
Mosquitoes (Diptera: Culicidae) near a reservoir in the Western part of the Brazilian State of Santa Catarina

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Biota Neotropica v6 (n3) –<http://www.biotaneotropica.org.br/v6n3/pt/abstract?inventory+bn02606032006>

Date Received 06/09/2005

Revised 10/20/2006

Accepted 11/10/2006

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Abstract

Marcondes, C.B; Fernandes, A. and Muller, G.A. **Mosquitoes (Diptera: Culicidae) near a reservoir in the Western part of the Brazilian State of Santa Catarina.** *Biota Neotrop.* Sep/Dec 2006 vol. 6, no. 3 <http://www.biotaneotropica.org.br/v6n3/pt/abstract?inventory+bn02606032006> ISSN 1676-0611

Anopheline and other mosquitoes (Diptera: Culicidae) in the southern Brazilian State of Santa Catarina have been studied mostly near the Atlantic sea coast and are not well known in other regions of the state. Collections were made near a reservoir in the western portion of the state. At least 26 species were represented in the collections; 10 are recorded for the first time for the state: *Coquillettidia venezuelensis*, *Cq. juxtamansonia*, *Mansonia wilsoni*, *Ochlerotatus fluviatilis*, *Psorophora ciliata*, *Ps. discruciens*, *Ps. lanei*, *Culex bigoti*, *Sabethes belisarioi* and *Sa. identicus*, and 12 for the first time in the western portion of the state: *Anopheles albitarsis*, *An. intermedius*, *An. lutzi*, *An. parvus*, *An. strodei*, *Chagasia fajardi*, *Cx. quinquefasciatus*, *Limatus durhamii*, *Sa. aurescens*, *Sa. melanonymphe*, *Trichoprosopon pallidiventer* and *Wyeomyia limai*. The possible medical and veterinary significance of the findings is discussed.

Key words: *Culicidae*, *Santa Catarina*, *Brazil*, *Anopheles*, *Psorophora*, *reservoir*, *dam*.

Resumo

Marcondes, C.B; Fernandes, A. and Muller, G.A. **Mosquitos (Diptera: Culicidae) nos arredores de uma represa no oeste do estado brasileiro sulino de Santa Catarina, Brasil.** *Biota Neotrop.* Sep/Dec 2006 vol. 6, no. 3 <http://www.biotaneotropica.org.br/v6n3/pt/abstract?inventory+bn02606032006> ISSN 1676-0611

Anofelíneos e alguns outros mosquitos (Diptera: Culicidae) no Estado de Santa Catarina, no sul do Brasil, foram estudados principalmente ao leste, próximo à costa, e não são bem conhecidos em outras regiões do estado. Foram realizadas coletas nas proximidades de uma represa no oeste do estado. Pelo menos 26 espécies estavam representadas nas amostras; dez delas são relatadas pela primeira vez no estado: *Coquillettidia venezuelensis*, *Cq. juxtamansonia*, *Mansonia wilsoni*, *Ochlerotatus fluviatilis*, *Psorophora ciliata*, *Ps. discruciens*, *Ps. lanei*, *Culex bigoti*, *Sabethes belisarioi* e *Sa. identicus*, e 12 pela primeira vez no oeste do estado: *Anopheles albitarsis*, *An. intermedius*, *An. lutzi*, *An. parvus*, *An. strodei*, *Chagasia fajardi*, *Cx. quinquefasciatus*, *Limatus durhamii*, *Sa. aurescens*, *Sa. melanonymphe*, *Trichoprosopon pallidiventer* e *Wyeomyia limai*. A possível importância médica e veterinária dos relatos é discutida.

Palavras-chave: *Culicidae*, *Santa Catarina*, *Brazil*, *Anopheles*, *Psorophora*, *represa*, *hidrelétrica*.

