Host plant selection of two *Mansonia* Blanchard species (Diptera: Culicidae) in a heterogeneous habitat of Buenos Aires City, Argentina

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ABSTRACT: Larvae and pupae of the genus *Mansonia* Blanchard attach to the roots of aquatic plants by means of modified structures to obtain oxygen. A study of the association of larval *Ma. indubitans* and *Ma. titillans* with floating macrophytes was conducted at Macáes Pond, Argentina. Fifty-four sampling units were taken from January to May 2003. Three genera of host plants were considered: *Pistia, Limnobium,* and *Salvinia.* A total of 402 immatures of *Ma. indubitans* and 217 of *Ma. titillans* were captured and associations between *Mansonia* immatures and roots of each genera were assesed. Significant association was noted between *Ma. indubitans* and certain host plant species (K-W H=42.74, df=2, p<0.001). The same result was observed for *Ma. titillans* (K-W H=23.42, df=2, p<0.001). Both *Mansonia* species utilized roots of *P. stratiotes* in significantly higher proportions than expected by random selection. Both species showed significant negative association with *Salvinia* spp., while no clear relationships were detected with *L. laevigatum. Journal of Vector Ecology* 30 (2): 201-205.

Keyword Index: Mansonia, habitat selection, mosquitoes, host plant.

INTRODUCTION

Animals perceive their environment as a heterogeneous mosaic of habitats (Sutherland and Poppy 1997) and display selective adaptations for occupying those sites with favorable conditions for their breeding, growth, and survival (Greene and Stamps 2001).

Several culicid species are adapted to aquatic habitats with the presence of floating plants (Poi de Neiff and Neiff 1980, Balseiro 1986, Lounibos and Dewald 1989, Lounibos and Escher 1985). Among them, larval instars and pupae of species of the genus *Mansonia* Blanchard attach to roots of aquatic plants by means of modified structures to obtain oxygen (Ronderos and Bachmann 1964). The genus *Mansonia* is represented by twenty-three species, some of which are vectors of filariasis (Forattini 1965). In spite of this fact, very few studies have been reported regarding *Mansonia* immatures and host plant associations.

Ma. indubitans Dyar and Shannon and *Ma. titillans* Walker share a wide geographic range in America, from the southern United States down to Buenos Aires Province in Argentina (Forattini 1965). In this area, they associate with a diverse range of host plant species (Slaff and Haefner 1985, Almiron and Brewer 1996, Ferreira et al. 2003). Ferreira (1999) and Ferreira et al. (2003) reported a differential association of *Ma. humeralis, Ma. indubitans, Ma. titillans* and *Ma. amazonensis* to *Eichhornia crassipes* and *Pistia stratiotes* in the central Amazon region. Roots of *Eichhornia crassipes* had higher larval numbers of *Ma. indubitans* and

Ma. titillans, compared to *Ceratopteris* sp. (Ferreira et al. 2003). In Argentina, García et al. (1995) reported the only work concerning immature seasonality and abundance of *Mansonia* in pure stands of *P. stratiotes* in Punta Lara, Province of Buenos Aires.

The aim of the present study was to determine host-plant selection and to survey the spatial distribution of *Ma. indubitans* and *Ma. titillans* in a heterogeneous habitat of floating macrophytes.

MATERIALS AND METHODS

Field studies were conducted at the Macáes Pond, located in Costanera Sur Reserve (S 34°36'26.7" O 58°20'54.4"), Buenos Aires City, Argentina. This freshwater habitat was overgrown with floating plants, mainly *Salvinia* spp. (*S. herzogii* de la Sota and *S. rotundifolia* Wlld.), *Pistia stratiotes* L., and *Limnobium laevigatum* (H. and B.) Heine, representing a heterogeneous environment for immature instars of *Mansonia*.

