

Crepuscular activity of culicids (Diptera, Culicidae) in the peridomicile and in the remaining riparian forest in Tibagi river, State of Paraná, Brazil

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ABSTRACT. Crepuscular activity of culicids (Diptera, Culicidae) in the peridomicile and in the remaining riparian forest in Tibagi river, State of Paraná, Brazil. Human-attracted mosquitoes were collected for one hour, around sunset time (half hour before and half after), from April to December 2006, in two environments (riparian forest and near houses), in Tibagi river basin, Palmeira municipality, State of Paraná. Seven-hundred forty-nine mosquitoes, belonging to 13 species, were collected. *Psorophora champerico* Dyar & Knab, 1906 (42.86%) and *Psorophora discrucians* (Walker, 1856) (40.59%) were the most frequent species. No significant differences between quantities of *Ps. champerico* ($t = -0.792$; d.f. = 16; $p = 0.43$) and *Ps. discrucians* ($t = 0.689$; d.f. = 16; $p = 0.49$) obtained in riparian forest and near houses were observed, indicating similar conditions for crepuscular activity of these species in both environments. *Psorophora champerico* and *Ps. discrucians* responded (haematophagic activity) to environmental stimuli associated with the twilight hours differently in distinct habitats studied. The former species is registered for the first time in the Atlantic forest biome.

KEYWORDS. Crepuscular activity; mosquitoes; *Psorophora discrucians*; *Psorophora champerico*.

RESUMO. Atividade crepuscular de culicídeos (Diptera, Culicidae) no peridomicílio e remanescentes de matas ciliares do Rio Tibagi. Estado do Paraná, Brasil. Mosquitos atraídos por humanos foram coletados por uma hora em torno do crepúsculo vespertino (meia hora antes e meia hora depois), de abril a dezembro de 2006, em dois locais (mata ciliar e peridomicílio) na bacia do Rio Tibagi, município de Palmeira, Estado do Paraná. Foram capturados 749 mosquitos distribuídos em 13 espécies. *Psorophora champerico* Dyar & Knab, 1906 (42,86%) e *Ps. discrucians* (Walker, 1856) (40,59%) foram as espécies mais frequentes. Não foram registradas diferenças significativas entre as médias de indivíduos capturados entre os pontos de mata ciliar e peridomicílio para *Ps. champerico* ($t = -0,792$; g.l. = 16; $p = 0,43$) e para *Ps. discrucians* ($t = 0,689$; g.l. = 16; $p = 0,49$). Isto demonstra que os dois ambientes estudados fornecem condições semelhantes para a atividade crepuscular destas espécies. *Psorophora champerico* e *Ps. discrucians* responderam (atividade hematofágica) aos estímulos ambientais associados ao horário crepuscular de forma distinta nos diferentes habitats analisados. Foi registrada pela primeira vez a presença de *Psorophora champerico* no bioma Mata Atlântica.

PALAVRAS-CHAVE. Atividade crepuscular; mosquitos; *Psorophora discrucians*; *Psorophora champerico*.

Because of transmission of several pathogens and disturbance caused by bites, studies on the ecology of mosquitoes are very important for public health. In South region of Brazil, urbanization and exploitation of environment have caused several modifications in areas originally covered by forest. After these modifications, some species, such as *Ochlerotatus scapularis* (Rondani, 1848) e *Psorophora ferox* (Humboldt, 1819) could proliferate, becoming pests, sometimes transmitting viruses and parasites (Forattini *et al.* 1981; Walsh *et al.* 1993; Marchi *et al.* 2010).

In Paraná state, most studies have been developed in eastern region, because of the presence of extensive forested areas (e.g. Sant'Ana & Lozovei 2001; Silva *et al.* 2004; Bona & Navarro-Silva 2008). In the western region of the state, forests have been reduced to small fragments near rivers and creeks because of the land use mainly for agriculture. Although the mosquito fauna around Londrina municipality was studied (e.g. Lopes *et al.* 1993, 2002), mosquito species distribution in that area is still poorly known.

The existence of forest fragments near rivers allows contact between mosquitoes and human populations, the former sometimes biting near domiciles. The present work aims to study the crepuscular biting activity of mosquitoes in two areas, one in peridomicile and other inside a riparian forest, near the Tibagi River, in the midwest region of the State of Paraná.

