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SCIENTIFIC NOTE

OCCURRENCE OF *LIMATUS DURHAMII* IN ARTIFICIAL CONTAINERS IN ATLANTIC FOREST, SÃO PAULO, BRAZIL

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ABSTRACT. *Limatus durhamii* has wild habits with ecological plasticity in anthropized environments. We report the occurrence of this species in several types of artificial containers in 2 fragments of the Atlantic Forest in the city of São Paulo, Brazil. A total of 1,428 larvae were collected, in which plastic containers had the highest abundance of immature forms of *Li. durhamii*, with 579 (40.5%) specimens collected, followed by glass bottles with 464 (32.5%) and metal cans with 223 (15.6%). The high abundance of *Li. durhamii* in artificial containers points to an adaptation process to impacted environments. Therefore, studies that investigate the feeding habits and vectorial capacity of this species are essential to understanding its epidemiological role in the environment.

KEY WORDS Atlantic Forest, artificial containers, breeding sites, *Limatus durhamii*, mosquito, São Paulo

The genus *Limatus* Theobald belongs to the Sabethini tribe and comprises 9 species distributed in the Neotropical region with 5 species in Brazilian territory (Forattini 2002, Harbach 2007). Adults of *Li. durhamii* (Theobald, 1907) are active during the day and are found in the forests of South and Central America (Hervé et al. 1986). This species has been found naturally infected with several arboviruses, such as the Guama virus, Maguari virus, Tucunduba virus, and Caraparu virus (Segura and Castro 2007, Dias et al. 2022), all belonging to *Orthobunyavirus* genus (*Peribunyaviridae* family; Adams et al. 2017). Those viruses cause nonspecific symptoms, such as fever, headache, arthralgia, myalgia asthenia, and chills (Groseth et al. 2017, Matos et al. 2019).

Immature forms of *Li. durhamii* develop in canopy and soil breeding sites, such as broken bamboo, tree holes, fruit peels, escargots, stone holes (Lopes 1999, Hernández-Rodríguez et al. 2018), snail shells (Mangudo et al. 2017), and artificial containers (Lopes 1999, Zequi et al. 2005). Researchers observed *Li. durhamii* in the same artificial breeding sites with *Aedes aegypti* (L.), *Aedes albopictus* (Skuse), and *Culex quinquefasciatus* Say (Honório et al. 2006). The species were collected in artificial breeding sites in ecotopes with urban characteristics (Lopes 1999).

Immature forms (larvae and pupae) of the mosquito were collected monthly between March 2015 and April 2017 from artificial containers in 2 remnants of the Atlantic Forest: the Capivari-Monos Protection Area (CMPA) and the Cantareira State Park (CSP). Both sites are located in the metropolitan region of São Paulo state and serve to shelter, protect, and ensure conservation of biodiversity in eastern Brazil. Suction samplers were used for collection procedures. Three collection sites were selected at CMPA and CSP. Each site shows a different level of anthropization. The collected immature forms were placed in plastic containers with individual information and sent to the Laboratório de Entomologia em Saúde Pública, Faculdade de Saúde Pública, where they were monitored until the adults emerged and were euthanized with ethyl acetate. The dichotomous key by Lane (1953) was used for identification. Figure 1 shows an adult specimen and larvae of *Li. durhamii.*

A total of 1,428 *Li. durhamii* larvae were collected in artificial breeding sites (Table 1). The highest abundance of immature forms of this species was found in plastic containers, with 579 specimens collected, followed by glass bottles (464 specimens) and metal cans (223). Specimens of *Li. durhamii* were found in more types of artificial breeding sites in areas of CMPA than in the CSP. Some artificial containers e.g., water reservoirs, tarpaulins, tires, and asbestos roofs, were not found in CSP. Glass bottles were present only in the CSP environment. Plastic, metal, and ceramic containers were present in both sites. Even with less artificial container variability, CSP showed 28% more presence of *Li. durhamii* larvae than CMPA. It is worth noting that abundance may have been affected by the number of different kinds of containers scattered throughout the collection sites. The most abundant artificial containers were plastics (49 units), glass (21 units), and metal (20 units) containers.

