

# Immature mosquitoes (Diptera: Culicidae) in a eutrophic landfill tank from State of Rio de Janeiro, Brazil

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## ABSTRACT

**Introduction:** To determine the faunal composition of immature culicids inhabiting a percolation tank in the landfill of Sapucaia, State of Rio de Janeiro, Brazil, immature mosquitoes were collected over a two-day period during the third weeks of April, August and October 2011. **Results:** The species found were *Culex usquatus*, *Lutzia bigoti*, *Anopheles argyritarsis* and *Limatus durhamii*. This study is the first to report the colonization of eutrophic breeding sites by these species. **Conclusions:** The oviposition behavior observed in this study suggests a secondary adaptation or change in habit to select eutrophic environments during the developmental stages of the observed species.

**Keywords:** *Anopheles argyritarsis*. Eutrophic breeding. Culicidae. Larva. *Limatus durhamii*. *Lutzia bigoti*.

In addition to the change in behavior by adults, some culicid larvae can survive and develop in artificial breeding sites, indicating that these mosquitoes are carriers of a genetic adaptation. The use of artificial containers as breeding sites in anthropogenic areas demonstrates genetic plasticity, which directs the evolution of these culicids toward domiciliation<sup>1</sup>.

According to Martins and Barbeitos<sup>2</sup>, many insect physiological, morphological and behavioral adaptations are conditioned through the detection of signals produced by environmental changes occurring on a global and/or local scale (e.g., reduction of a particular resource). These changes could alter one or more biotic or abiotic variables that inform an insect or its offspring of a transition to a new environmental situation. Once the insect is in the new environment, the odds of survival and reproduction are effectively evaluated by the insect.

This study aimed to determine the culicid faunal composition in a landfill in Sapucaia, State of Rio de Janeiro, Brazil.

Sampling was conducted at the Sapucaia landfill located on the Mangueira da Boa Esperança farm, Highway BR 393, kilometer marker 124.4, at 21°57'37"S and 42°51'10"W at an altitude of 251 m above mean sea level (Figure 1A, 1B and 1C). Immature mosquitoes were collected from a percolation tank, which receives waste water manure generated by leaching from the Sapucaia City landfill in the State of Rio de Janeiro, over a two-day period during the third weeks of April, August and October 2011. During the collection period, daily temperature

and pH readings were recorded. Specimens were collected by pouring water into a polyethylene tray and using a standard entomological ladle. After separation, the larvae and pupae were removed and placed in 250ml plastic bags (Whirl-Pak Bags®, San Diego, California, USA) for transport to the laboratory.

The larvae and pupae were screened in the laboratory. A portion of the specimens was preserved in 70° GL ethanol for subsequent identification, while selected specimens were kept alive for the purpose of following their life cycles. The culicids were identified by direct observation of evident morphological characteristics under an optical microscope and based on the dichotomous keys described in the literature<sup>3-5</sup>.

In total, 1,135 immature Culicidae specimens were collected, including 1,100 (96.9%) specimens from *Culex* (*Culex*) *usquatus* Dyar, 20 (1.8%) specimens from *Anopheles* (*Nyssorhynchus*) *argyritarsis* Robineau-Desvoidy, 8 (0.7%) *Lutzia* (*Lutzia*) *bigoti* (Bellardi) specimens and 7 (0.6%) *Limatus durhamii* Theobald specimens.

The water temperatures in the percolation tank where the immature mosquito forms were found ranged from 24°C to 34°C and varied among the collection periods. In comparison, the pH varied slightly and remained neutral to slightly basic.

Among the species found in this study, some epidemiological importance can be assigned to only two species. *An. argyritarsis* was considered a possible vector of malaria, and further studies concluded that an absence of data supported this hypothesis. Some arboviruses have been isolated from *Limatus* spp., including *Li. durhamii*, which demonstrates the possibility of these mosquitoes being a vector for these viruses (Forattini<sup>5</sup>).

Although the collected species have already been found to colonize different types of artificial breeding sites, there has been no record of their colonization in breeding sites with physical characteristics similar to those of a strongly eutrophic landfill, as observed in this study.

