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Mansonia spp. (Diptera: Culicidae) associated with two species of macrophytes in a Varzea lake, Amazonas, Brazil

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Abstract

Ferreira RLM, Pereira ES, Har NTF, Hamada N. 2003. *Mansonia* spp. (Diptera: Culicidae) associated with two species of macrophytes in a Varzea lake, Amazonas, Brazil. Entomotropica 18(1):21-25.

Mansonia spp. larvae, in association with two species of macrophytes (*Eichhornia crassipes* and *Ceratopteris* sp.), were studied. Also, *Mansonia* spp. larval infection by Trichomycetes fungi was verified. The samples were collected in Camaleão Lake, Amazonas, Brazil, during four different periods of the year: high water, falling water, low water and rising water. A total of 705 *Mansonia* larvae were collected; 26% were in the 1st to 3rd instars and 74% were in the 4th instar. *E. crassipes* had higher numbers of *Mansonia* spp. larvae (n = 623) than *Ceratopteris* sp. (n = 82). Four *Mansonia* species were collected (*M. humeralis*, *M. indubitans*, *M. amazonensis* and *M. titillans*); the first of these was the most abundant species in the four sampling periods and in both plant species studied. Trichomycetes fungi were not observed infecting the digestive tracts of the dissected *Mansonia* spp. larvae (n = 190).

Additional key words: Aquatic insects, aquatic plants, mosquitoes, Trichomycetes.

Resumo

Ferreira RLM, Pereira ES, Har NTF, Hamada N. 2003. *Mansonia* spp. (Diptera: Culicidae) associadas a duas especies macrofitasem um lago de Varzea, Amazonas, Brasil. Entomotropica 18(1):21-25.

Larvas de *Mansonia* spp. em associação com duas espécies de macrófitas (*Eichhornia crassipes* e *Ceratopteris* sp.) foram estudadas. A infecção larval de *Mansonia* spp. por fungos Trichomycetes também foi verificada. As amostras foram coletadas no Lago Camaleão, Amazonas, Brasil, em quatro períodos do ano: cheia, vazante, seca e enchente. Um total de 705 larvas de *Mansonia* foram coletadas; sendo 26% do 1^0 ao 3^0 estádio e 74% do 4^0 estádio. *E. crassipes* apresentou um maior número de larvas de *Mansonia* spp. (n = 623) do que *Ceratopteris* sp. (n = 82). Quatro espécies de *Mansonia* foram coletadas (*M. humeralis*, *M. indubitans*, *M. amazonensis* e *M. titillans*); *M. humeralis* foi a espécie mais abundante nos quatro períodos amostrados e nas duas espécies de plantas. Fungos Trichomycetes não foram observados infectando o trato digestivo das larvas de *Mansonia* spp. dissecadas (n = 190).

Palavras chaves adicionais: Insetos aquáticos, mosquitos, plantas aquáticas, Trichomycetes.

Introduction

Female *Mansonia* are known for their hematophagic behavior, and, when in high density, they can cause serious medical and social problems, as has occurred in some hydroelectric dams in the Amazon region (Tadei et al. 1991). Females have both diurnal and nocturnal activity, making life difficult for humans and other animals in places where *Mansonia* females are found in high density. As in all hematophagous insects, some species in this genus have potential as vectors of etiologic agents that cause diseases such as arboviruses to humans and other animals (Karabatsos 1985).

The immature live associated with aquatic plants, obtaining O_2 from the plant tissues and ingesting suspended organic matter by filter feeding. In the Amazon region aquatic plants grow in abundance in inundated areas and maintain large populations of invertebrates and vertebrates (Junk 1973); they are a fundamental part of this ecosystem. When the ecosystem is disturbed and loses its equilibrium, the aquatic plants quickly increase their populations, causing serious problems (Tadei et al. 1991). Culicidae species other than those in the genus *Mansonia* that are closely associated with aquatic plants include *Aedeomyia squamipennis* (Lynch Arribálzaga), *Coquillettidia* sp., *Culex* sp., *Uranotaenia* sp. and *Anopheles* sp. (Lounibos and Escher 1985; Tadei 1990).

