

# A Survey of Mosquito Species in Public Schools of Metro Manila, Philippines Using Ovitrap as Surveillance Tool

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## ABSTRACT

**Objective.** This study assessed the species composition of mosquitoes collected from ovitraps in selected public schools of Metro Manila, Philippines.

**Materials and Methods.** Ovitrap were installed from November 2013 to February 2014, in purposively selected public elementary and high schools of Metro Manila. Ovitrap were installed inside classrooms and collected weekly and examined for mosquito eggs and larvae. Speciation was done once a month from November 2013 to February 2014. All positive paddles were immersed in water for larval emergence, reared to fourth instars and were identified using taxonomic keys.

**Results.** A total of 1,482 ovitraps were installed in the selected public schools, and 18,325 larvae were collected from elementary schools, while 16,670 larvae were collected from high schools. The mean ovitrap index or infestation rate was 49.69% during the period of data collection. Mosquito larvae were identified as *Aedes aegypti* (88.94%) and *Aedes albopictus* (11.06%). *Aedes aegypti* and *Aedes albopictus* coexisted in some of the examined paddles. No significant differences were observed between the type of school and the presence of *Aedes* larvae. Significant differences were observed between total number of mosquito larvae and months of collection.

**Conclusion.** The presence of *Aedes* mosquitoes in schools evidently shows that continuous vector surveillance in schools is necessary as this information will help in the formulation of proactive vector control activities, thereby preventing the occurrence of mosquito-borne diseases.

**Key Words:** mosquito, *Aedes*, vector, school, surveillance

## INTRODUCTION

Mosquitoes are known vectors that transmit pathogenic microorganisms contributing to the toll of morbidities and mortalities worldwide. These organisms proliferate in the environment and continually affect the quality of life of each individual affected by mosquito-borne diseases. In the Philippines, numerous mosquito-borne diseases like dengue, malaria, and filariasis continue to affect each individual. Newer reports present that mosquitoes likewise transmit diseases like the Chikungunya and Zika viruses. The burden of mosquito-borne diseases to the general public may bring about morbidity and or death.

Among the mosquito-borne diseases, dengue is considered to be the most important disease in the world<sup>1</sup> and in the country. Millions of lives worldwide are at risk of the viral infection transmitted by mosquito vectors. All

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the regions of the country appear to be vulnerable to the transmission of mosquito-borne diseases. Dengue infections are one of the important mosquito-borne diseases, as 186,416 cases and 59 deaths were reported in 2012. In Metro Manila alone, a total of 16,046 cases and 29 deaths have been documented.<sup>2</sup> The same report presents that children mostly under 10 years of age are affected. Like dengue, the Chikungunya viral infection is an emerging concern in the country. As of 2013, a total of 4,745 cases of the viral infection were reported, and 47.03% were serologically confirmed. Of this total number, about 674 cases, with 59.40% serologically confirmed, were reported in Metro Manila.<sup>3</sup> Both *Aedes aegypti* and *Aedes albopictus* have been known to transmit mosquito-borne diseases. The occurrence of *Aedes* mosquitoes in the country has been documented nationwide, making all regions of the country vulnerable to the transmission of mosquito-borne diseases;<sup>4,5,6</sup> however, limited studies on the occurrence and population ecology of *Aedes albopictus* in the country have been reported.

Different localities in the country recognize the threats brought about by these diseases and consider different strategies in looking after the welfare of the general population. Children in schools are recognized as important vulnerable groups in the Philippines, as their burden of mosquito-borne diseases is great as they may be hospitalized, suffer long-term disabilities, incur foregone opportunities by missing out in school, and, in worse conditions, even die. The risk of being bitten by mosquitoes among children is very high, especially that mosquitoes can thrive abundantly in environments as long as artificial containers can act as their breeding habitats.<sup>7</sup> There is a need to monitor the occurrence of mosquito vectors in places where children meet and congregate and to institute vector surveillance strategies so that appropriate preventive and control measures may be put in place to protect the children's public health and welfare.

Most vector surveillance activities in the country have been directed in the communities, and to date, no study has explored vector surveillance activities in populous places like schools. This study aimed to assess the species composition of mosquitoes collected from ovitraps in selected public schools in the National Capital Region in the Philippines. Ovitrap are proven to be sensitive in detecting mosquitoes like the *Aedes* populations even in low infestation levels and in indoor and outdoor environments.<sup>8</sup> Results pertaining to this study are significant, as they enable us to understand the vector's dynamics and help government and communities in formulating comprehensive vector control operations in public spaces like schools.

