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First record of *Limatus durhamii* Theobald (Diptera: Culicidae) in Campeche, Mexico

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Limatus Theobald (Diptera: Culicidae) is a genus of forest mosquito that occurs in Central America, eastern South America, and the West Indies. It is placed in the tribe Sabethini of subfamily Culicinae. Immature stages develop in bamboo cavities, tree holes, fallen bracts, coconut husks, cacao pods, and also in other small water containers such as fallen leaves and spathes, snail shells, rock holes, and a variety of small artificial containers (Lane 1953; Calderón-Arguedas et al. 2009; Campos et al. 2011; Baak-Baak et al. 2014; Mangudo et al. 2017). Currently 9 valid species of *Limatus* Theobald are recognized, all with Neotropical distribution. In Mexico, 2 species have been recorded, *Limatus asulleptus* (Theobald) (Ortega-Morales et al. 2015) and *Limatus durhamii* Theobald (Díaz-Nájera & Vargas 1973). *Limatus durhamii* can be found with the synonyms of *Simondella curvirostris* Laveran, *Dendromyia paraensis* Theobald, *Limatus cacophrades* Dyar & Knab, and *Limatus exhibitor* Shannon & Del Ponte, and is a suspected vector of the genus *Orthobunyavirus* (subfamily: Bunyaviridae) (Berger 2016). The genus *Orthobunyavirus* includes about 53 species containing more than 193 viruses, grouped into about 20 serogroups based on antigenic relationships, and the majority of the viruses distributed worldwide that are transmitted by mosquitoes but are not well studied (Elliott & Blakqori 2011; Plyusnin et al. 2012), except those that have medical (e.g., La Crosse and Oropouche viruses) or veterinary importance (e.g., the newly emerged Schmallenberg virus).

In Mexico, *Li. durhamii* has been recorded in the states of Chiapas, Guerrero, Oaxaca, Puebla, San Luis Potosí, and Yucatán (Díaz-Nájera & Vargas 1973; Casas-Martínez & Orozco-Bonilla 2006), Quintana Roo (Pletsch 1986; Ortega-Morales et al. 2010), Tamaulipas (Ortega-Morales et al. 2015), Tabasco, and Veracruz (Heinemann & Belkin 1977).

Immature stages were collected in 4 municipalities of the state (Campeche, Escárcega, Hecelchakán, and Tenabo) from natural breeding sites outside houses, and all water sources were checked from Jan to Dec 2015 Mosquito larvae were collected each mo for 3 consecutive d in the morning, for a total collection effort of 36 days. The larvae were transported alive in plastic bags to the Public Health Laboratory of Campeche State. The collections were conducted in both the dry and rainy seasons. Entomological capture is an activity of the epidemiologic surveillance developed by the Secretary of Health of Mexico.

Taxonomic determinations of immature mosquitoes were based on morphological characteristics of fourth instar larvae using taxonomic keys (Carpenter & LaCasse 1955; Ibáñez-Bernal & Martinez-Campos 1994) at the Secretary of Health of Campeche, Mexico, followed by confirmation from the Institute for Diagnostic and Epidemiological Reference. A voucher collection of mosquito larvae was deposited in the Public Health Laboratory of Campeche State.

A total of 194 specimens were collected (160 larvae, 34 pupae) representing 6 species belonging to 4 genera (*Aedes aegypti* (L.), *Ae. scapularis* (Rondani), *Culex coronator* Dyar & Knab, *Cx. nigripalpus* Theobald, *Haemagogus anastasionis* Dyar, and *Li. durhamii*). A total of 18 mosquito larvae of *Li. durhamii* (9.28%) were collected in natural and artificial breeding sites in the municipalities of Campeche (3: 19.87434°N, 90.47324°W), Escárcega (6: 18.61466°N, 90.73309°W, and 19.00915°N, 91.28392°W), Hecelchakán (6: 20.12974°N, 90.18111°W, and 20.17465°N, 90.14391°W), and Tenabo (3: 20.0344°N, 90.22798°W) for the first time in the state (Fig. 1). Species collected during the study, and the places where they were found, are listed below (Table 1).