Trichomycetes (Zygomycota) fungi are obligate symbionts associated with the digestive tracts of various insects and other arthropods. The relationship of Trichomycetes to their hosts is generally commensalistic, but it can be pathogenic or mutualistic (Lichtwardt 1986; López Lastra 1990). *Smittium morbosum* Sweeney can be pathogenic to species of *Anopheles*, *Aedes* and *Culex* (Sweeney 1981); other species may have this same relationship and with adequate studies could be used to control populations of species that are noxious to humans.

Knowledge of the distribution of mosquito species, their habitats and control agents is essential to developing integrated control methods for these insects, which can be very annoying at high density. In Central Amazonia, biological studies of *Mansonia* are limited to the reports by Ferreira (1999), Ferreira & Nunes de Mello (1999) about *Mansonia* eggs, larvae and pupae on *Eichhornia crassipes* (Mart.) Solms. (Pontederiaceae) and *Pistia stratiotes* Linnaeus; (Araceae). The objectives of the present study are to survey the *Mansonia* spp. associated with *E. crassipes* and *Ceratopteris* sp. at different water levels of the Negro River and to verify the larval infection of *Mansonia* spp. by Trichomycetes fungi.

Materials and Methods

The present study was done in Camaleão Lake, Marchantaria Island, Iranduba County (AM), Brazil (60º00'N; 3º15'S) (Figure 1). This island is located 15 km from the city of Manaus and it is surrounded by white water of the Solimões (Upper Amazon) River, near the meeting of the black and white waters of the Negro and Solimões Rivers. Lake Camaleão is part of the floodplain or várzea where the water is rich in sediments and nutrients, with distinct inundation and non-inundation periods (Junk 1973).

Information on the water level of the Negro River was used to determine the inundation period in the study area. These data were obtained at the Capitania dos Portos (port authority) in Manaus, AM, and were composed of daily measurements made at Manaus. The present study was done in four distinct periods: high water (June), falling water (August), low water (October) and rising water (March), 1998/99 in *Ceratopteris* sp. and *E. crassipes* meadows, both species of plant are known to hold *Mansonia* spp. (Ferreira 1999a, b).

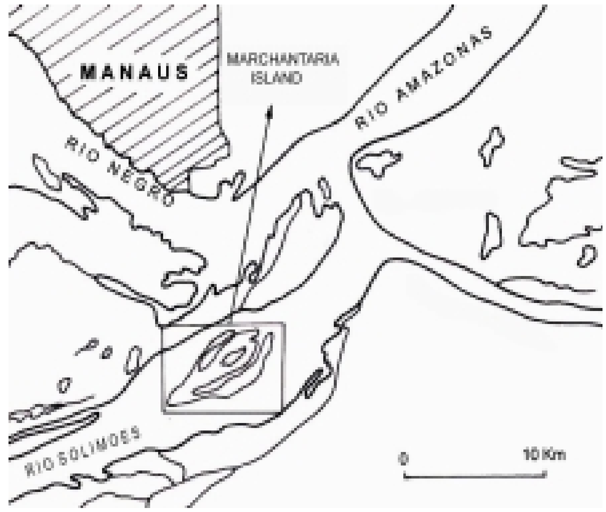


FIGURE1. Map of Marchantaria island in the Solimões river, Manaus, Amazonas, Brazil.

Sampling was done in four *E. crassipes* meadows and four *Ceratopteris* sp. meadows chosen randomly at points between the Solimões River and the center of the lake. In each meadow the plants were collected from the water and immediately placed in a net (40 x 30 x 10 cm) and transferred to a plastic container (55 x 30 x 7 cm). The plant roots were cut with scissors and knife. Eleven liters (0.011m^3) of roots were collected in each meadow. Before cutting the roots, the plants used to fill the 11-liter container were counted. Each plastic container of roots was closed with a lid and transported to the laboratory. The larvae that came out of the roots were collected using plastic pipettes and taken to the laboratory in a plastic container containing a small aquatic plant and water from the habitat. Identification to species was based on Ronderos & Bachman (1963), and only last-instar larvae were identified at the specific level.

A total of 190 last-instar larvae were dissected to observe the presence of Trichomycetes fungi associated with their digestive tracts, following the technique of Lichtwardt (1986). The technique consists of pulling out the median and posterior intestines through a ventral-median incision in the larva, placing these structures in distilled water under a cover slip and examining them under a compound microscope to verify the presence of Trichomycetes fungal structures.