Introduction

The western region of the southern Brazilian State of Santa Catarina has a different vegetation (mixed Atlantic forest) and climate (drier, and in recent years suffering droughts), compared with the eastern region; a mountain chain ("Serra do Mar" or "Serra Geral") separates the two regions. The mosquito fauna in Santa Catarina was studied mostly in the middle of the 20th century, due to the occurrence of malaria, related to *Anopheles (Kerterszia)* spp., in the eastern region (e.g., Rachou & Ferraz 1951, Ferreira 1965). Marcondes et al. (2003) and Paterno & Marcondes (2004) recorded 32 species new for this state and the southernmost state, Rio Grande do Sul, pointing out the need for improved knowledge of the mosquito fauna in these states.

The mosquito fauna of western Santa Catarina State is not well known, even with the occurrence of malaria in humans in western Paraná (Falavigna-Guilherme et al. 2005) and yellow fever in howler monkeys in Rio Grande do Sul (Vasconcelos et al. 2003). The distribution of anophelines in the State of Santa Catarina has been studied, due to the occurrence of malaria, but only in the eastern quarter, where this disease had been reported (Rachou & Ferraz 1951).

Western Santa Catarina has been heavily deforested in the last 50 years, and the raising of chickens and pigs has become important, along with soybean production. Due to the need for electricity, dams have been built. The building of reservoirs introduces ecological modifications, possibly promoting the proliferation of vectors and a reduction in the diversity of the mosquito fauna (Tubaki et al. 2004). Deforestation was probably the cause of the modification of the phlebotomine sand fly (Diptera: Psychodidae) fauna in Araçatuba, in the western part of the State of São Paulo,

where *Lutzomyia longipalpis* (Lutz & Neiva 1912) became prevalent (Costa et al. 1997), whereas *L. whitmani* (Antunes & Coutinho 1939) had been common in the 1930s (Barretto 1943). Simultaneously, visceral leishmaniasis became highly prevalent in the region, while the cutaneous form became much rarer.

Due to the paucity of knowledge on mosquitoes in the western region of the State of Santa Catarina, a survey of the mosquitoes near the reservoir of the Quebra Queixo Hydroelectric Power Station is reported.

Material and methods

The vegetation in the area of the reservoir consists of rain forest mixed with rare specimens of the Brazilian pine (*Araucaria augustifolia*), and has been severely modified by human activity, mostly the planting of eucalyptus, corn and soybean.

Collections were carried out on five two-day visits to the area around the reservoir of the Quebra Queixo Hydroelectric Power Station, formed in the River Chapecó, in the Municipalities of Ipuauçu (26°37'53"S; 52°57'18"W, 720 m above sea level and São Domingos (26°33'29"S; 52°31'54"W, 635 m a.s.l.), in the western part of the State of Santa Catarina (Figure 1), from March 2004 to April 2005. In April 2004, no material was obtained, due to bad weather, but pieces of bamboo were hung in trees (see below). Mosquitoes were collected by the following methods: SHIP (Shannon trap with light for one hour just after sunset, in a secondary forest, 10 m from the border of the reservoir, near a spillway, about 800 m from the electric turbines, 26°39'39.7" S 52°32'53.1" W); RILH (in a strip of forest, 200 metres wide,



Figure 1 – Maps of Brazil and Santa Catarina State. The red circle indicates the region where mosquitoes were collected (Municipalities of Ipuauçu and São Domingos) and the red square indicates the closer big city (Chapecó).

beside a diversion of the river, near the turbines, in the morning, landing on humans), RIBA (in bamboo, locally called "taquaras" with holes, 26°37'06.8" S; 52°32'50.8" W); RIHO (in holes in stones in the above-mentioned river, formed by diversion of water for production of electricity); SEBA (in artificially cut pieces of bamboo, with two compartments, an upper and a lower, hung on trees, in a small patch of secondary forest, with cattle, 300 m from the border of the reservoir, 26°40'20.5" S; 52°32'17.6" W); HOFO (in a house near this small patch of forest); HEHO (in a henhouse near the border), all in Ipuauçu, and in SHSD (a secondary forest near a beach on the border of the reservoir, with a Shannon trap with light), in São Domingos.