MATERIAL AND METHODS

The study area is situated in Atlantic Forest biome, and its climate is subtropical humid, with no dry season; mean annual temperature is 18°C and rainfall is 1,550 mm (Mendonça 2000). Collections were carried out in a locality situated near Tibagi river, at Palmeira municipality, Paraná state (25°23'16"S, 49°58'58"W, 820 m altitude). There are two houses in the location, one is always occupied by three inhabitants, and the other occasionally by eight. At one side of houses, at 300 m, there is an area, utilized for sugar cane

and corn plantations, and on the other side, at 30 m, riparian vegetation around Tibagi River.

Two collection sites, separated by 800 m, were selected: (1) near both houses, in the peridomicile, and (2) in a riparian forest, on river margin. The riparian forest was 20 m wide, and it contains bushes and trees, varying from dense to more open distributed, with some ground depressions that accumulate water from both rain and river flooding.

Nine field collections were carried out from April to December 2006. Collections started 30 minutes before sunset (periods 1 and 2) and lasted for 30 minutes after sunset (periods 3 and 4). The local starting time fluctuated according to sunset hour, previously informed by Instituto Agrônômico do Paraná (IAPAR), from 05:09 to 06:30 p.m., and ended from 06:09 to 07:30 p.m. Collectors arrived 30 minutes before starting collections in order to prevent "intrusion effect" (Forattini *et al.* 1981).

Two collectors worked in each point, one attracting mosquitoes and the other collecting them, utilizing a battery-fed suction device, before mosquito could bite the person. Collector vials were replaced every 15 minutes. Mosquitoes were deposited in Coleção Entomológica Pe. J. S. Moure, in Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná.

Williams means (X_w) multiplied by 100 (Forattini *et al.* 1981) were estimated for the most frequent species. Comparisons between means of these species and between collection points were made by t test, using Statistic 7.0 software (StatSoft). Data were normalized by formula $Y' = (Y+0.5)^{1/2}$, and were validated by Shapiro-Wilk test of normality.

Adult mosquitoes were identified using descriptions and identification keys by Dyar & Knab (1906), Lane (1953),

Consoli & Lourenço-de-Oliveira (1994) and Forattini (2002). Genera and subgenera of Culicidae were abbreviated according to Reinert (1975) and *Ochlerotatus* was considered as a genus (Reinert 2000).

RESULTS AND DISCUSSION

Seven-hundred forty-nine mosquitoes of eight genera and 13 species were collected (Table I). *Psorophora* was the most abundant (84.25%) and, also the most diversified genus, with four species. *Psorophora* includes several aggressive and anthropophilic species, is active during crepuscular period, proliferates in sylvatic degraded environments, and their immature forms are associated to temporary larval habitats (Teodoro *et al.* 1994; Forattini 2002; Oscherov *et al.* 2007).

Psorophora champerico (42.86%) e *Ps. discruciens* (40.59%) were the most abundant species in collections. The last one had been collected during vespertine crepuscule in residual forests and modified vegetation, in several states of Brazil (Forattini *et al.* 1968; Consolim *et al.* 1993; Natal *et al.* 1998; Marcondes *et al.* 2006). Distribution of *Ps. champerico* includes Central America, northern part of South America and Amazon region (Lane 1992; Reinert *et al.* 2005). This is the first report of the species in Atlantic forest, near the southern limit of the bioma, indicating underestimation of its distribution (Tabarelli *et al.* 2005).

The amount of specimens of both species varied among collections with high standard deviations (*Ps. champerico*: 7.56 ± 10.49 in riparian forest and 12.50 ± 22.62 in peridomicile; *Ps. discruciens*: 9.60 ± 23.54 and 5.60 ± 10.97 , respectively). Variation was probably caused by seasonal fluctuation in temperatures and rain and to transitory nature of

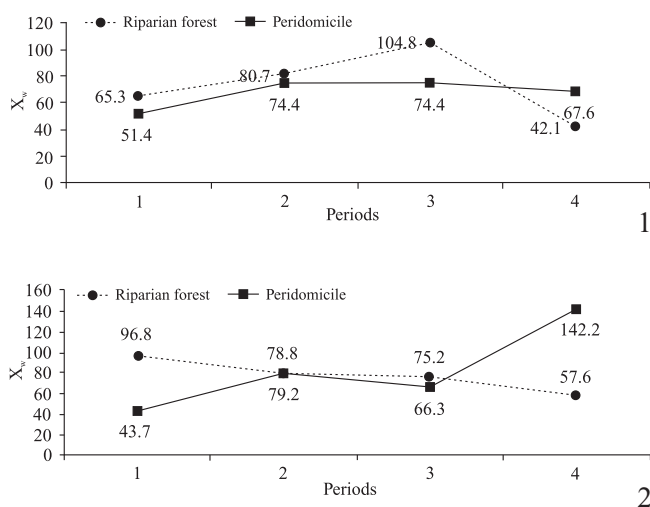
Table. I. Culicidae collected in riparian forest and peridomicile areas in Palmeira municipality, State of Paraná, Brazil, from April to December of 2006.

