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SCIENTIFIC NOTE

INFLUENCE OF CLIMATIC FACTORS ON *PSOROPHORA* (*JANTHINOSOMA*) *ALBIGENU* IN PANTANAL LANDSCAPE, MATO GROSSO STATE, BRAZIL

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ABSTRACT. In order to assess the influence of climatic variations in temperature, relative humidity, and rainfall upon the population density of *Psorophora albigenu* (Peryassú, 1908) in its natural habitat, samplings were carried out at different times of the year in Mato Grosso, Brazil. Mosquitoes were captured with the use of suction tubes and Shannon traps during 2 different periods of the day and 1 at night. A total of 2,637 *Ps. albigenu* specimens were captured, including 497 (18.8%) in March 2009, 1,240 (47.0%) in January 2010, and 484 (18.4%) in January 2011. These months represented 84.2% of this species occurrence during the collection period. November was the month of the lowest occurrence of the species, with only 10 (0.4%) specimens collected in 2009 and 8 (0.3%) specimens in 2010. The climatological variable that presented a linear correlation coefficient within the 95% confidence interval was rainfall, with a linear correlation indicator of 0.793, above the relevance factor of 0.708, showing a relationship between the frequency of *Ps. albigenu* and rainfall of the region.

KEY WORDS Climatic variables, Culicidae, landscape ecology, *Psorophora albigenu*

The genus *Psorophora*, included in the subfamily Culicinae, is only present in the Americas and is currently divided into 3 subgenera, comprising 42 species in the neotropical region (Consoli and Lourenço-de-Oliveira 1994). The species *Psorophora albigenu* (Peryassú) is included in the subgenus *Janthinosoma*, and its distribution is restricted to South America, covering Argentina, Bolivia, Brazil, Colombia, Paraguay, Peru, Suriname, Uruguay, and Venezuela (Forattini 2002).

Studies regarding the genus *Psorophora* are very scarce, particularly concerning *Ps. albigenu*. This study presents the opportunity to analyze the ecological and biological configurations of this species. We also hope to evaluate behavior specificities that are often observed in exclusively wild-type mosquitoes, which can be found in different parts of Brazil.

In Brazil, more than 200 different arboviruses have been isolated, of which approximately 40 are pathogenic to humans (Figueiredo 2007). Among the 5 most important arboviruses to public health, responsible for severe disease or death, two are transmitted by species of the genus *Psorophora*. Additionally, even though some species of *Psorophora* have already been found naturally infected with arboviruses such as Ilhéus, Mayaro, western equine encephalomyelitis (WEE), Rocio, Venezuelan equine encephalitis, and others (Rosa et al. 1998), members of this genus are not generally considered effective human pathogen vectors, mainly because of their eclectic hematophagy.

Little is known about the vectorial capacity of *Ps. albigenu*, as it has not yet been found infected under natural conditions. However, in laboratory infection tests, this species has shown to be susceptible to WEE virus, and may act as a possible enzootic vector of this disease (Turell et al. 2008).

High population density and its impact on human activities represents the predominant problem associated with these mosquitoes. This has been reported in some regions of North America in relation to *Psorophora columbiae* (Dyar and Knab), *Psorophora cyanescens* (Coquillett), and *Psorophora varipes* (Coquillett). The increased mosquito density, resulting from agricultural practice and artificial irrigation, produces a severe pest problem for both humans and domestic animals, consequently producing economic devaluation for these areas (Forattini 2002).

The present study has the goal of evaluating how possible climatic variations in temperature, relative humidity (RH), and rainfall can influence the population density of *Ps. albigenu* in the area of the Transpantaneira Park Road, Mato Grosso, Brazil (TPR).

Psorophora albigenu specimens were captured on Transpantaneira Park Road (TPR), located 65 km from Poconé (MT), southwest of the state of Mato Grosso near the border with the state of Mato Grosso do Sul, at the confluence of the Paraguay and Cuiabá rivers.