The occurrence of *Li. durhamii* in artificial containers (tires, plastic, and metal containers) was previously reported (Lopes 1999, Zequi et al. 2005,

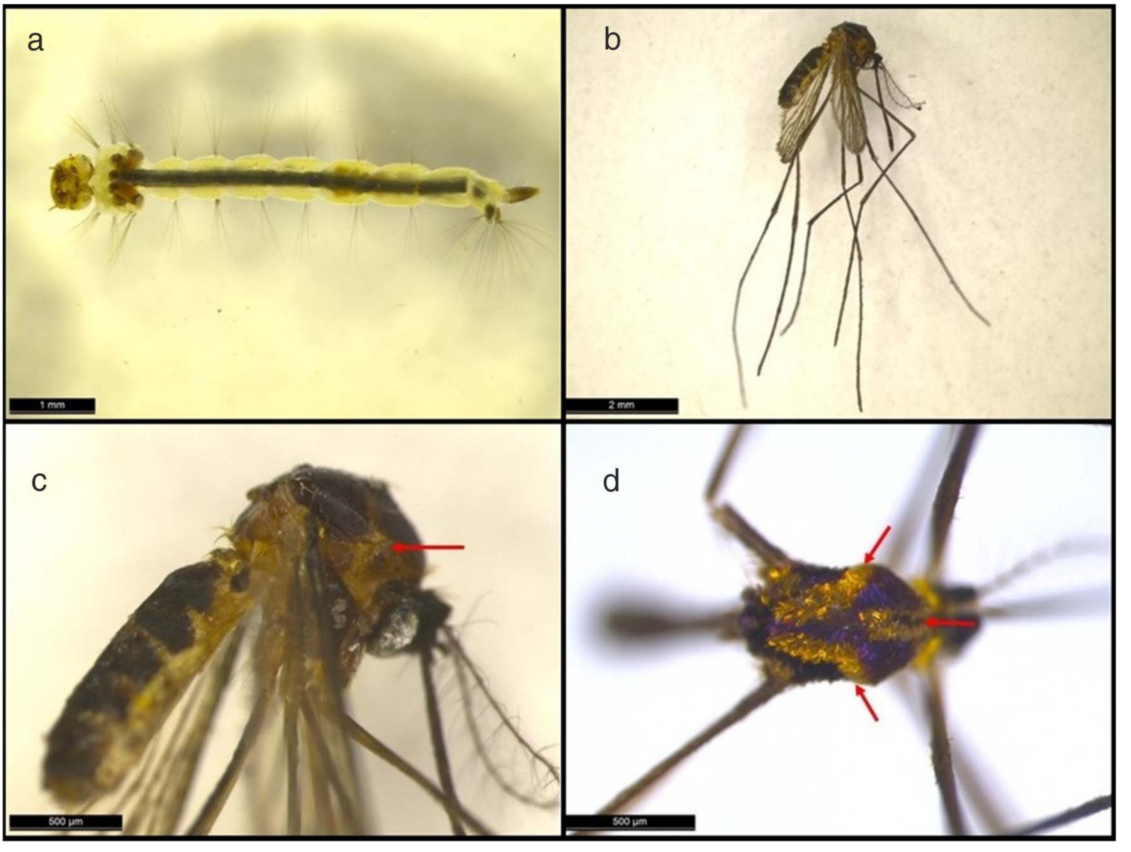

Fig. 1. Images of sampled specimens. (a) *Limatus durhamii* larvae photographed alive. (b) *Li. durhamii* adult specimen. (c, d) The arrows indicate the yellow metallic aspect of mesonotum scales: lateral and dorsal views (characteristic of this species).