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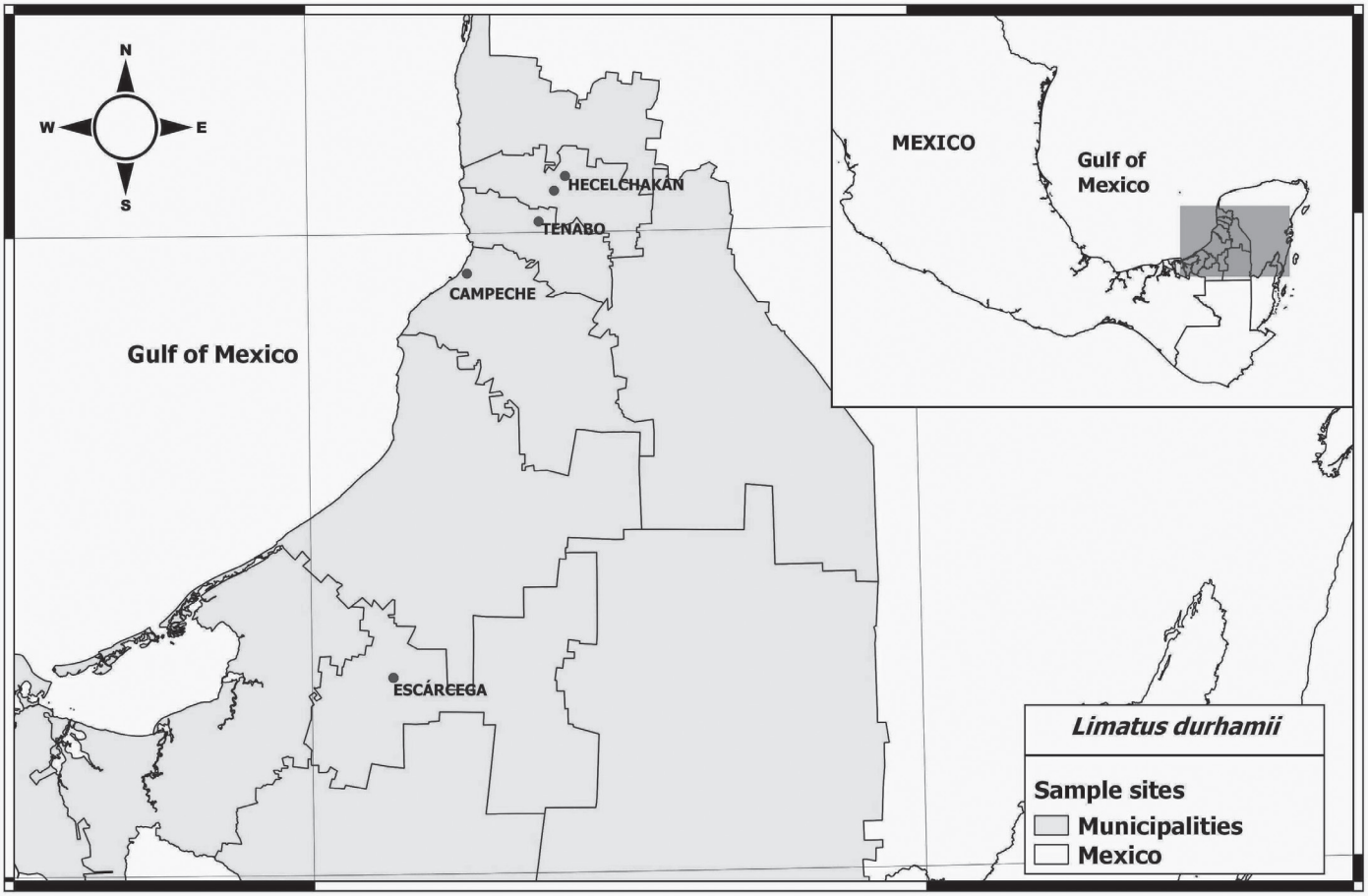

Fig. 1. Map of the state of Campeche and its municipalities, showing the locations of collection records of *Limatus durhamii*.

Currently, 50 mosquito species have been recorded in Campeche State. This study adds *Limatus durhamii* to the mosquito fauna record of Campeche with collections in 4 municipalities of the state. Diseases transmitted by arthropods have shown recent changes in dissemination, either by the intercontinental movement of different strains of etiologic agents, the introduction of vectors and exotic reservoirs, or by the susceptible human population that migrates towards endemic areas (Rueda & Hernández 2008). Faunistic studies are necessary to gain information not only of the vector and host species present in the zone, but to recognize their breeding sites, and the environmental factors that determine their presence in the different ecosystems and seasons. Mosquito studies are important for adopting appropriate health measures to control the diseases they transmit, in accordance with the vector species, their abundance, and the time of year favoring the transmission of pathogenic agents. These studies also allow detection of exotic species in a given region (Keesing 2010).