## MATERIALS AND METHODS

The study was conducted in selected public elementary and high schools located in the 16 cities and 1 municipality of Metro Manila. Based on the population per city/

municipality, one study site was assigned for every 500,000 individuals. The study sites were the barangays (villages) in the city/municipality. A total of 28 barangays were drawn out. In every barangay, 1 public elementary and 1 public high school were selected. The selection of the schools was based on the student enrollment population within that barangay. In the case of more than one public high school or public elementary school in the barangay, the school with the most number of students was chosen. The public elementary and public high schools in the study sites were determined based on the population size of the city and municipality of Metro Manila. A total of 56 public schools were identified. Twenty-nine elementary schools and 27 high schools were purposively selected from the different communities of Metro Manila depending on the student enrollment population data from the Department of Education. The total number of ovitraps installed was based on the total number of instructional classrooms in each school. An instructional classroom was defined as a room with walls and roof, has no air-conditioned facility and is used to hold the classes from 8 AM to 5 PM. Arbitrarily, 30% of the total number of instructional classrooms was used as fixed collection sites. A total of 735 ovitraps were installed in the elementary schools, and 747 ovitraps were installed in the high schools. The ovitraps were placed inside the classrooms in areas free from disturbances. A sign was placed near the ovitraps to inform the students not to disturb or play with the ovitraps. The trained field collectors installed and collected the ovitraps every week from November 2013 to February 2014. During collection, it was ensured that the ovitrap cans were thoroughly cleaned by brushing the inside surface, then refilled with clean tap water and new paddles for re-installation. Collected water and paddles were brought to the Medical Entomology Laboratory of the Department of Parasitology, College of Public Health, UP Manila. The collected water was examined for larvae, and paddles were examined for the presence of eggs weekly. Speciation was done once a month from November 2013 to February 2014. All positive paddles were individually placed in plastic containers with water and small amounts of ground dog food and left to stand for 4 – 5 days to allow the development of the emerged larvae to the fourth instar stage. The fourth instar larval stages were taxonomically identified using standard entomological keys.<sup>9</sup> Mosquito larvae per location, month of collection, and type of school (elementary or high school) were recorded and compared using analysis of variance (ANOVA) and independent *t* test. A test with a  $p < 0.05$  indicates that all statistical analyses are significant. All statistical analyses were performed using the GNU PSPP software.

## RESULTS

A total of 1,482 ovitraps were installed in the selected public schools. From November 2013 to February 2014, a

total of 18,325 (52.36%) mosquito larvae were collected from public elementary schools and 16,670 (47.64%) larvae from public high schools of Metro Manila, Philippines. During this period, the mean ovitrap index or infestation rate was  $49.69\% \pm 22.1$ . From the collected larvae in elementary schools, 16,214 (88.48%) were identified as *Aedes aegypti*, and 2,111 (11.52%) were *Aedes albopictus*. In public high schools, 14,909 (89.44%) were identified as *Aedes aegypti* and 1,761 (10.56%) were *Aedes albopictus*. Most of the collected mosquito larvae were those of *Aedes aegypti* (88.94%), compared to *Aedes albopictus* (11.6%). Figure 1 shows the distribution of *Aedes* spp larvae in the selected public schools. Each colored dot also represents the selected schools in the study. It can be noted that in most schools, the co-existence of both *Aedes* species were documented.



Figure 1. Distribution of *Aedes* spp larvae in selected public schools in the NCR.

The *Aedes aegypti* fourth instar larva's abdomen shows comb scales with stout, subapical spines, and/or multiple stout spines, whereas the *Aedes albopictus* fourth instar larva's abdomen shows comb scales without subapical spines or multiple stout spines (Figure 2).

Nineteen of the 29 elementary schools and 21 of the 27 high schools had mixed *Aedes* infestations in the ovitraps examined. Single infestation of *Aedes aegypti* in the ovitraps of nine elementary and six high schools were observed. No single infestation of *Aedes albopictus* in the ovitraps of the public elementary and high schools of Metro Manila was seen. There was no significant differences on the type of school and the total mosquito larvae ( $t = 0.206, p = 0.837$ ).

No significant differences on the type of school and the *Aedes aegypti* larvae ( $t = 0.388, p = 0.698$ ) alone were seen. Likewise, no significant differences on the type of school and the *Aedes albopictus* larvae ( $t = -0.404, p = 0.686$ ) alone collected were seen. Figure 3 shows that *Aedes* spp larvae were found in all selected schools from the sixteen (16) cities and one (1) municipality of Metro Manila. No significant differences were observed on *Aedes aegypti* larvae seen across all the cities and municipality assessed ( $F = 0.811, p = 0.674$ ). Significant differences of the total mosquito larvae ( $F = 5.978, p = 0.000$ ) and *Aedes albopictus* larvae ( $F = 7.824, p = 0.000$ ) based on the different cities and municipality assessed were observed. Significant differences on the total mosquito larvae ( $F = 8.396, p = 0.000$ ), *Aedes aegypti* larvae ( $F = 7.428, p = 0.00$ ), and *Aedes albopictus* larvae ( $F = 3.166, p = 0.001$ ) across the months of collection were likewise observed, as shown in Figure 4.