Adult mosquitoes attracted by humans or light were collected by suction tubes, prepared with plastic transparent tubes (CB Marcondes et al. - accepted). Immature forms were obtained from holes in stones, cut bamboo or bamboo with natural or artificial holes (Marcondes & Mafra 2003), and bromeliads. Immature forms were transported to the laboratory in Florianópolis in insulated packaging, which maintained the temperature between 15 and 20 °C. In the laboratory, the immature forms were separately reared in plastic vials, in 500 ml cups, covered with netting. The original water was diluted with distilled water, and fish food (Tetramin™) and sometimes 1st-2nd instar larvae of *Culex quinquefasciatus* were supplied. The exuviae of 4th instar larvae and pupae were preserved in ethanol 80 °GL. Adult mosquitoes were killed by ethyl acetate vapour, and preserved dry in small boxes with naphthalene. They were identified with descriptions and keys of Lane (1953) and Forattini (1965, 2002). Genera and subgenera were abbreviated as proposed by Reinert (2001). *Ochlerotatus* was accepted as a genus (Reinert 2000).

All the collected mosquitoes were included in the collection of Laboratório de Entomologia Médica of Departamento de Microbiologia e Parasitologia of Universidade Federal de Santa Catarina, and some voucher specimens were donated to the collection of Departamento de Epidemiologia of Faculdade de Saúde Pública of USP, at São Paulo.

Results

Mosquitoes of the following species were collected (details in Table 1; * - new record for Santa Catarina, ** - new record for the western region of state): Anophelinae: *An. (Ano.) intermedius* (Peryassu, 1908), *An. (Nys.) albitarsis* Lynch Arribalzaga, 1878 s.l., *An. (Nys.) lutzii* Cruz, 1927, *An. (Nys.) parvus* (Chagas, 1907), *Chagasia fajardi* (Lutz, 1904); Culicinae: Aedini: *Oc. (Och.) fluviatilis* (Lutz, 1904)*, *Oc. (Och.) serratus* complex*, *Psorophora (Janthinosoma) discrucians* (Walker, 1856)* *Ps. (Jan.) ferox* (Von Humboldt, 1819), *Ps. (Jan.) lanei* Shannon & Cerqueira, 1943*, *Psorophora (Psorophora) ciliata* (Fabricius, 1794)*; Culicini: *Culex (Culex) quinquefasciatus* Say, 1823**, *Cx.*

(Cux.) coronator Dyar & Knab, 1906 complex*, *Culex (Lutzia) bigoti* (Bellardi, 1862)*; Mansoniini: *Coquillettidia (Rhynchotaenia) juxtamansonia* (Chagas, 1907)*, *Cq. (Rhy.) venezuelensis* (Theobald, 1912)*, *Mansonia (Mansonia) wilsoni* (Barretto & Coutinho, 1944)*; Sabethini: *Limatus durhamii* Theobald, 1901**, *Sabethes (Peytonulus) aurescens* (Lutz, 1905)**, *Sa. (Sabethes) belisarioi* Neiva, 1908*, *Sa. (Pey.) identicus* Dyar & Knab, 1907*, *Sa. (Sabethinus) melanonymphe* Dyar, 1924**, *Trichoprosopon (Trichoprosopon) pallidiventer* (Lutz, 1905)**, *Wyeomyia (Wyeomyia) limai* Lane & Cerqueira, 1942**, Toxorhynchitinae: *Toxorhynchites* sp.

Discussion

The mosquito fauna near the reservoir of Quebra Queixo includes at least 26 species. The fauna is different from that in forested areas in the eastern portion of the state, where *Wyeomyia (Phoniomyia)* spp. are common and diverse, as are *Runchomyia reversa* (Lane & Cerqueira 1942) and *Oc. scapularis* (Rondani 1848) (Marcondes et al. 2003; Paterno & Marcondes 2004) and, after sunset, *An. (Kerteszia)* spp. (Aragão 1974).

The absence of *Oc. scapularis*, a common species near reservoirs in the western areas of the states of São Paulo (Tubaki et al. 2004) and Paraná (Teodoro et al. 1995), is remarkable. The ecology and southern distributional limit of this species should be defined. In Rio Grande do Sul, it was collected only in the central and eastern parts of the state (Cardoso et al. 2005). Temperatures at Ipuauçu/São Domingos can be about 0 °C at some times, and the ground, where *Oc. scapularis* develops (Forattini 2002), is sometimes covered in frost. However, its presence in areas with similar or lower temperatures, such as Texas, USA (Forattini 2002), and Córdoba, Argentina (Almirón 2001), contradicts this hypothesis. The distribution of this species (Forattini 2002, p. 574) requires confirmation.