Species	Peridomicile	Riparian forest	Total	%
Anophelinae				
<i>Anopheles strodei</i> Root, 1926	11	13	24	3.20
Culicinae: Aedini				
<i>Ochlerotatus pennai</i> (Antunes & Lane, 1938)	1	–	1	0.13
<i>Ochlerotatus scapularis</i> (Rondani, 1848)	6	10	16	2.14
<i>Ochlerotatus serratus</i> (Theobald, 1901)	23	33	56	7.48
<i>Psorophora albigena</i> Peryassu, 1908	–	1	1	0.13
<i>Psorophora albipes</i> (Theobald, 1907)	2	3	5	0.67
<i>Psorophora champerico</i> (Dyar & Knab, 1906)	200	121	321	42.86
<i>Psorophora discruciens</i> (Walker, 1856)	111	193	304	40.59
Culicinae: Aedeomyiini				
<i>Aedeomyia squamipennis</i> (Lynch Arribáizaga, 1878)	1	–	1	0.13
Culicinae: Culicini				
<i>Culex vaxus</i> Dyar, 1920	–	7	7	0.93
Culicinae: Mansoniini				
<i>Coquillettidia juxtamansonia</i> (Chagas, 1907)	1	–	1	0.13
Culicinae: Sabethini				
<i>Runchomyia reversa</i> Lane & Cerqueira, 1942	2	8	10	1.34
<i>Trichoprosopon soaresi</i> Lane & Cerqueira, 1942	–	2	2	0.27
Total	358	391	749	100.00

larval habitats. This influence of temperature and other seasonal factors on mosquitoes was also noted by Silva & Lozovei (1998) in a fragment of Atlantic Forest in the Paraná state.

There was no significant difference between the mean amount of mosquitoes collected between points 1 and 2 for *Ps. champerico* ($t = -0.792$; d.f. = 16; $p = 0.43$) and *Ps. discruciens* ($t = 0.689$; d.f. = 16; $p = 0.49$). This shows that, even having potential larval habitats only in the riparian forest, both environments provided similar conditions for adults activity of both species. These results contrast with those of Guimarães *et al.* (1989) and Barbosa *et al.* (2008), which showed, also in rural areas, that species of *Psorophora* have a lower activity around houses, compared to forest fragments.

Biting activity of *Ps. champerico* in peridomicile increased from period 1 ($X_w = 43.7$) to period 4 ($X_w = 142.2$), while in riparian forest, Williams means were respectively 96.8 and 57.6 (Fig. 1). The biting activity of *Ps. discruciens* also increased from period 1 ($X_w = 51.4$) to period 4 ($X_w = 61.6$) in peridomicile, and in riparian forest X_w were respectively 65.3 and 42.1 (Fig. 2). Propensity of *Psorophora* mosquitoes to bite preferably in peridomicile in the end of crepuscular period can have epidemiological implications and should be more extensively studied. Gomes *et al.* (2010) also observed influence of environment on activity peak of mosquitoes.



Figs. 1–2. Williams's means (X_w) of *Psorophora champerico* (1) and *Psorophora discruciens* (2) collected in vespertine crepuscular period, separated in 15-minutes periods (1, 2, 3 and 4) in riparian forest and peridomicile at Palmeira municipality, state of Paraná, Brazil, from April to December 2006.

Thus, the dominance of species of *Psorophora* in relation to other groups of Culicidae captured in the Tibagi area, both in peridomicile and in the riparian forest, indicates a possible epidemiological importance of these mosquitoes when they feed upon humans during the crepuscular period. This study demonstrated that species as *Ps. champerico* and

Ps. discruciens show biting pattern similar in peridomicile area and riparian forest, but their activity peaks during the twilight can vary depending on the habitat.

ACKNOWLEDGEMENTS

We thank CNPq for Ph. D. scholarship for ACDB and GAM. Aristides Fernandes (DE/FSP/USP), for helping in the identification of some mosquitoes. Everaldo Hass for authorizing collection in his property and to biologist Cezar Capriglioni Carvalho Junior for assistance in the field collection of mosquitoes.

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