RESUMO — Entre os meses de Janeiro/Fevereiro de 1997, foi realizado um levantamento entomológico nos seringais e comunidades localizadas no vale do rios Acre e Purus, como parte do projeto "Revisitando a Amazônia de Carlos Chagas; da Borracha a Biodiversidade". Foram capturados no processo de pouso, um total de 1.285 anofelinos pertencentes a 11 espécies. As quatro espécies encontradas em maior número foram: *Anopheles albittarsis* s.l. (n= 778), *A. darlingi* (n= 359), *A. rangeli* (n= 69) e *A. oswaldoi* (n=60). Também foram coletadas um total de 252 larvas pertencentes a 10 espécies de anofelinos. As espécies mais abundantes foram: *A. albittarsis* (n= 88), *A. deaneorum* (n= 45) e *A. triannulatus* (n= 40). O número reduzido de anofelinos coletados e a ausência do *A. darlingi* nos seringais sugere que essa região não é de alta endemicidade para malária. Outros mosquitos do gênero *Diptera* coletados foram: *Culex* sp., *Mansonia titillans*, *Mansonia pseudotitillans*, *Psorophora ciliata*, *Psorophora* sp., *Coquillettidia (Rhynchoetaenia)* sp., *Simulium amazonicum* e *S. sanguineum*.

Palavras chaves: *Anopheles*, Malaria, Amazonas

INTRODUCTION

In 1911 Carlos Chagas visited the seringais (rubber production communities) along the Acre and Purus rivers in western Amazon (Fig. 1) (Cruz, 1913). The intent of the journey was to survey the health situation in the local commu-

nities. One of the most prevalent diseases that he found was malaria. At the same time, he collected several species of mosquitoes including the suspected malaria vector *Cellia albipes* (= *A. (Nys.) albimanus*). Since that time very little information has been collected from the riverine communities in the Purus River

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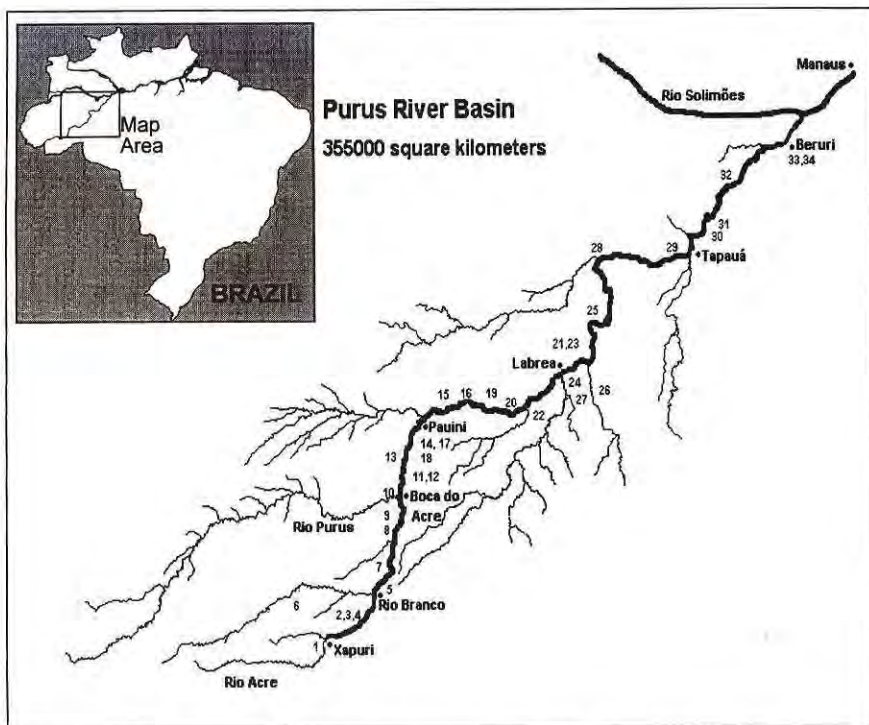


Figure 1 . Sites of collection along the rivers Acre and Purus (Purus River Basin). See Tables 1 and 2 for site descriptions.

Basin (Deane *et al.*, 1948; Roberts *et al.*, 1987; Natal *et al.*, 1992; Barata *et al.*, 1993; Fundação Nacional de Saúde, unpublished data).