In studies of the fauna in the region of Rio Grande do Sul ("Alto Uruguai") (Cardoso et al. 2004, 2005) near Ipuauçu/São Domingos, four species of Anophelinae (*An. albitarsis*, *An. evansae*, *An. parvus* and *Ch. fajardi*) and seven species of Culicinae (*Cq. venezuelensis*, *Cx. quinquefasciatus*, *Oc. fluviatilis*, *Ps. ferox*, *Sa. aurescens*, *Tr. pallidiventer* and *Wye. limai*) were common in the present study.

Other than *An. albitarsis s. l.* and *An. strodei*, considered secondary vectors of *Plasmodium* in Brazil (Forattini 2002), other species of the genus collected in Ipuauçu/São Domingos have never been implicated as vectors. Only one female of *An. albitarsis s. l.* was collected in the present study. Rachou & Ferraz (1951) studied the anophelines from 38 municipalities in the eastern portion of the state; there are no published data for the remainder of the state, probably because there are not yet reports of malaria in this region. However, many inhabitants of the western part of the state travel

Table 1 – Mosquitoes collected near a water reservoir in the West of the Brazilian State of Santa Catarina, in the municipalities of Ipuacu and São Domingos, from March 2004 to April 2005. Details of codes for collections are in the main text.

Species	Code	Quantity and sex	Date
<i>Anopheles intermedius</i>	SHSD	1 ♀	8.X.2004
<i>An. albitarsis s.l.</i>	SHSD	1 ♀	8.X.2004
<i>An. lutzi</i>	SHSD	1 ♀	8.X.2004
<i>An. parvus</i>	SHIP	1 ♀, 2 ♂	8.X.2004
<i>An. strodei</i>	SHSD	2 ♀	8.X.2004
<i>Chagasia fajardi</i>	SHSD	1 ♀	8.X.2004
<i>Ochlerotatus fluviatilis</i>	SHIP	6 ♀	8.X.2004
		4 ♀, 3 ♂	21.III.2005
	SHSD	5 ♀	10.II.2005
		4 ♀	22.IV.2005
		1 ♀, 3 ♂	23.IV.2005
	HEHO	1 ♀	8.X.2004
	RIHO, in the middle of the river	1 ♀, 2 ♂	10.II.2005
		1 ♂	22.IV.2005
	RILH	2 ♀, 1 ♂	8.X.2004
		2 ♀	10.II.2005
<i>Oc. serratus complex</i>	SHIP	7 ♀	2.III.2004
<i>Psorophora ciliata</i>	SHIP	1 ♀	22.II.2005
<i>Ps. discrucians</i>	SHIP	7 ♀	10.II.2005
<i>Ps. ferox</i>	RILH	1 ♀	10.II.2005
<i>Ps. lanei</i>	SHIP	1 ♀	10.II.2005
<i>Culex bigoti</i>	RIHO, only near the borders and the vegetation	10 larvae	21.III.2005
		5 ♀, 1 ♂, from immature forms	22.IV.2005
<i>Cx. coronator complex</i>	SHIP	7 ♀	2.III.2004
<i>Cx. quinquefasciatus</i>	HOFO, in a water closet	10 ♀, 10 ♂	8.X.2004
<i>Coquillettidia juxtamansonia</i>	SHIP	2 ♀	1.III.2004
		1 ♀	22.IV.2005
<i>Cq. venezuelensis</i>	SHIP	7 ♀	1.III.2004
	SHSD	4 ♀	2.III.2004
	TOFU	2 ♀	8.X.2005
		1 ♀	10.II.2005
<i>Mansonia wilsoni</i>	SHIP	25 ♀	7.X.2004
		26 ♀, 6 ♂	1.III.2005
<i>Limatus durhamii</i>	RILH	1 ♀	10.II.2005
<i>Sabethes aureescens</i>	RIBA	4 ♀	10.II.2005
		5 ♀, 2 ♂	24.III.2005
		6 ♀, 5 ♂	22.IV.2005