Fifty-four quadrangular sampling units of 0.14 m² were randomly taken from January to May 2003. The species and number of plants per sampling unit were registered. Because of the difficult identification of species level in the field, individuals of *Salvinia* were considered at generic level. A total of three genera of host plants were considered: *P. stratiotes*, *L. laevigatum*, and *Salvinia* spp. Each plant with a single differentiated root was considered as an individual. Individual plants joined to each other with a stolon were separated before larval collection. The number of larvae and pupae was counted for each plant. Immatures were obtained by shaking plants vigorously in a plastic container with water and collecting them with plastic pipettes. They were fixed *in situ* with 80% ethanol. Fourth-instar larvae and pupae were identified to specific level according to Ronderos and Bachmann (1963). Early-instar larvae were not taken into account in this study.

The monthly abundance of host plants and immatures (larvae and pupae) per plant between plant species was compared with the Kruskal-Wallis test, followed by *a posteriori* comparisons using the Mann-Whitney test. The frequency of both species of *Mansonia* on different plant species was tested by the standard Chi-Square test.

In addition, we calculated the overlap in resource use of both *Mansonia* species with Hurlbert's Index (Hurlbert 1978), $L=\Sigma(pij*pik/ai)$; where *pij* is the proportion of plant i of the total plants utilized by *Mansonia* immatures of species j; *pik* is the proportion of plant *i* of the total plants utilized by *Mansonia* immatures of species j; *pik* is the proportion of plant *i* of the total plants utilized by *Mansonia* immatures of species j; *pik* is the proportion of plant *i* of the total plants utilized by *Mansonia* immatures of species *k*, and *ai* is the proportional amount of plant *i* in the environment. This index takes a value of 0 if both species share no resources, it is 1 when the two species utilize each resource in proportion to its abundance, and >1 when both species utilize certain resources in selective ways and the preference of the two species tends to coincide (Krebs 1999).

The abundance of *Ma. indubitans* and *Ma. titillans* was correlated (Spearman rank correlation) with the number of plants for each species.

RESULTS

During the five months of sampling, the proportion of host plant species was constant and the heterogeneous habitat showed the same pattern of abundance of vegetal species. The mean number of host plant species was compared for each month, but no significant differences were detected for *P. stratiotes* (K-W H=1.29, df=4, *P*=0.862), *Salvinia* spp. (K-W H=2.05, df=4, *P*=0.725), and *L. laevigatum* (K-W H=8.03, df=4, *P*=0.09) (Figure 1).

A total of 402 immatures of *Ma. indubitans* and 217 of *Ma. titillans* were captured. Significant association was noted between *M. indubitans* and the host plant species (K-W H=42.74, df=2, P<0.001). The same result was observed for *M. titillans* (K-W H=23.42, df=2, P<0.001). Immatures of *M. indubitans* were significantly more abundant on *P. strtatiotes*, and no differences were found between *P. stratiotes* and *L. laevigatum* for *M. titillans*. Both *Mansonia* were very scarce on *Salvinia* spp (Table 1). No significant differences of abundance per plant were noted between *M. indubitans* and *M. titillans* for any host plant species (K-W H=0.43, df=2, P=0.507).

The frequency of both culicids on roots of each type of plant showed significantly higher frequencies of *Ma. indubitans* than *Ma. titillans* on roots of *P. stratiotes* (χ^2 =75.95, df=1, *P*<0.001), but no difference was registered on roots of *L. laevigatum* (χ^2 =2.47, df=1, *P*= 0.116). The calculated Hurlbert's Index, L= 4.909, suggested that both

Mansonia species utilized roots of *P. stratiotes* in significantly major proportions rather than selecting resources at random.

The total amount of *Ma. indubitans* immatures was significantly correlated to the plant number of *P. stratiotes* (Rs=0.716, P<0.001) per samplig unit. On the other hand, a negative correlation was registered between *Ma. indubitans* immatures and plant number of *Salvinia* spp. (Rs=-0.637, P<0.001). No significant relationship between *Ma. indubitans* and *L. laevigatum* was registered (Rs=-0.228, P=0.096).

Similar results were obtained from *Ma. titillans*. This species showed a significant positive relationship with *P. stratiotes* (Rs=0.489, P<0.001), as well as significant negative association with *Salvinia* spp. (Rs=-0.579, P<0.001), and no significant correlation with *L. laevigatum* (Rs=-0.001, P=0.994).