From January 19 to February 25, 1997, the project "Revisitando a Amazônia de Carlos Chagas; da Borracha a Biodiversidade" conducted a survey of the seringaís visited by Carlos Chagas along the Acre and Purus rivers. This article presents the results of the survey of the anopheline fauna.

MATERIALS AND METHODS

The rivers of the Purus River Basin meander from the foothills of the Andes in Peru to the Solimões river 100 km west of Manaus, Brazil (Fig. 1). They are turbid, whitewater rivers.

Tributaries of the Acre and Purus rivers are usually clearwater streams and rivers (igarapés). Throughout the basin there are many lakes and flooded igapós (black and clearwater floodplains) and várzeas (muddy inundations) (Pires & Prance 1985). The ochre to brownish soils are of fluvial origin. Along the main channel the shoreline varies from vertical cliffs, stable sloping shoreline (45°) to beaches. Most towns and rubber communities visited are situated on cliffs overlooking the river or on sloping shorelines. Beach areas were used primarily for subsistence agriculture.

The survey began in the municipality of Xapuri ($10^{\circ} 39'S$, $68^{\circ} 30'W$), Acre State and ended in the municipality of Beruri, Amazonas State ($03^{\circ} 53'S$, 61°

22'W). The latitude and longitude of each collection site was recorded using a Garmin^R geographical positioning system (GPS) recorder.

Adult mosquitoes were collected landing on human baits from 18:00-21:00 h. Mosquitoes were put into small holding cartons and kept dry for future identification. Larval surveys were conducted for a minimum of 2 hours at each site by 2 persons; using standardized larval dippers (500ml). Larval collections were made at all potential breeding sites that were accessible in and around the seringais and the larger towns. Mosquitoes were identified using the keys of Faran (1980) and Consoli & Lourenço de Oliveira (1994).

A collection of other Culicidae and Simuliidae, was made at various seringais.

RESULTS

The results of the survey are summarized in Tables 1 and 2. Of the 18 adult collections made, 13 were positive for *Anopheles*. Overall, 11 different *Anopheles* species and 1285 specimens were collected landing in humans. The four most abundant species were *Anopheles albitarsis* s.l. (n=778) *A. darlingi* (n=359), *A. rangeli* (n=69) and *A. oswaldoi* (n=60). The presence and abundance of each species differed by collection site (Tab. 1). The majority of the anophelines collected were from larger towns such as Lábrea and Boca do Acre. The seringais accounted for only 14% of the total adults collected.

Larval collections were made in 21 localities of which 18 were positive

(Tab. 2). Not all breeding sites in each location were positive. Ten different anopheline species were collected during the survey and a total of 252 larvae were identified. The most abundant species collected were *A. albitarsis* s.l. (n=88), *A. deaneorum* (n=45) and *A. triannulatus* (n=40). Only one *A. darlingi* larva was collected at Yapui on Rio Ituxi, Lábrea. The main larval breeding sites were river backwaters, streams, and artificial ponds. Várzeas and igapós were consistently negative for *Anopheles* larvae.

Along with the anophelines, we collected several other genera of mosquitoes. *Culex* sp. was almost always collected during human biting counts. When one entered the forest in search of larval breeding sites large numbers of *Mansonia titillans*, *Mansonia pseudotitillans*, *Psorophora ciliata*, *Psorophora* sp., and/or *Coquillettidia (Rhynchotaenia)* sp. were found biting. *Simulium amazonicum* and *S. sanguineum* were the daytime biting Simuliidae collected during the survey.

DISCUSSION

It is difficult to compare the results of this survey with that of Carlos Chagas because the anopheline species collected by Chagas, *Cellia albipes* Theobald, is a junior synonym of *A. (Nys.) albimanus* whose name was erroneously applied to other anophelines species of the subgenus *Nyssorhynchus* (Faran, 1980).

The majority of adults and larvae were collected around the larger towns (Tabs. 1 & 2). The seringais showed very low densities of anophelines. This may have been due to the low

Table 1. Adult *Anopheles* collected from the Acre and Purus rivers, Amazon Basin, Brazil, from January 19 to February 22, 1997.

