Treeholes as relevant larval habitats for *Aedes aegypti* surveillance: urban, suburban and forest spatial distribution in a dengue affected area

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Running head: Treeholes as *Aedes aegypti* larval habitat

Abstract

Aedes aegypti (L.) (Diptera: Culicidae), the main vector of dengue and urban yellow fever in the world, is highly adapted to the human environment. Artificial containers are its most commonly used larval habitat, but it may develop in tree holes and other phytotelmata. This study assessed whether tree holes in San Ramón de la Nueva Orán, a city located in subtropical montane moist forest where dengue outbreaks occur, are relevant as larval habitat for *Ae. aegypti* and if the species may be found in natural areas far from human habitations. Water holding tree holes were sampled during three years once a month along the rainy season using a siphon bottle, in urban and suburban sites within the city and in adjacent forested areas. Larvae and pupae were collected and the presence and volume of water in each tree hole were recorded. Finding *Ae. aegypti* in forested areas was an isolated event; however, the species was frequently collected from tree holes throughout the city and along the sampling period. Moreover, larvae were collected in considerably high numbers, stressing the importance of taking into account these natural cavities as potential reinfestation foci within dengue control framework.

Keywords: Culicidae, landscape, phytotelmata, population ecology, vector

Introduction

Aedes aegypti (*Stegomyia aegypti*) (L.) (Diptera: Culicidae) is the main vector of dengue and urban yellow fever in the world (Gubler, 2004). *Aedes aegypti* is highly adapted to the human environment, and artificial containers are its most commonly used larval habitat (Forattini, 2002). Nevertheless, in some countries in Africa, where the species might have originated, it is a regular component of the tree hole fauna (Anosike *et al.,* 2007). Observations of *Ae. aegypti* developing in tree holes and other natural water containers are also occasionally reported from other regions of the world. In Cuba, immature stages were found in tree holes, coconut shells, and axils of banana leaves (Marquetti *et al.,* 2005). In Brazil, larvae were found in native bromeliads on rocky slopes (Malta Varejao *et al.,* 2005) and in public and private gardens (Mocellin *et al.,* 2009).

In Argentina, in the province of Misiones, the National Coordination of Vector Control (Ministry of Health of Argentina) has reported finding larvae in the axils of banana leaves Stein *et al.,* (2011) and Campos *et al.* (2011) observed the species in the axils of Araceae, at the Puerto Iguazú National Park. Stein *et al.* (2013) found *Ae. aegypti* larvae in the epiphyte *Aechmea distichantha* Lemaire (Poales: Bromeliaceae) both in semi-urban and rural localities of pedemontane forest of the subtropical mountainous Yungas rainforest in the province of Tucumán, north western Argentina. In Aguaray city, Salta province, we detected larvae and pupae using tree holes as larval habitat (Mangudo *et al.,* 2011). Reports of *Ae. aegypti* breeding in natural habitat in forested areas far from urbanization are less frequent.

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164 **Table 1.** Tree species that were positive for *Aedes aegypti* immature stages (larvae and/or
165 pupae) in sidewalks and public access areas in urban, suburban and Yunga Forest sites in
166 San Ramón de la Nueva Orán, Salta province, Argentina.

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Tree species	Trees with holes[1]	Positive holes	Immature culicids
Delonix regia (Bojer) Raf. (Fabales: Fabaceae)	8 / 38	6	3095
Bauhinia sp. L. (Fabales: Fabaceae)	7 / 54	6	824
Thevetia nereifolia Juss. (Gentianales: Apocynaceae)	1 / 76	1	358
Morus sp. L. (Rosales: Moraceae)	3 / 51	2	306
Ficus sp. L. (Rosales: Moraceae)	4 / 69	1	41
Broussonetia papyrifera (L.) Vent. (Rosales: Moraceae)	2 / 28	2	3
Jacaranda sp. Juss. (Lamiales: Bignoniaceae)	5 / 45	4	170
Citrus sinensis Osbeck (Sapindales: Rutaceae)	3 / 41	3	155
Lagerstroemia indica (L.) Pers (Myrtales: Lythraceae)	3 / 30	2	95
Mangifera indica L. (Sapindales: Anacardiaceae)	1 / 41	1	6
Undetermined sp.	3 / 3	1	9
Total	**40 (476)**	**29**	**5062**

168 [1] Trees with water holding holes in relation to trees examined.

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Figure Legend

Figure 1. Location of study area and tree holes that harboured *Aedes aegypti* larvae and/or pupae on every sample (black figures), at least once (grey figures), or never (white figures).