<i>Sa. belisarioi</i>	HOFO	1 ♀, trying to bite humans in a roof terrace, at 12 a.m.	2.III.2004
<i>Sa. identicus</i>	RIBA	1 ♀	10.II.2005
<i>Sa. melanonymphe</i>	RIBA	1 ♀	2.III.2004
<i>Trichoprosopon pallidiventer</i>	SEBA	2 ♀, 1 ♂	8.X.2004
<i>Wyeomyia limai</i>	RIBA	5 ♀, 3 ♂	24.III.2005
		5 ♀, 3 ♂	22.IV.2005
<i>Toxorhynchites</i> sp.	RIHO, near the borders and the vegetation	10 immature forms, not developed to adults	8.III.2005

frequently to the states of Mato Grosso, Rondonia and Acre, which include areas endemic for malaria, and the possibility of introduction of the parasites into the Ipuacu/São Domingos region should not be disregarded.

Near a reservoir in the western area of the State of Paraná, about 300 km to the northwest of the Ipuacu/São Domingos area, *An. (Nys.) darlingi* Root, 1926 has been collected (Falavigna-Guilherme et al. 2005), and the southern limit of this important species should be investigated. Rossi (2001) mentioned its presence in several Argentinean provinces near Santa Catarina and southward. It is usually associated with large reservoirs with aquatic vegetation (Forattini 2002). The finding of mosquitoes of *Mansoniini* (*Coquillettidia* and *Mansonia*), whose immature forms obtain air from aquatic plants, in Ipuacu/São Domingos, could be an indication of suitable conditions for this anopheline. Although *Anopheles (Kerteszia)* spp. have not yet been found in the western part of the southern Brazilian states, two species (*An. bambusicolus* Komp, 1937 and *An. cruzii* Dyar & Knab, 1908) were collected in the Argentinean province of Misiones (Rossi 2001), about 300 km to the west of Ipuacu/São Domingos. Collections from bromeliads in the strip of forest near the river Chapecó, in Ipuacu, and in São Domingos failed to yield immature stages of mosquitoes. Mosquitoes were not sought after sunset in the (small) forested area in Ipuacu, which is probably the best time and environment for the collection of *Anopheles (Kerteszia)* spp. (Forattini 2002, p. 362). More studies should be developed in reserve areas in the region, which might have these mosquitoes, as in the National Park of Iguacu (Guimarães et al. 2003).

Psorophora ferox had been reported by Paterno & Marcondes (2004), allegedly for the first time in the state, in Florianópolis, but it had been reported in Joaçaba (27°10'41" S; 51°30'17" W, 523 m altitude), in the western portion of the state (Guedes et al. 1965). It was suspected as a vector of Rocio virus in the south of the State of São Paulo (Souza Lopes et al. 1981, Mitchell et al. 1986), and was infected with EEE virus in the United States (Cupp et al. 2004). Several species of *Psorophora*, which are large, aggressive mosquitoes, were collected in the present study, and their potential as biters of humans and domestic animals should be investigated.

Although holes in stones are the preferred breeding habitat of *Oc. fluviatilis*, the species is well adapted to artificial breeding places, such as those in cemeteries (Chahad & Lozovei 1994). This mosquito seems to prefer humans and other mammals (Shannon 1931, Consoli 1976), and does not bite hens in the laboratory (Consoli 1976). It is a good experimental vector of *Plasmodium gallinaceum* Brumpt, 1935 (Tason de Camargo & Kretzli 1978). Because this protozoon may be pathogenic to hens (Williams 2005), the presence of the protozoan and the importance of this mosquito in the western area of Santa Catarina, where huge numbers of hens are produced, should be investigated.

