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***AECHMEA DISTICHANTHA* (BROMELIACEAE) EPIPHYTES, POTENTIAL
NEW HABITAT FOR *AEDES AEGYPTI* AND *CULEX QUINQUEFASCIATUS*
(DIPTERA: CULICIDAE) COLLECTED IN THE PROVINCE OF TUCUMÁN,
NORTHWESTERN ARGENTINA**

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Aedes (Stegomyia) aegypti (Linnaeus) is a mosquito-associated with urban environments, and its larvae and pupae develop in a wide variety of artificial habitats (Forattini 1965). In the early 1960s, 17 countries and territories in the Americas, including Argentina, certified its eradication (Kerr et al. 1964). But a decade and a half later, they were re-colonized by *Ae. aegypti* due to the abandonment of the vector control programs. In 1987, the vector was again detected in Argentina, and during the early 1990s it colonized 16 provinces and 580 of the 854 existing municipalities (Coto & Masuh 2003). This is the only vector responsible for dengue epidemics that have occurred in our country from 1997 to date, recording more than 25,000 cases of DEN-1 in 2009 (Ministry of Public Health 2009).

Several studies conducted in Argentina report the presence of *Ae. aegypti* in a wide variety of artificial habitats in urban areas showing stable behavior of this species in relation to habitat preference, but also its ability to adapt to new conditions imposed by man (Campos 1993; Campos & Maciá 1996; Avilés et al. 1997; Schweigmann et al. 1997; Augier 1998; Almirón & Ludueña Almeida 1998; Stein & Oria 2002; Stein et al. 2002, 2007, 2011; Mangudo et al. 2010; Campos et al. 2011). In Brazil, *Ae. aegypti* has been collected from bromeliads in public and private gardens (Forattini et al. 2000; Mocellin et al. 2009), although as some authors suggested, these habitats do not contribute importantly to the production of its immatures (Mocellin et al. 2009; Santos et al. 2010). In relation to natural habitats in which *Ae. aegypti* has been observed in Argentina, Mangudo et al. (2010) found the species in treeholes in Aguaray city, Salta province, while Campos et al. (2011) observed this species in the axils of Araceae, at the National Park in Puerto Iguazú, province of Misiones. The phytotelmata have been identified as important habitats for vectors of human disease (O'Meara et al. 1995).

Culex (Culex) quinquefasciatus Say has also been found colonizing the same artificial locations as *Ae. aegypti* in urban environments, although it differs in behavior (Schweigmann et al. 1997; Almirón & Ludueña Almeida 1998; Oria et al. 1999, 2002; Stein & Oria 2002; Stein et al. 2002, 2007, 2011). This species is a competent vector of St. Louis Encephalitis virus in Argentina (Diaz 2009). Many other arboviruses have been isolated from *Cx. quinquefasciatus*, including Oropouche virus in Brazil. Vertical transmission of the Japanese encephalitis virus has also been demonstrated in this species (Lourenço-de-Oliveira & da Silva 1985; Johansen et al. 2001).

This is the first report of larvae of *Aedes aegypti* and *Culex quinquefasciatus* in epiphytic bromeliads in semi-urban and rural localities in the province of Tucumán, northwestern Argentina (Fig. 1). Both localities are in the subtropical mountainous rainforest also called Yungas that extends from the Bolivia border (S 22°) up to the north of Catamarca province (S 29°), traversing Salta, Jujuy and Tucumán provinces (Cabrera 1994; Brown & Grau 1995; Brown et al. 2001). In the Yungas it is possible to recognize 4 vegetation strata within forests (piedmont forest, mountain forest, and mountain wood and altitude grasses). The piedmont forest receives average annual precipitation of 820 mm (550-1400 mm) and the average annual temperature is 21.5 °C (average maximum = 27.6 °C, average minimum = 15.4 °C). The localities are situated in the piedmont forest, which is characterized by native vegetation patches with areas that are strongly modified by human activities (deforestation and agriculture). It is common to see increased plantings of sugar cane, soybean and citrus (Prado 1995; Dantur Juri et al. 2010a, 2010b). The forest is called "tipa and pacará" (*Tipuana tipu* (Benth.) Kuntze; Fabales: Fabaceae) and (*Enterolobium contortisiliquum* (Vell.) Morong; Fabales: Fabaceae), including canopy trees such as *Blepharocalyx salicifolius* (H.B.K.) (Myrtales: Myrtaceae),