Municipality	Locality	Geographic Coordinates	<i>A. rangeli</i>	<i>A. oswaldoi</i>	<i>A. darlingi</i>	<i>A. albitarsis s.l.</i>	<i>A. triannulatus</i>	<i>A. rondoni</i>	<i>A. benarrochi</i>	<i>A. brazilensis</i>	<i>A. minor</i>	<i>A. matto-grossensis</i>	<i>A. medlopunctatus</i>
Xapuri	Larantal (1) ²	10° 39' S 68° 30' W	0	0	0	0	0	0	0	0	0	0	0
Xapuri	Sao Francisco de Iracema ¹ (2)	10° 31' S 68° 07' W	0	0	1	1	0	0	0	0	0	0	0
Xapuri	Paraiso ¹ (3)	10° 15' S 67° 48' W	19	34	0	0	3	0	0	0	1	1	1
Rio Branco	Univ.Federal Acre (5)	---	0	2	0	0	0	0	0	0	0	0	0
Rio Branco	Novo Horizonte ¹ (6)	09° 55' S 67° 37' W	0	0	0	0	0	0	0	0	0	0	0
Rio Branco	Bela Vista ¹ (7)	" "	0	0	0	0	0	0	0	0	0	0	0
Boca do Acre	Sao Francisco ¹ (8)	---	1	2	0	0	0	0	0	0	0	0	0
Rio Branco	Riozinho do Rola ¹ (9)	10° 03' S 67° 51' W	48	19	0	17	4	2	2	0	0	0	0
Boca do Acre	Bairro Macacheral (10)	08° 45' S 67° 23' W	1	1	0	496	0	0	3	0	0	0	0
Boca do Acre	Bairro Macacheral (11)	" "	0	0	0	264	0	0	0	0	0	0	0
Paulini	Bairro Cozoma (14)	07° 43' S 67° 00' W	0	0	33	0	0	0	0	0	0	0	0
Paulini	Guajarrã ¹ (15)	07° 41' S 06° 53' W	0	0	0	0	0	0	0	0	0	0	0
Paulini	Sta. Candida ¹ (16)	07° 42' S 65° 41' W	0	0	0	0	0	0	0	0	0	0	0
Lábrea	Lábrea (21)	07° 15' S 64° 48' W	0	0	260	0	0	0	0	2	0	0	0
Camutama	Bairro Tanque (25)	06° 32' S 64° 23' W	0	0	29	0	0	0	0	0	0	0	0
Lábrea	Camahá ¹ (26)	06° 42' S 64° 20' W	0	0	29	0	0	0	0	0	0	0	0
Tapauá	Boca do Tapauá (28)	05° 45' S 64° 23' W	0	0	0	0	0	0	0	0	0	0	0
Tapauá	Bairro Fernando Mendes (30)	05° 37' S 63° 11' W	0	2	7	0	0	0	0	0	0	0	0
Total			69	60	359	778	7	2	5	2	1	1	1

¹ Seringais; all other localities are villages along the rivers.² () Locality number from Figure 1.

Table 2. Larval *Anopheles* collected from the Acre and Purus rivers, Amazon Basin, Brazil, from January 19 to February 22, 1997¹.