Weak epidemiological evidence suggests a role of *Oc. fluviatilis* in the transmission of yellow fever virus (Soper et al. 1933), and the western half of Santa Catarina was an epidemic region until the 1960s. The recent finding of howler monkeys infected by yellow fever virus in western Rio Grande do Sul (Vasconcelos et al. 2003) prompted the vaccination of about 500,000 inhabitants in western Santa Catarina (Secretaria Estadual de Saúde 2005, pers. commun.). The risk of transmission of this virus constitutes an additional reason for the study of the mosquito fauna in the western area of the three southern Brazilian states (and of south-eastern São Paulo).

There seem to be differences between the mosquito fauna in holes in the stones on the river Chapecó. Based on dozens of holes examined, only *Cx. bigoti* and *Toxorhynchites* sp. were found in the holes along the margin, near the vegetation, while only *Oc. fluviatilis* was found in the holes far from the margins. The former holes are rich in rotting leaves and partially protected from sunlight, contrasting with the other holes, which are poor in organic matter and well exposed to sunlight. The immature forms of *Oc. fluviatilis* are probably not subjected to predation by large larvae in the holes far from the margins; possibly, they are eliminated from the other holes by predators. Detailed experimental studies on the ecology of these species should be carried out in the holes in the stones. The absence of an association between *Oc. fluviatilis* and *Cx. bigoti* in tires (Lopes et al. 1997a) may be related to isolation of the breeding places of the species. *Toxorhynchites* sp., *Cx. bigoti* and *Li. durhamii* were efficient in the control of *Cx. eduardoi* Casal & Garcia, 1968 and *Cx. quinquefasciatus* (Lopes 1999) in the State of Paraná.

The bamboo hung on ropes, which were prepared to collect *Sa. belisarioi*, collected only *Tr. pallidiventer*. Mosquitoes of this species are common in bamboo with natural holes (Prado 1935) or artificially cut holes (Lopes et al. 1997b); they were infected with an arbovirus ("Anhembi", of Bunyamvera group) on the coast of the State of São Paulo (Souza Lopes et al. 1975).

Sa. aurescens and *Wy. limai*, collected in bamboo near the river Chapecó, are the predominant mosquitoes in artificially drilled bamboo at Santa Catarina Island (Marcondes & Mafra 2003). Both species occurred also in bamboo with natural holes near Curitiba, State of Paraná, among 17 species of mosquitoes (Lozovei 1998).

Wyeomyia (Phoniomyia) was absent in the present study, contrasting with its frequency and diversity in the eastern forested areas (Marcondes et al. 2003; Paterno & Marcondes 2004). This may be due to the small size of the forest, inadequacy of the local bromeliads or distribution of these species. The collection of only one species of this subgenus in a large and well-preserved area in western Paraná (Guimarães et al. 2003) and none in "Alto Uruguay" (Cardoso et al. 2005) supports the last hypothesis, suggesting that their distribution in the southern states is mostly in the eastern region, at lower altitudes, near the coast. However, more collections should be done in the western part of the State of Santa Catarina.

The mosquito fauna near Quebra Queixo reservoir, although diverse, does not seem as hazardous, at least for anophelines, as those near reservoirs in Goiás in central Brazil (Guimarães et al. 2004) and São Paulo (Tubaki et al. 2004), where *An. darlingi*, *An. albicans* s.l. and other vectors are very common. Some species are potentially hazardous to human and poultry health, and should be further studied.

Acknowledgements

To ETS – Energia, Transporte e Saneamento, Florianópolis, for the transportation and financial help to the field work. To CNPq (Proc.-690143/01-0) and FAPESC, for the financial help. To Dr. Peter Adler (Clemson University, Clemson, USA), for checking the English language. To Dr. Carlos José Carvalho-Pinto (MIP/CCB/UFSC) for furnishing *Cx. quinquefasciatus* larvae.

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Title: Mosquitoes (Diptera: Culicidae) near a reservoir in the Western part of the Brazilian State of Santa Catarina.

Authors: Marcondes, C.B; Fernandes, A. and Muller, GA.

Biota Neotropica, Vol. 6 (number 3): 2006
<http://www.biotaneotropica.org.br/v6n3/pt/abstract?inventory+bn02606032006>

Date Received 06/09/2005 - Revised 10/20/2006
Accepted 11/10/2006

ISSN 1676-0611