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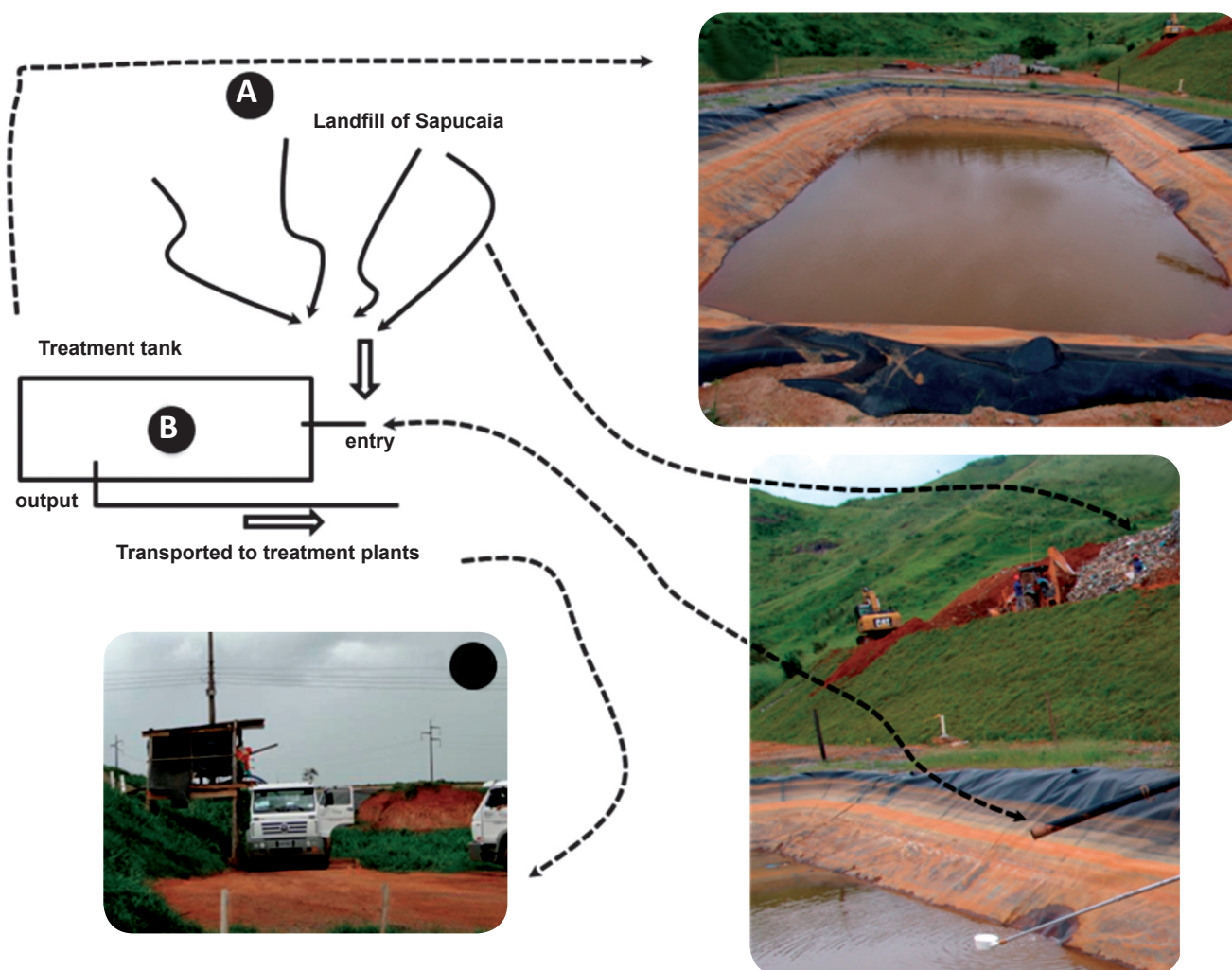


FIGURE 1 - Appearance of the container from which immature forms were collected: the percolation tank in the landfill of Sapucaia, State of Rio de Janeiro . A: Landfill of Sapucaia, B: Treatment tank and C: Transport to treatment plants.

Horsfall<sup>6</sup> reported *An. argyritarsis* breeds in slightly flowing liquid accumulations within the soil of typical emergent vegetation. These requirements restrict the occurrence of this species in artificial breeding sites, which are normally located above ground, created with clean water and protected from excessive temperature elevations.

Forattini et al.<sup>7</sup> discovered immature forms of *An. argyritarsis*, *Aedes albopictus* (Skuse) and *Culex quinquefasciatus* Say occupying the same water tank. Carreira-Alves<sup>8</sup> collected *An. argyritarsis* from a disabled, uncovered water tank in the municipality of Maricá, State of Rio de Janeiro . This finding was in agreement with Silva et al.<sup>9</sup>, who revealed the presence of *An. argyritarsis* and *Ae. albopictus* sharing a water tank containing clean water. This natural behavior of *An. argyritarsis* to exploit artificial breeding sites containing clean water does not correspond with the findings of the present study.