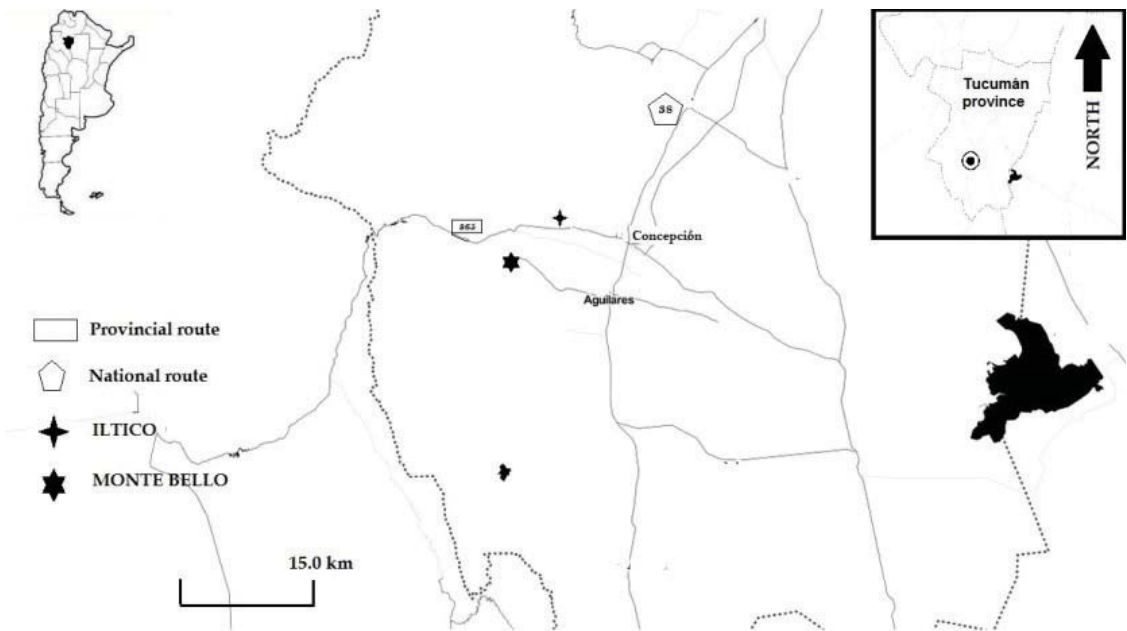


Fig. 1. Map of the study area.

Juglans australis Griseb. (Fagales: Juglandaceae), *Terminalia triflora* (Griseb.) Lillo (Myrtales: Combretaceae), *Handroanthus impetiginosus* (Mart. ex DC.) Mattos (Lamiales: Bignoniaceae), *Jacaranda cuspidifolia* Mart. (Lamiales: Bignoniaceae), *Jacaranda mimosifolia* D. Don., *Tabebuia avellanedae* Lor. ex Griseb. (Lamiales: Bignoniaceae), *Tecoma stans* (L.) C. Juss. ex Kunth (Lamiales: Bignoniaceae), *Salix humboldtiana* Willd. (Malpighiales: Salicaceae), *Acacia visco* Griseb. (Fabales: Fabaceae), *Scutia buxifolia* Reissek (Rosales: Rhamnaceae), *Ceiba chodatii* Hassl. (Malvales: Malvaceae), *Celtis pubescens* (Kunth) Spreng. (Rosales: Cannabaceae), *Allophylus edulis* (St. Hil.) Radlkofer (Sapindales: Sapindaceae) and *Eugenia uniflora* L. (Myrtales: Myrtaceae), among others. Climber or aerial plant species belong to the families Bignoniaceae, Ulmaceae, and Amaranthaceae. There are also vascular epiphyte plants such as Bromeliaceae (Prado 1995; Dantur Juri et al. 2010a, 2010b).

Epiphytic bromeliads situated on various species of trees and on a roof of an abandoned construction were inspected in Monte Bello (S 27° 22' 43.89" W 65° 44' 30.02"; 535 m asl) and Iltico (S 27° 20' 13.56" W 65° 39' 25.07"; 411 m asl) localities (Fig. 1). They were found at heights between 0.50 m and up to 4 m above ground level. There were 2 collections, one in Nov 2012 and the other in Mar 2013 (Table 1, Fig. 2). We consider these sampling sites as natural habitats located in a residual primitive forest or wild ecosystem (Monte Bello) and the other as a primitive forest but modified by human activities (Iltico). The larvae and pupae were collected using a glass bottle (1,500

mL), with a rubber stopper with two holes through which were inserted 2 flexible plastic tubes. One tube was introduced into the bromeliad's water reservoir (phytotelm), and then by applying suction with the other tube, all the water contained in the phytotelm was collected together with the immature stages of the mosquitoes. The water containing the larvae and/or pupae was transported to the laboratory in jar labeled with names of collectors and the date and site of collection. The larvae and pupae were reared to obtain adults in the laboratory.