## DISCUSSION

Dengue fever and Chikungunya infections are important causes of morbidities in the country.<sup>3</sup> The occurrences of these ailments have been attributed to the mosquito vectors, and reports have indicated that the most commonly inflicted are children below 15 years of age.<sup>10</sup> Most vector surveillance studies in the country have been focused in the community setting. This was the first study that focused on vector surveillance in a school setting. This was a prospective study,

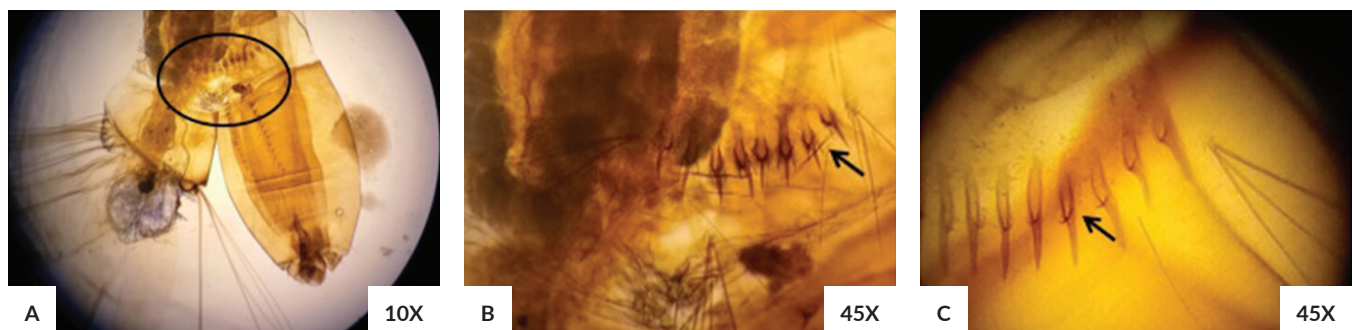


Figure 2. Taxonomic characters of the fourth instar larval stages of *Aedes aegypti* and *Aedes albopictus*. (A) Abdomen with comb scales. (B) Comb scales with stout subapical spines *Aedes aegypti*. (C) Comb scales without subapical spines *Aedes albopictus*.

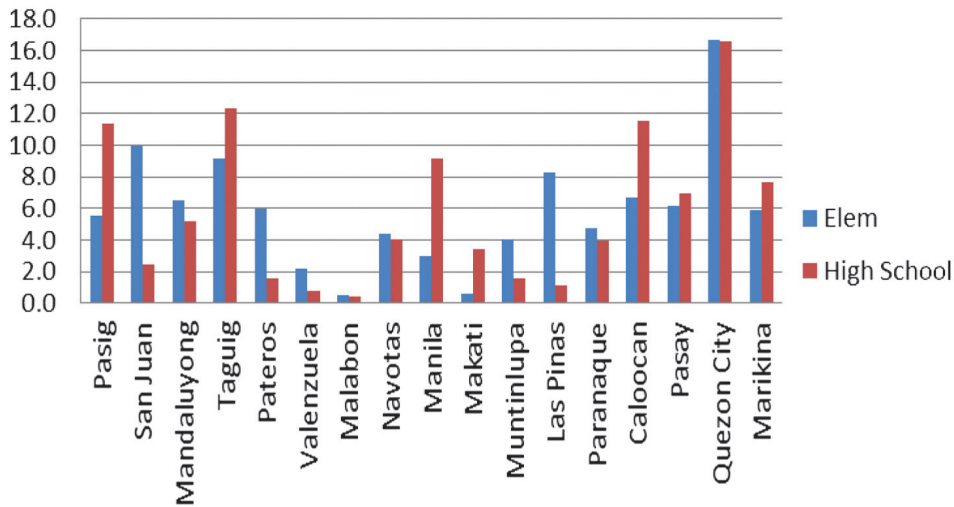


Figure 3. Percent distribution of *Aedes* spp larvae across cities/municipalities, Metro Manila, November 2013 to February 2014.