The climate of this region is categorized as Aw according to the classification of Köppen. It is a typically tropical region, where rainfall controls the

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river regime, which, in turn, determines the flood cycle. There are two well-defined seasons: dry (May to September) and rainy (October to April). Rainfall months are responsible, on average, for more than 80% of annual rainfall, ranging from 1,000 mm to 1,200 mm (Schults and de-Lamonica-Freire 2000) and the flood period usually occurs between January and April (Rebellato and Nunes-da-Cunha 2005). With the exception of winter months (June to August) when the temperature on certain days drops below 10°C, the temperature averages at other times of the year are higher than 25°C, with maximums exceeding 40°C.

The predominant vegetation cover consists of savanna subformations, forest savanna (cerradão), savanna (cerrado), grassy savanna (wetland), savanna park (murundus field), and ciliary forest (Loureiro et al. 1982). In addition, it exhibits seasonally flooded forest, deciduous forest (dry forest), semi-deciduous seasonal forest, and evergreen seasonally flooded forest (landizal) (Campos-Filho 1998).

During the flood season, which begins in the summer, the depressions are flooded forming large lakes (bays), for about 6 months, characterized by the presence of macrophytes (Ministério Do Meio Ambiente [MMA] 2004).

The sampling site located at 16°39′54.3″S and 56°47′38.2″W has an altitude of 114 m in the plain area, with arboreal vegetation, flooded field, and aquatic vegetation. This area is 55 km 55 of the MT-060, known as Transpantaneira highway.

Specimens were collected every 2 months between March 2009 and January 2011, comprising 12 samplings, in 3 periods throughout the day: diurnal (10 a.m. to 12 p.m and 2 p.m. to 4 p.m.) and twilight (6 p.m. to 8 p.m.). At each period, mosquitoes occasionally attracted by the team members or found in surrounding vegetation were captured with manual suction tubes. In the crepuscular and nocturnal periods, an automatic Centers for Disease Control and Prevention (CDC) trap with CO_2 (dry ice) (BioQuip®, Ranch Dominguez, CA) and Shannon trap were installed 2 m above the ground level.

During sampling, temperature and air RH variations were measured hourly. A thermohydrometer was fixed at the collection site, one meter above ground. Measurements of rainfall averages were obtained from the Center for Weather Forecasting and Climate Studies (CPTEC / INPE). The climatic data from the capture sites were transcribed into the field form with location descriptions and sample dates.

Mosquitoes were identified by direct observation of the morphological characters evidenced by the stereoscopic microscope and based on dichotomous keys by Lane and Cerqueira (1942), Lane (1953), Consoli and Lourenço-de-Oliveira (1994), and Forattini (2002). Abbreviated names of genera and subgenera were used in line with Reinert (2001). All identified specimens were incorporated into the Entomological Collection of the Oswaldo Cruz Institute, Fiocruz.

To analyze the species seasonal frequency data, we calculated the percentage distribution in each collection period, throughout the months. In order to know the possible alterations in the frequency of *Ps. albigenu* and the relationship between the faunal distribution and the local climatic variables (temperature, RH, and rainfall), analyses were performed with the use of Pearson's linear correlation coefficient, with a confidence range ratio of 95%, where the probability of 2 variables being above this value without having a true correlation of 5%. The relevance factor for the number of samples used in this study was 0.708.

A total of 2,637 *Ps. albigenu* specimens were collected, including 497 (18.8%) in March 2009, 1,240 (47.0%) in January 2010 and 484 (18.4%) in January 2011, representing 84.2% of the species occurrence throughout the collection period. November was the month of the lowest occurrence of the species, with only 10 (0.4%) specimens collected in 2009 and 8 (0.3%) specimens in 2010 (Table 1).

The monthly temperature data obtained at CPTEC indicated a pattern in the region, with the lowest temperatures recorded in May and July 2009 (25.5°C and 24.0°C) and 2010 (23.8°C and 23°C) and the highest temperature recorded in September 2010 (29.4°C). Relative humidity data showed low variation, except for a sudden drop in September 2010 (45.4%). Analysis of monthly precipitation data showed that the highest indices were observed in March 2009 (274.5 mm), in the period between November 2009 and March 2010 (variation between 155 and 419.5 mm) and in the period between November 2010 and January 2011 (variation between 159.3 and 337.2 mm). The lowest indices were registered in July 2009 (0.5 mm) and between July and September 2010, with a variation of 4.8 to 4.4 mm, characterizing the driest months.