Ochoa-Gómez et al. (2012) mention that distribution of mosquitoes can change due to occupation of new habitats following anthropogenic activities that generate disturbances in the environment. This new record of *Li. durhamii* in municipalities for the state of Campeche possibly affirms the comment of Berti (2012), who mentioned that there are many factors that can accelerate the emergence of vector-borne diseases, including environmental changes, habitat modifications, variations of human and animal demography, deterioration of strategies of vector control, or changes

Table 1. Record number of associated specimens to *Limatus durhamii* in collection localities.

	Collected larvae						Collected pupae	
Localities	*Ae. aegypti*	*Ae. scapularis*	*Cx. coronator*	*Cx. nigripalpus*	*Ha. anastasionis*	*Li. durhamii*	*Aedes* spp.	*Culex* spp.
Imi	14		6			3	6	
Colonia Procesadora	14	3			2	3	4	2
Colonia Benito Juárez	33		1			2	10	
Colonia San Francisco	34			1		4		9
Colonia 10 de mayo	20					2		3
Colonia Fátima	12		2			4		
TOTAL	127	3	9	1	2	18	20	14

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in pathogen genetics. These factors contribute to the depletion of the abundance and distribution of many species, whereas others have increased explosively to become pests (Peña & Neyra 1998).

The main focus of the surveillance of culicid mosquitoes has been on the genera *Aedes*, *Anopheles*, and *Culex*, with emphasis on geographic distribution and other aspects relevant to the implementation of control activities (Rodriguez & De La Hoz 2005) due to the importance of these species on public health. However, there has been less research on other genera, possibly due to their lower epidemiological impact (Barreto et al. 1996) and transmission of arboviruses (Gubler 2002), as is the case of the mosquitoes in the genus *Limatus*.

Honório et al. (2006) and Talaga et al. (2017) mentioned that species of *Limatus* have been found with a high rate of prevalence in artificial water containers along with mosquitoes of *Aedes*, and reported an interspecific competition with native species for food. Likewise, Ortega-Morales et al. (2010) mentioned that *Li. durhamii* immatures were observed preying on *Ae. aegypti* larvae. These mosquito species larvae are saprophagous, and in the absence of decaying matter they can behave like facultative predators of other mosquito species (Lopes 1999). In a study conducted in Costa Rica, *Li. durhamii* was reported living with *Ae. aegypti* in the same artificial containers (Marín et al. 2009). Berger (2016) mentioned that mosquitoes of the genus *Limatus* are potential vectors of Orthobunyaviruses, and Berti et al. (2015) mention that they are potential vectors of arbovirus.

This study documents for the first time the occurrence of *Limatus durhamii* in the state of Campeche. Further studies are necessary to investigate the establishment of *L. durhamii* elsewhere in the country and its potential to transmit arboviruses.

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Summary

A total of 194 specimens were collected (160 larvae, 34 pupae) representing 6 species from 4 genera (*Aedes aegypti*, *Ae. scapularis*, *Culex coronator*, *Cx. nigripalpus*, *Haemagogus anastasionis*, and *Limatus durhamii*). In the study, a total of 18 larvae of *Li. durhamii* (9.28%) were collected in natural and artificial breeding sites in the municipalities of Campeche (3), Escárcega (6), Hecelchakán (6), and Tenabo (3). We report here the first collection record of *Li. durhamii* for the state of Campeche in southern Mexico. Further studies are necessary to investigate the geographic distribution of *Li. durhamii* throughout the country.

Key Words: Mosquitoes, *Limatus*, *Orthobunyavirus*

Sumario

Un total de 194 ejemplares fueron recolectados (160 larvas, y 34 pupas) lo que representa 6 especies pertenecientes a 4 géneros (*Aedes aegypti*, *Ae. scapularis*, *Culex coronator*, *Cx. nigripalpus*, *Haemagogus anastasionis* y *Limatus durhamii*). En el estudio, un total de 18 larvas de *Li. durhamii* (9,28%) fueron recolectadas en criaderos naturales y artificiales en los municipios de Campeche (3), Escárcega (6), Hecelchakán (6) y Tenabo (3), ver mapa. Con esto, se corrobora la presencia de 5 especies de mosquitos pertenecientes a 3 géneros, e informamos del primer registro de colecta de *Li. durhamii* para el estado de Campeche, en el sur de México. Este registro amplía la distribución geográfica de *Li. durhamii* en México que puede estar implicado como vector en los ciclos de transmisión de arbovirosis endémicos. Se necesitan estudios adicionales para investigar la distribución geográfica de *Li. durhamii* en todo el país.

Palabras Clave: Mosquitos, *Limatus*, *Orthobunyavirus*

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