DISCUSSION

A strong association between *Mansonia* immatures and *Pistia stratiotes* as host plants in subtropical areas of South America is documented (Neiff and Poi de Neiff 1978, Poi de Neiff 1983, García et al. 1995). However, previous works did not focus on the relationship between the abundance of immature instars of *Mansonia* and the availability of different species of host plants. Our results show a selective *Pistia stratiotes* pattern of root utilization by *Mansonia indubitans* and *Ma. titillans* in Macáes Pond.

Compared with results obtained in Florida by Slaff and Haefner (1985) and Ferreira (1999) for the Amazon region, the abundance of *Mansonia* on *P. stratiotes* reached lower levels in Buenos Aires. The study area is near the southern extreme of the distribution of *P. stratiotes* (Morrone and Zuloaga 1996) and this plant undergoes seasonal growth in accordance with a report by Dewald and Lounibos (1990) in North America. As a result, the sampling was restricted to the period in which the coverage of each host plant was constant.

Plant abundance and association patterns of both Mansonia showed similar trends, but in the case of M. titillans, analysis of abundance did not show differences between P. stratiotes and L. laevigatum. Conversely, frequency relationships between Ma. indubitans and Ma. titillans were 2:1 in the heterogeneous environment of Macáes Pond. A similar ratio concerning the pure stands of P. stratiotes was extremely biased to Ma. indubitans (García et al. 1995). However, it is interesting to point out that in Macáes Pond the frequency ratio of Ma. indubitans and Ma. titillans is equal on roots of L. laevigatum. These observations, in addition to our results, suggest that M. indubitans exhibits a closer relation with P. stratiotes, while Ma. titillans is associated with a broad range of plant species. Similar trends were detected for Ma. dyari compared to Ma. titillans in North America (Lounibos and Escher 1985, Slaff and Haefner 1985).

Differential utilization of the roots of *P. stratiotes*, as compared to other species, could be related to diverse factors such as the oviposition behavior of female adults or characteristics of the different kind of roots used as habitat. Oviposition on *P. stratiotes* by adult *Mansonia* females (Mattingly 1972, Lounibos and Linley 1987, Lounibos and



Figure 1. Mean number of host plant species ± SD obtained over five months, from January to May 2003, at Macáes Pond, Buenos Aires City, Argentina.

	Ma. indubitans		Ma. titillans	
Species	Mean ± SE (sampling units)	Total	Mean ± SE (sampling units)	Total
Pistia stratiotes (n=446)	0.783 ± 0.290 a*	354 (88%)	0.273 ± 0.077 a	157 (72%)
Limnobium laevigatum (n=617)	$0.088 \pm 0.027 \text{ b}$	38 (10%)	0.113 ± 0.028 a	53 (25%)
<i>Salvinia</i> spp. (n= 2280)	$0.007 \pm 0.002 \text{ b}$	10 (2%)	$0.007 \pm 0.003 \text{ b}$	7 (3%)
Total		402		217

Table 1. Mean number of immatures \pm SE (sampling units) and total immature frequency of *Ma. indubitans* and *Ma. titillans* collected from aquatic vegetation during January to May, 2003 at Macáes Pond, Buenos Aires City, Argentina.

* Means followed by different letters are significantly different. Kruskal-Wallis test for 3-way comparisons (P<0.01), Mann-Whitney for 2-way comparisons (P<0.05).

Dewald 1989, Ferreira and Nunes de Mello 1999) resulted in high densities of larval and pupal instars. On the other hand, roots of floating plants could have different characteristics, such as aerenchyma size or hardness of its tissues, that could be determinants for positive or negative selection by *Mansonia* immatures. In this sense, laboratory assays showed selective attachments of 4th instar *Mansonia* larvae on healthy plants (McDonald and Lu 1973). In our study, both *Mansonia* species appeared to avoid *Salvinia* spp. "roots" although this genus was dominant in Macáes Pond.

The sizes of the host plant species were not measured. This issue is important because the absence of data on plant size precludes inferences on host plant selection proportional to macrophyte biomass. On the other hand, the particular relationship between niche overlap and competition is complex (Holt 1987). For this reason, the measures of Hurlbert's Index obtained in our study may not imply interspecific competition between *Mansonia* species.

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