The linear correlation coefficient between air temperature and the number of specimens found was 0.120, which implies a nonsignificant correlation between them. As shown in Fig. 1a, the number of specimens found did not change significantly in the months with higher temperature averages in relation to the months with lower mean values.

The RH presented a correlation index with specimen number of 0.431, which was below the indicator for a 95% confidence interval. Although it showed a slight similarity in its curve of temporal variation, the index found indicate that the RH was not a factor in the incidence of *Ps. albigenu* specimens (Fig. 1b).

The only climatological index that presented a linear correlation coefficient within the 95% confidence interval was rainfall, with a linear correlation indicator of 0.793, above the relevance factor of 0.708. Figure 1c presents the coincident indices, which show a strong correlation between the

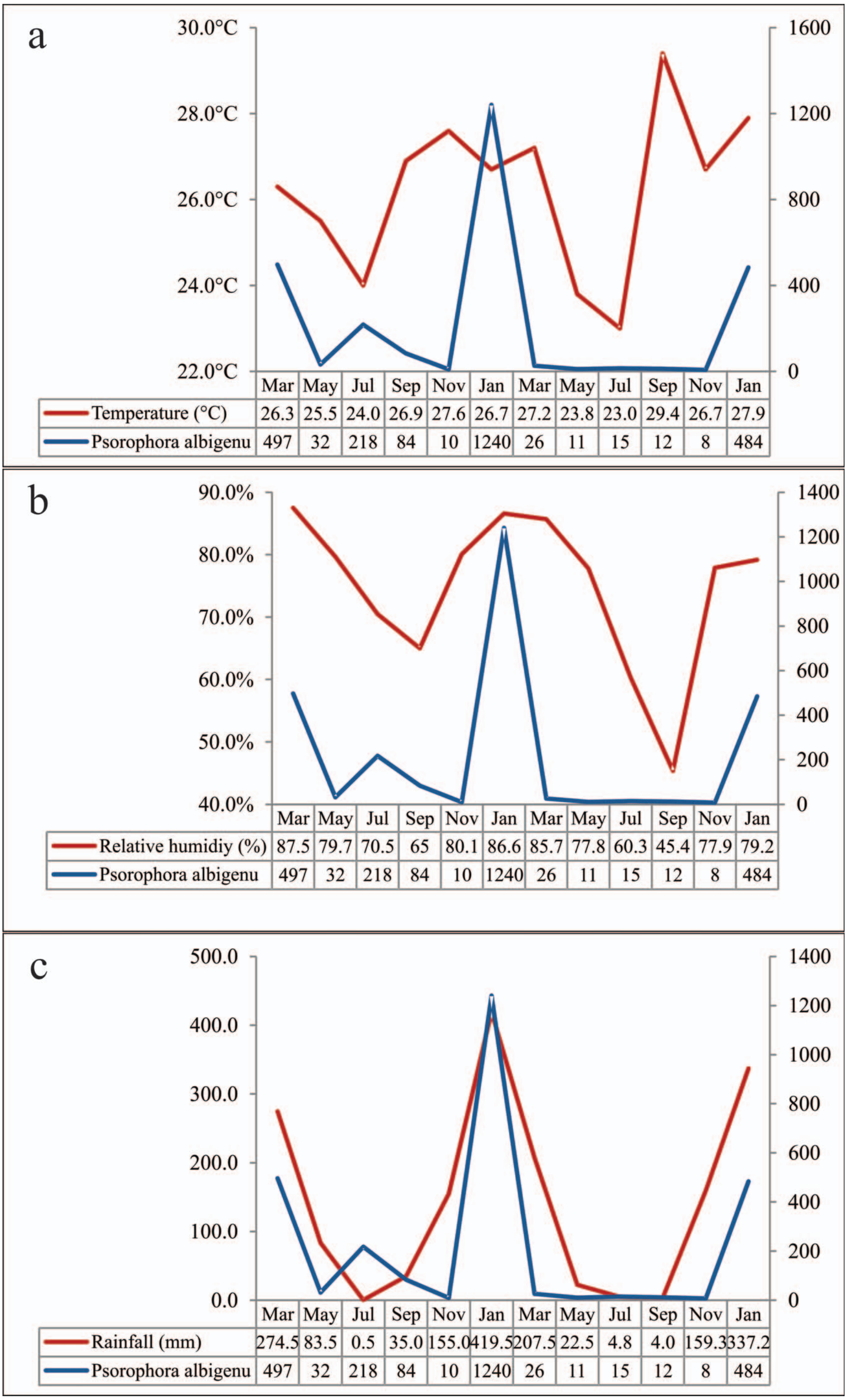

Fig. 1. Influence of the climatic factors on *Psorophora albigenu* in the period of 2009/2011, around the Transpantaneira Park Road, Pocone Municipality, Mato Grosso, Brazil. (a) Air temperature influence on the frequency of *Ps. albigenu*. (b) Air humidity influence on the frequency of *Ps. albigenu*. (c) Precipitation influence on the frequency of *Ps. albigenu*.

Table 1. Distribution of *Psorophora albigenu* between the months of March 2009 and January 2011 in the collection area, around the Transpantaneira Park Road, Poconé Municipality, Mato Grosso, Brazil.[1]

	2009–2011																								
	Mar		May		Jul		Sep		Nov		Jan		Mar		May		Jul		Sep		Nov		Jan		
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	Total
OATM	295	59.4	26	81.3	189	86.7	68	81.0	4	40.0	351	28.3	4	15.4	2	18.2	11	73.3	4	33.3	2	25.0	129	26.7	1,085
SH	0	0.0	6	18.8	18	8.3	0	0.0	0	0.0	84	6.8	11	42.3	5	45.5	4	26.7	0	0.0	0	0.0	28	5.8	156
CDC	202	40.6	0	0.0	11	5.0	16	19.0	6	60.0	805	64.9	11	42.3	4	36.4	0	0.0	8	66.7	6	75.0	327	67.6	1,396
Total	497	18.8	32	1.2	218	8.3	84	3.2	10	0.4	1240	47.0	26	1.0	11	0.4	15	0.6	12	0.5	8	0.3	484	18.4	2,637