Municipality	Locality	Geographic Coordinates	<i>A. nunez-tovari</i>	<i>A. rangeli</i>	<i>A. oswaldoi</i>	<i>A. darlingi</i>	<i>A. alb-tarsis s.l.</i>	<i>A. trian-nulatus</i>	<i>A. shanoni</i>	<i>A. brazil-ensis</i>	<i>A. deane-orum</i>	<i>A. per-yassui</i>
Xapuri	Laranga ² (1)	10° 39' S 68° 30' W	0	0	0	0	2	6	0	0	0	0
Xapuri	Sao Fransisco de Iracema ² (2)	10° 31' S 68° 07' W	0	0	0	0	0	13	0	0	0	0
Xapuri	Itú ² (4)	—	0	0	0	0	8	0	0	0	0	0
Boca do Acre	Bairro Praia do Gado (12)	08° 45' S 67° 23' W	0	1	0	0	53	0	0	0	31	0
Boca do Acre	Rio Mapiá ² (13)	—	1	2	0	0	2	0	0	0	8	0
Paulini	Cidade Alta (17)	07° 43' S 67° 00' W	0	0	0	0	4	0	0	0	0	0
Paulini	Bairro Cozama (18)	" "	0	0	0	0	0	0	1	0	0	0
Paulini	Cachoeira do Hilario ² (19)	07° 40' S 65° 59' W	0	0	0	0	0	0	0	0	0	0
Paulini	Santa Candida ² (20)	07° 42' S 65° 41' W	0	0	0	0	0	0	0	0	0	0
Lábrea	Marraã ² (22)	07° 28' S 65° 18' W	0	0	0	0	1	0	0	0	5	0
Lábrea	Faz. Paiva (23)	07° 15' S 64° 48' W	0	0	0	0	0	15	0	3	0	0
Lábrea	B.R. 230, Km 3 (24)	" "	0	0	0	0	12	6	0	8	1	0
Lábrea	Rio Ituxi, Yapui ² (27)	07° 19' S 64° 55' W	3	0	0	1	0	0	0	0	0	0
Lábrea	Camahá ² (26)	06° 42' S 64° 20' W	0	0	0	0	0	0	0	0	0	0
Tapauá	Boca de Tapauá (28)	05° 45' S 64° 23' W	0	0	0	0	4	0	0	0	0	0
Tapauá	Vila Tapauá ² (Floresta) (29)	05° 42' S 64° 24' W	0	0	0	0	0	0	0	0	0	2
Tapauá	Bairro Açais (30)	05° 37' S 63° 11' W	0	0	0	0	2	0	0	0	0	0
Tapauá	Tambaqui ² (31)	05° 11' S 62° 54' W	0	0	0	0	0	0	0	0	0	2
Tapauá	Aracari ² (32)	05° 11' S 62° 54' W	0	0	15	0	0	0	0	0	0	0
Beruri	Nova Trombeta ² (33)	04° 28' S 81° 22' W	0	0	0	0	0	0	0	0	0	6
Beruri	Boca do Assair (34)	03° 53' S 81° 22' W	0	0	8	0	0	0	0	0	0	0
TOTAL			4	3	23	1	88	40	1	11	45	10

¹ Thirty *Anopheles* larvae could not be identified to species.² Seringais; all other localities are villages along the rivers.³ () Locality number from Figure 1.

number of positive breeding sites. It was somewhat surprising that the flooded várzea and igapós were negative because they have been considered important anopheline breeding sites; particularly for *A. darlingi* (Forattini, 1962). It may be due to the fact that the Acre and Purus rivers are muddy water rivers and *A. darlingi* prefers clear water (Deane *et al.*, 1948). The presence of adult *A. darlingi* next to clear water igarapés in the towns of Lábrea and Canutama and along the Mucuím river would support this conclusion.

The four most abundant *Anopheles* collected in this study, *A. albitarsis* s.l., *A. darlingi*, *A. rangeli* and *A. oswaldoi*, have been implicated in the transmission of malaria in the Amazon Basin (Arruda *et al.*, 1986; Deane, 1986; Zimmerman, 1992; Branquinho *et al.*, 1993). *A. albitarsis* is a species complex (Wilkerson *et al.*, 1995) and only one other member of this complex, *A. deaneorum*, can be separated by morphological characteristics (Rosa-Freitas, 1989). In this survey we did not collect any adults of *A. deaneorum* (Tab. 2).

The results of our survey complement previous studies on *Anopheles* from Acre State (Deane *et al.*, 1948; Natal *et al.*, 1992; Barata *et al.*, 1993) and Amazonas State (Deane *et al.*, 1948; Xavier & Mattos, 1976; Roberts *et al.* 1987; Tadei *et al.*, 1993; Osorio Quintero *et al.*, 1996; Baggio, unpublished data). Deane *et al.* (1948) surveyed several sites from Acre State to Para State. During their survey anophelines were collected from Xapuri, Rio Branco, Boca do Acre, and Lábrea. The results of our survey at these same sites were similar to Deane *et al.* (1948). The major

difference was that we could separate *An. deaneorum* from *An. albitarsis* s.l. and they could not. In conclusion, we extend the distribution records for several species of anophelines, including the new species *An. deaneorum*, to include previously unsurveyed stretches of the Acre and Purus rivers from the municipality of Xapuri, Acre State, to Beruri, Amazonas State.

The low number of anophelines collected at the seringais sites suggests that the seringais along the Acre and Purus rivers are not high-risk malarious areas. This is supported by the results of the malaria serology survey conducted during this study (Arruda, unpublished data). However, Deane *et al.* (1948) found seringais along Rio Zinho, Acre State to have high malaria prevalence and large numbers of *A. darlingi*. In contrast, our entomological data suggest that the risk of malaria transmission in the communities along and next to the igarapés is higher. Further research is warranted to confirm this conclusion.

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