Results and Discussion

A total of 705 *Mansonia* larvae were collected; 26% (n = 82) were in the first to third instars and 74% (n = 623) were in the fourth instar. Both sampled plant species showed differences in larval mean density (larvae/m^3 and larvae/plant), in the four periods evaluated (Tables I and II). Four *Mansonia* species were collected in the study area: *M. humeralis* (Dyar & Knab), *M. indubitans* Dyar & Shannon, *M. titillans* (Walker) and *M. amazonensis* (Theobald). *Mansonia indubitans* is reported for the first time in Camaleão Lake, the other three species were already reported, based on egg masses, by Ferreira & Nunes de Mello (1999). Ferreira (1999) studied *Mansonia* spp. in *E. crassipes* and *P. stratiotes*, reporting higher densities of larvae and pupae in *E. crassipes* than in *P. stratiotes* in the falling-water period (August-October). *Mansonia* (*Mansonia*) is neotropical, and some species such as *M. indubitans* and *M. titillans* reach the extreme southern portion of the nearctic region. According to Guimarães (1997), this subgenus has 13 species, 10 of which occur in Brazil and six in Amazonia (Cerqueira 1961).

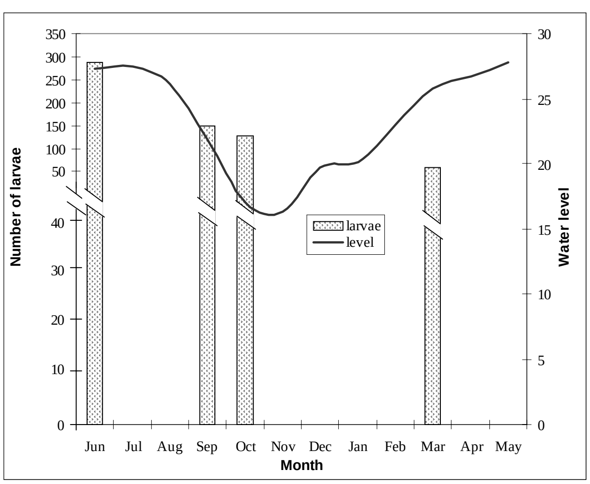
Mansonia humeralis was the most abundant species in the four periods evaluated and in both species of aquatic plant studied. These results agree with the observations of egg masses by Ferreira (1999), who reported that 74% of egg masses collected in Camaleão Lake belonged to *M. humeralis*.

Last-instar larvae of three *Mansonia* species were collected in the high-water period in *Ceratopteris* sp., four species in falling water, two in low water and none in rising water. In *E. crassipes*, four *Mansonia* species were collected in the first three periods evaluated, and in the fourth period three species were collected, *M. amazonensis* being the species that was not collected in this period.

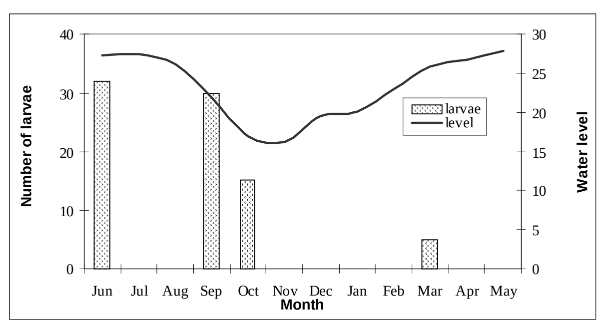
The data indicate that *Ceratopteris* sp. not only shelters a lower number of *Mansonia* spp., but also has a lower *Mansonia* species richness in some periods of the year. We suggest the following hypotheses to explain this fact: a) the size of the aerenquima in *E. crassipes* is larger than in *Ceratopteris* sp.; *Eichhornia* can therefore hold more oxygen and could maintain a greater number of larvae; b) the fact that the root tissues of *Ceratopteris* sp. are more rigid would impede perforation by the larval siphon; or c) based on the fact that many species in the Pteridophyta division have toxic secondary substances (Tokarnia et al. 1979), *Ceratopteris* sp. may have secondary substances that would be noxious or repellent to *Mansonia* larvae.