Calderón-Arguedas et al. 2009, Ortega-Morales et al. 2010). Its tolerance to environmental pressures makes it the Sabethini species best adapted to artificial breeding sites (Forattini 2002). Our findings corroborate those of Lopes et al. (1993), who also found *Li. durhamii* in artificial containers such as plastic, tires, and metal, with the greatest abundance being in plastic ones. Calderón-Arguedas et al. (2009) also reported the presence of *Li. durhamii* in plastic and metal containers; however, it was more abundant in metal ones. Nonetheless, Lopes (1999) and Zequi et al. (2005) reported that *Li. durhamii* was the most abundant of all species in tires.

Table 1. Types of artificial containers in CMPA and CSP where *Limatus durhamii* specimens were collected.

Container	CMPA	CSP	Total	%
Plastic container	381	198	579	40.5
Water reservoir	1	0	1	0.07
Glass bottle	0	464	464	32.5
Metal container	104	119	223	15.6
Tarpaulin	9	0	9	0.6
Tire	78	0	78	5.5
Asbestos roof	4	0	4	0.28
Ceramic container	21	49	70	4.9
	598	830	1,428	100

In addition, *Li. durhamii* larvae feed on decaying matter present in water, but in the absence of resources, they can be predate on larvae on other mosquito species as well (Lopes 1999). Lopes (1999) reported larvae of *Li. durhamii* coexisting in an artificial container with larvae of *Culex eduardoi* Casal and Garcia, *Culex bigoti* Bellardi, *Cx. quinquefasciatus*, and *Toxorhynchites* sp. in a riparian forest in an urban area in southern Brazil, and Marín et al. (2009) observed *Li. durhamii* and *Ae. aegypti* larvae living in the same artificial container. Honório et al. (2006) and Ortega-Morales et al. (2010) reported *Li. durhamii* preying on *Ae. aegypti* larvae, and Olano et al. (2015) registered *Li. durhamii* larvae coexisting with *Ae. aegypti* and *Cx. quinquefasciatus* within schools located in ecotypes with wild and periurban characteristics. The presence of *Li. durhamii* and *Ae. aegypti* larvae in the same artificial container (Marín et al. 2009, Olano et al. 2015) is indicative of its adaptation process to impacted and peridomestic environments.

Our scope does not measure water volume for each container; based on local observation, glass bottles, metal, ceramic, and plastic containers, and tires (more effective breeding sites) can accumulate less water volume than water reservoirs. Asbestos roofs and tarpaulins showed less frequency of *Li. durhamii* larvae due to the minimum potential water accumulation capacity, where leaves can occupy all of the spaces.

Although both localities were Environmental Protection Areas, each one has different conservation stages. This becomes evident when observing the different types of artificial breeding sites found. Plastic containers may be the best indicator of human disturbance. This artificial breeding site was the most common in the 2 localities. Tarpaulins, tires, and asbestos roofs were present only in the CMPA area. Glass bottles were found only in the CSP area. Unlike the CMPA, the CSP is the type of park where people use its trails as a place for leisure and nature appreciation. On these occasions, it is common to consume different types of drinks, and as a result, the bottles often are abandoned, becoming breeding sites for mosquito species.

The scant information about the biology of *Li. durhamii* contrasts with its medical-epidemiological importance (Lorenz et al. 2019). This species was found in high abundance in some culicid fauna investigations (Ceretti-Junior et al. 2020, Evangelista et al. 2021) and was registered as naturally infected with yellow fever virus (Obara et al. 2012). Barrio-Nuevo et al. (2020) detected Zika virus in *Li. durhamii* during a study in forest fragments of São Paulo municipality. Different from other Sabethini species, the high presence of *Li. durhamii* in artificial breeding sites may point to an adaptation process. The evidence of interaction of *Li. durhamii* and etiological agents shows the necessity of blood meal habit and vectorial capacity investigations of this mosquito species and its importance in public health scenarios.

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