The culicids were sorted and identified following the Lane (1953) and Darsie (1985) determination keys. The bromeliads were also identified as *Aechmea distichantha* Lemaire (Poales: Bromeliaceae) a native species, in all cases. In Monte Bello we collected 5 larvae of *Ae. aegypti* and 1 larva and 1 pupa of *Cx. quinquefasciatus* from the bromeliads located on the roof of an abandoned building, only 10 m from the nearest house and the same distance from the primitive forest (Fig. 2a). At Iltico, we collected 6 larvae of *Ae. aegypti* from epiphytic bromeliads located 4 m high above ground on a tree at 2 m from the nearest houses (Fig. 2b). *Aedes aegypti* specimens were collected with larvae of *Culex* (*Culex*) *fernandezi* García & Cavalieri, *Culex* (*Microculex*) *imitator* Theobald and *Toxorhynchites* (*Lynchiella*) *guadalupensis* Dyar & Knab, while *Cx. quinquefasciatus* was collected with larvae of *Tx. guadalupensis* (Table 1).

Aedes aegypti was found in clear or turbid water, with or without organic matter, and with or without an unpleasant odor. *Culex quinquefas-*

TABLE 1. MOSQUITO SPECIES COLLECTED IN BROMELIADS FROM MONTE BELLO AND ILTICO LOCALITIES, PROVINCE OF TUCUMAN, BETWEEN NOV 2012 AND MAR 2013.

Mosquito species	Localities	Localities characteristics	Collection date	Number of specimens
<i>Aedes aegypti</i>	Monte Bello	Primitive forest	13.IX.2012	3 larvae
	Monte Bello	Primitive forest	03.III.2013	2 larvae
	Iltico	Modified forest	03.III.2013	6 larvae
<i>Culex fernandezi</i>	Monte Bello	Primitive forest	13.IX.2012	3 larvae
	Monte Bello	Primitive forest	03.III.2013	18 larvae
<i>Culex imitator</i>	Monte Bello	Primitive forest	13.IX.2012	28 larvae
	Monte Bello	Primitive forest	03.III.2013	15 larvae
	Iltico	Modified forest	13.IX.2013	27 larvae
	Iltico	Modified forest	03.III.2013	32 larvae
<i>Culex quinquefasciatus</i>	Monte Bello	Primitive forest	13.IX.2012	1 larva and 1 pupa
<i>Toxorhynchites guadalupensis</i>	Monte Bello	Primitive forest	13.IX.2012	18 larvae
	Monte Bello	Primitive forest	03.III.2013	3 larvae
	Iltico	Modified forest	13.IX.2013	10 larvae
	Iltico	Modified forest	03.III.2013	5 larvae

ciatus was found in clear water without organic matter.

Despite the fact that the degree of infestation of nearby houses was not assessed either by the authors or by public health authorities, these observations should be taken into consideration by the latter, because the findings of *Ae. aegypti*

and *Cx. quinquefasciatus* in bromeliads located in wild and semi-urban environments could indicate a possible degree of invasion and adaptation to the primitive forest, or they may be a consequence of high infestations levels in nearby houses (Malta Verajao et al. 2005). This finding requires in-depth studies to reveal the real behavior of these



Fig. 2. Mosquito habitats provided by the *Aechmea distichantha*, a bromeliad epiphyte in the Yungas of north-western Argentina. (2a) Aspect of residual primitive forest in Monte Bello, meters from bromeliads where larvae of *Ae. aegypti* were found. (2b) Aspect of the abandoned building where epiphytic bromeliads were found from which the larvae of *Ae. aegypti* were collected. (2c) Epiphytic bromeliads from which larvae of *Ae. aegypti* and *Cx. quinquefasciatus* were collected at Iltico.

species in the study area, the true role of bromeliads as producers of these medically important mosquitos, and to determine and adopt appropriate control measures.

SUMMARY

Larval habitats of *Aedes (Stegomyia) aegypti* (Linnaeus) and *Culex (Culex) quinquefasciatus* Say in the epiphyte *Aechmea distichantha* Lemaire (Poales: Bromeliaceae), were found and described both in semi-urban and rural localities of piedmont forest of the subtropical mountainous Yungas rainforest in the province of Tucumán, northwestern Argentina. This finding suggests that these anthropophilic disease vectors have achieved a degree of introduction and adaptation to the primitive forest, and that the bromeliad, which possesses phytotelmata, has an epidemiological role in providing natural water containers for the breeding of mosquito vectors.

Key Words: natural habitat, *Aedes aegypti*, *Culex quinquefasciatus*, phytotelmata, adaptation

RESUMEN

Aechmea distichantha Lemaire (Poales: Bromeliaceae) epífita se describe como hábitat larval de *Aedes (Stegomyia) aegypti* (Linnaeus) y *Culex (Culex) quinquefasciatus* Say halladas tanto en localidades semi-urbanas como rurales de los bosques de piedemonte de la selva subtropical montañosa de las Yungas de la provincia de Tucumán, noroeste de Argentina. Este hallazgo sugiere que estos vectores antropofílicos han alcanzado cierto grado de introducción y adaptación al bosque primitivo, y que la bromelia (fitotelmata), tiene un papel epidemiológico en el suministro de contenedores naturales de agua para la cría de mosquitos vectores.

Palabras Clave: hábitat natural, *Aedes aegypti*, *Culex quinquefasciatus*, fitotelmata, adaptación

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