In the studied period mean density of *Mansonia* spp. larvae was 708 specimens/m^3 and 0.37 specimens/plant in *E. crassipes* and 93 specimens/m^3 and 0.03 specimens/plant in *Ceratopteris* sp. The highest numbers of larvae on the two plants occurred mainly in the low- and falling-water periods (Tables I, II; Figs 2a, b). It is possible that this happens because the larger amount of nutrients present in the rising period allow the growth rate to increase; aquatic plants proliferate and provide more shelter and food to associated fauna (Junk 1970).

None of the dissected last-instar larvae (n = 190) was infected with Trichomycetes species. In Argentina, García et al. (1995) observed that only 1.8% of dissected *M. titillans* and *M. indubitans* were infected with *Smittium* sp. (Trichomycetes: Harpellales). Experiments in the laboratory indicated that spore production decreases as a function of increasing temperature in three species of *Smittium* (Lichtwardt 1986). Since the water temperature of *Mansonia* spp. habitat in the study area was high (29°C to 32°C), it is possible that temperature is related to the absence of Trichomycetes in the dissected *Mansonia* spp. larvae.



a)



b)

FIGURE 2. Total number of *Mansonia* spp. larvae collected in Camaleão lake, Iranduba County, AM, on *E. crassipes* **(a)** and C*eratopteris* sp. **(b)**, in the high-water (June), falling-water (September), low-water (October) and rising-water (April) (1998-1999).

TABLE I. Mean density (larvae/m^3 and larvae/plant) and relative percentage (%) of *Mansonia* spp. (Diptera:Culicidae) on *Eichhornia crassipes* (Pontederiaceae), in Camaleão Lake, Iranduba County, Amazonas, Brazil, in the June 1998 – March 1999 period.

Species	High water Mean density (±SD)			Falling water Mean density (±SD)			Low water Mean density (±SD)			Rising water Mean density (±SD)	
	Larvae/ m^3	Larvae/plant	(%)	Larvae/m^3	Larvae/ plant	(%)	Larvae/m^3	Larvae/plant	(%)	Larvae/m^3	Larvae/plant
M. humeralis	3295 ± 6591	1.21 ± 2.42	81	1818 ± 1962	0.74 ± 0.68	63	2068 ± 591	1.19 ± 0.35	84	932 ± 1087	1.26 ± 1.43
M. indubitans	432 ± 864	0.6 ± 0.32	11	455 ± 324	0.22 ± 0.18	16	23 ± 45	0.01 ± 0.03	1	68 ± 87	0.09 ± 0.12
M. titillans	250 ± 500	0.09 ± 0.18	6	250 ± 227	0.12 ± 0.12	13	182 ± 210	0.10 ± 0.12	7	23 ± 45	0.03 ± 0.06
M. amazonensis	91 ± 182	0.3 ± 0.07	2	386 ± 381	0.19 ± 0.20	9	182 ± 129	0.10 ± 0.07	7	0	0

TABLE II. Mean density (larvae/m^3 and larvae/plant) and relative percentage (%) of *Mansonia* spp. (Diptera:Culicidae) on *Ceratopteris* sp. (Parkeriaceae), in Camaleão Lake, Iranduba County, Amazonas, Brazil, in the June 1998 – March 1999 period.

Species	High water Mean density (±SD)			Falling water Mean density (±SD)			Low water Mean density (±SD)			Rising water Mean density (±SD)	
	Larvae/ m^3	Larvae/plant	(%)	Larvae/m^3	Larvae/ plant	(%)	Larvae/m^3	Larvae/plant	(%)	Larvae/m^3	Larvae/plant
M. humeralis	432 ± 402	0.15 ± 0.14	83	364 ± 668	0.09 ± 0.14	64	250 ± 261	0.07 ± 0.07	92	0	0
M. indubitans	68 ± 87	0.02 ± 0.03	13	159 ± 318	0.1 ± 0.19	28	23 ± 45	0.01 ± 0.01	8	0	0
M. titillans	23 ± 45	0.01 ± 0.01	4	23 ± 45	0.00 ± 0.01	4	0	0	0	0	0
M. amazonensis	0	0	0	23 ± 45	0.01 ± 0.01	4	0	0	0	0	0

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