[1] OATM: occasionally attracted by the team members, SH: Shannon trap, CDC: automatic CDC with CO_2 (dry ice).

frequency of *Ps. albigenu* and the rainfall of the region.

The studied area presents a period of drought between autumn and mainly winter (July to September), with mild temperatures, and a period of higher rainfall in the summer (January to March) and spring (October to December), generally with a high RH.

Considering the general sum of the distribution of *Ps. albigenu* over the course of one year, the period that was most favorable for the occurrence of this species in the TPR was between summer and autumn, during the rainy season, which was confirmed by linear correlation analysis, where the analyzed specimens presented positive correlation for rainfall.

This data are in agreement with Silva et al. (2010) and Guimarães et al. (2001), according to which, in the tropical climate, the frequency of mosquitoes is mainly controlled by rainfall and the seasonal distribution of species of the genus *Psorophora* occurs mainly during rainy months. Some authors have observed that there is an association between breeder availability and rainfall (Hayes and Charlwood 1979; Guimarães et al. 2000), which is fundamental for the development of immatures.

Guimarães et al. (2000) reported that variations in temperature and RH also directly influenced the development and activity of mosquitoes, which might disappear completely during the driest months of the year. This was not observed in this study, considering that the influence of other abiotic factors on the *Ps. albigenu* population, such as humidity and temperature, did not correlate with the population density of mosquitoes.

The period that was most favorable for *Ps. albigenu* occurrence in TPR was between summer and autumn, indicating the preference of the species during the rainy season. The variable pluviometric precipitation showed a positive correlation with population density of *Ps. albigenu*, whereas the variables of RH and temperature did not present correlation for the distribution of the species.

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