According to Machado-Allison<sup>10</sup>, *Lutzia bigoti* larvae exhibit a predatory feeding activity, and these larvae are able to colonize

artificial containers of small dimensions, such as tires, plastic containers, bamboo and tin cans<sup>1,11</sup>. In a study by Calado and Silva<sup>11</sup> investigating artificial containers introduced in rural São José dos Pinhais, Paraná State, the majority (96.4%) of *Lutzia bigoti* specimens were collected in shaded areas located in the peridomicile. This result was not consistent with the finding of the present study, in which the samples of *Lutzia bigoti* were collected from open breeding sites exposed to direct sunlight.

Lopes<sup>1</sup> reported that *Li. durhamii* predominantly colonized plastic containers. In a study conducted by Lourenço-de-Oliveira et al.<sup>12</sup> in Granja Calábria, Jacarepaguá, State of Rio de Janeiro, *Li. durhamii* was not found to breed in natural standing water pools but instead was collected from artificial containers, such as abandoned utensils, and domestic water sources. The immature forms of this species have diversified behavior regarding breeding-site selection and can colonize natural breeding sites, such as fruit peels, leaves, palm spadices and hollow trees, as well as artificial containers, such as buckets and barrels<sup>13</sup>.

As shown by Forattini<sup>5</sup>, adaptation to artificial containers by some Anophelinae to artificial containers may expand their range of breeding site locations. Given the observations reported in this study, the discovery of *An. argyritarsis*, *Li. durhamii* and *Lutzia bigoti* in this type of breeding site may indicate a possible change in habit and/or adaptation to eutrophic environments.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## REFERENCES

1. Lopes J. Ecologia de mosquitos (Diptera: Culicidae) em criadouros naturais e artificiais de área rural do Norte do Estado do Paraná, Brasil. V. Coleta de larvas em recipientes artificiais instalados em mata ciliar, São Paulo, Brasil. Rev Saude Publica 1997; 31:370-377.
2. Martins RP, Barbeitos MS. Adaptações de insetos a mudanças no ambiente: Ecologia e evolução da diapausa. Rev Oecol Bras 2000; 8:149-192.
3. Lane J. Neotropical Culicidae. Vol. I. São Paulo: Editora da Universidade de São Paulo; 1953.
4. Lane J. Neotropical Culicidae. Vol. II. São Paulo: Editora da Universidade de São Paulo; 1953.
5. Forattini OP. Culicidologia Médica. Vol. II São Paulo: Editora da Universidade de São Paulo; 2002;
6. Horsfall WR. Mosquitoes: their bionomics and relation to disease. New York: Hafner Publishing; 1972.
7. Forattini OP, Kakitani I, Marques GRAM, Brito M. Novos encontros de anofelíneos em recipientes artificiais. Rev Saude Publica 1998; 32:598-599.
8. Carreira-Alves JR. Encontro de anofelinos do subgênero *Nyssorhynchus* em recipientes artificiais, Maricá, RJ, Brasil. Rev Saude Publica 2001; 35: 407-408.
9. Silva JS, Acel AM, Guimarães AE, Alencar J. Encontro de larvas de *Anopheles (Nyssorhynchus) argyritarsis* em criadouros artificiais no Estado de Mato Grosso. Rev Soc Bras Med Trop 2008; 41:1-2.
10. Machado-Allison CE. Ecologia de los mosquitos (Culicidae). Larvas y Pupas. Acta Biol Venez 1981; 11:51-129.
11. Calado DC, Silva MAN. Comunidade de mosquitos (Diptera, Culicidae) em recipientes antrópicos introduzidos em área rural e urbana da região metropolitana de Curitiba, Paraná, Brasil. Rev Bras Zool 2001; 18:51-60.
12. Lourenço-de-Oliveira R, Heyden R, Silva TF. Alguns aspectos da ecologia dos mosquitos (Diptera, Culicidae) de uma área de planície (Granjas, Calábria), em Jacarepaguá, Rio de Janeiro. V. Criadouros. Mem Inst Oswaldo Cruz 1986; 81:265-271.
13. Lane J, Cerqueira NL. Os Sabetíneos da América (Diptera, Culicidae). Arq Zool 1942; 3: 473-849.