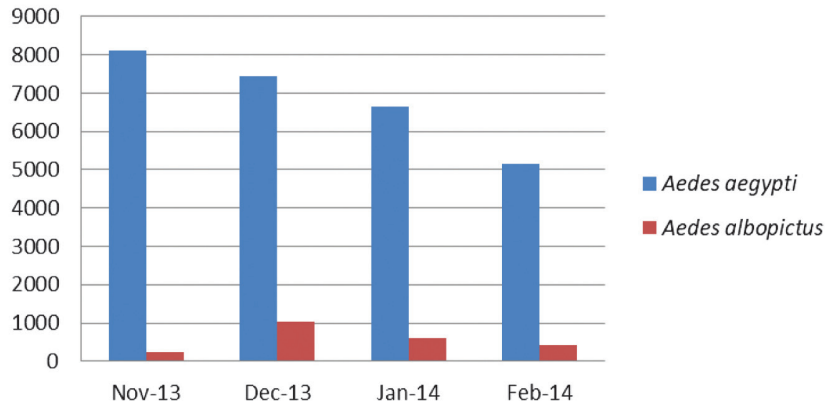


Figure 4. Distribution of *Aedes* spp larvae across public schools, Metro Manila, November 2013 to February 2014.

and its scope was limited on assessing the mosquito larvae obtained in the ovitraps installed inside the classrooms of public elementary and high schools of Metro Manila from November 2013 to February 2014. A significant difference in the occurrence of mosquito larvae, *Aedes aegypti*, and *Aedes albopictus* was observed during the months of collection. In Metro Manila, a type 1 climate is experienced where the months of November to April are considered as the dry-cool months.<sup>11</sup> The temperature and available moisture may decrease the mosquito density during the dry-cool months influencing the differences in the occurrence of the mosquito larvae during the period of collection.<sup>12</sup>

The predominance of *Aedes aegypti* in the ovitraps installed inside the classrooms was evident in the schools examined. No significant differences in the mosquito larvae, *Aedes aegypti* larvae, and *Aedes albopictus* larvae collected inside the classrooms of both elementary schools and high schools were evident. A study presents that *Aedes aegypti* prefers to breed in storage receptacles with clean water.<sup>7</sup>

A study also presented that these mosquitoes mostly favor indoor environments than those of its surrounding.<sup>13</sup> The coexistence of both *Aedes aegypti* and *Aedes albopictus* larvae in the ovitraps in the metropolis poses important threats to the public, especially that these mosquitoes play an important role in the transmission of both the dengue virus and the Chikungunya virus.<sup>14,15</sup> The distribution of the mosquitoes based on the larvae collected in the ovitraps varied from one city to another. The no-significant difference on the distribution of *Aedes aegypti* is likely, as the *Aedes aegypti* larvae were observed in almost all of the ovitraps across all the examined cities and municipalities of Metro Manila. The significant difference on the *Aedes albopictus* larvae and the total mosquito larvae may be attributable to their distribution and the few occurrence of the larvae compared to that of the *Aedes aegypti* in the ovitraps. The occurrence of coexistence of *Aedes aegypti* and *Aedes albopictus* in the ovitraps was observed in some of the schools. A study supports this result, indicating that the coexistence of *Aedes aegypti* and

*Aedes albopictus* is possible as both vectors could breed in the same containers indoors.<sup>13</sup> The abundance of *Aedes aegypti* over *Aedes albopictus* may be dependent on a variety of factors. Studies present that the environmental conditions and vector control measures instituted<sup>13,16</sup> predispose the distribution of mosquito larvae in the area. The coexistence of both mosquito larvae may be because both mosquitoes are anthropophilic, day biting and the female mosquitoes lay eggs in containers that may be damp or moist in and around human settlements.<sup>17</sup> The study was able to demonstrate the utility of the ovitraps as mosquito surveillance tool, concurring with other mosquito surveillance studies indicating that the use of ovitraps is effective in detecting the occurrence of mosquito populations at low infestation levels and at different geographic locations.<sup>8,18,19</sup>

## CONCLUSION

This study assessed the species composition of mosquitoes thriving in ovitraps installed indoors of public elementary and high schools of Metro Manila. *Aedes aegypti* was the most abundant larva observed in the paddles and water in the examined ovitraps. No single infestation of *Aedes albopictus* in the examined ovitraps was seen. The coexistence of both *Aedes aegypti* and *Aedes albopictus* in some ovitraps were observed in some schools of Metro Manila. Further research should examine the conditions that facilitated the coexistence or competition of mosquito larvae in breeding habitats, as this provides a more detailed analysis of understanding the distribution of vectors and the transmission of infectious diseases among the general populace.

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## Statement of Authorship

All authors approved the final version submitted.

## Author Disclosure

All authors declared no conflict of interest.

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