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Research Note

Distribution of mosquito larvae in various breeding sites in National Zoo Malaysia

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Abstract. Mosquitoes are principal vectors of major vector-borne diseases. They are widely found throughout urban and rural areas in Malaysia. They are responsible for various vector-borne diseases such as dengue, malaria, filariasis and encephalitis. A total of 158 mosquito larvae specimens were collected from the National Zoo, Malaysia, from 11 types of breeding habitats during the study period from end of May 2007 to July 2007. *Aedes albopictus* was the predominant species (35.4%), followed by *Tripteroides aranoides* (26.6%), *Lutzia halifaxii* (11.4%), *Aedes alboscutellatus* (10.1%), *Aedes caecus* (8.9%), *Armigeres* spp. (4.4%), *Malaya genurostris* (2.5%) and *Culex vishnui* (0.6%). It is important to have a mosquito free environment in a public place like the zoo. Routine larval surveillance should be implemented for an effective mosquito control program in order to reduce mosquito population.

Zoo, a public recreational park acts as the preservation and conservation centre for different groups of animals (i.e., carnivores, omnivores, amphibians, birds, reptiles and herbivores) for exhibition purposes. In 2001, 59 seriously ill people including 7 deaths were reported during an outbreak of West Nile virus caused by infected *Culex pipiens* in the zoo at New York City, along with dead horses, birds and cats (James, 2001). Therefore, zoo could be a place where there is high opportunity for mosquito borne diseases to spread to humans.

Although mosquito surveillance for adults and larvae has been regularly conducted in the country, there is however limited information on the presence of mosquito species in biological gardens (i.e., zoo). Thus, this study was a first attempt to determine and to detect the presence of mosquitoes in various breeding sites that were present throughout the zoo area.

The National Zoo with over 90% of its animals kept in a spacious exhibition park with a natural landscape, has been transformed to an open concept zoo. It is located at 31°2'35"N and 101°45'28"E, covered by a land area of 110 acres. Situated 13 km northeast of Kuala Lumpur, it is located at Taman Melawati, Ulu Kelang in Selangor state. The area surrounding the zoo was formerly covered with thick vegetation before it was developed and turned into a well-planned residential area. The zoo is home to 5137 specimens from 479 species of animals.

Larvae were collected from end of May 2007 to July 2007. A total of 24 water samples were collected from different breeding locations. All the samples were labeled (i.e.,

date and location of breeding sites) and were transferred into containers with 50 ml tap water and maintained until they reached the fourth instar larval stage while the pupae were maintained until they emerged as adult mosquitoes. At the fourth instar stage, larvae were killed by placing into 60ºC hot water and then preserved in 70-80% alcohol subsequent to species identification using a binocular compound microscope.

Aedes albopictus was the predominant species (35.4%, 56/158). A total of 56 larvae of *Ae. albopictus* were collected from different breeding sites including containers (22 larvae), rock holes (19 larvae), tires (5 larvae), food stall sites (5 larvae), drains (3 larvae) and tanks (2 larvae). The study also showed that 26.6% (42/158) of larvae were identified as *Tripteroides aranoides* which were collected from bamboos (36 larvae) and rock holes (6 larvae). The presence of *Lutzia halifaxii* was also detected in the study. Out of a total of 18 (11.4%) *Lutzia halifaxii*, 10 larvae were collected from wallow with the remaining collected in both drains (7 larvae) and tank (1 larva). In addition, the study also found the presence of *Aedes alboscutellatus* in artificial mud holes (10.1%, 16/158). *Aedes* (*Aedimorphus*) *caecus* (8.9%, 14/158) was obtained from animal foot prints and artificial mud holes. The other mosquito larvae identified in this study were *Armigeres* spp. (4.4%, 7/158), *Malaya genurostris* (2.5%, 4/158) and *Culex* (*Culex*) *vishnui* (0.6%, 1/158) with all larvae of each species found in containers, leaf axils and animal foot prints, respectively.

In general, mosquitoes can serve as vectors for many arthropod-borne diseases which may cause several clinical manifestations in humans. In the present study, of the 8 species of mosquitoes found only *Ae. albopictus*, *Cx. vishnui* and *Armigeres* spp. have been documented as important vectors for diseases such as chikungunya (Tesh *et al.*, 1976), Japanese encephalitis (Vythilingam *et al.*, 1993; Service, 2002) and filariasis (Cheong *et al.*, 1981; Das *et al.*, 1983), respectively.

The presence of *Cx. vishnui* in the zoo or any biological gardens should alert the management of the zoo as well as the public to take precautionary measures in order to avoid getting bitten by the species. According to Vythilingam *et al.* (1993) and Service (2002), *Cx. vishnui* is involved in the transmission of Japanese encephalitis (JE) virus. JE can cause brain infection in children below 10 years of age, with the greater risk in boys than in girls. In fact, most of the infected humans may suffer from encephalitis with 25-50% mortality for hospitalized cases and 50% manifesting neurological disorders in survivors of the disease (Sinniah, 2000).

Recently, *Ar. subalbatus* was incriminated as a vector of *Brugia pahangi* in humans (Aliota *et al.*, 2010; Muslim *et al.*, 2013). *Brugia pahangi* is primarily an animal parasite. *Armigeres subalbatus* has been observed in the zoo previously by one of us,

Table 1. Summary of mosquito's larval habitat in the National Zoo Malaysia according to species

Habitats	N	*Aedes albopictus*	*Culex vishnui*	*Armigeres* spp.	*Aedes caecus*	*Lutzia halifaxii*	*Aedes alboscutellatus*	*Tripteroides aranoides*	*Malaya genurostris*
Drains	10	3	0	0	0	7	0	0	0
Bamboos	36	0	0	0	0	0	0	36	0
Rock Holes	25	19	0	0	0	0	0	6	0
Wallow	10	0	0	0	0	10	0	0	0
Tanks	3	2	0	0	0	1	0	0	0
Artificialmud holes	19	0	0	0	3	0	16	0	0
Food stall sites	5	5	0	0	0	0	0	0	0
Animal foot prints	12	0	1	0	11	0	0	0	0
Containers	29	22	0	7	0	0	0	0	0
Leaf axils	4	0	0	0	0	0	0	0	4
Tires	5	5	0	0	0	0	0	0	0
Total (%)	**158 (100)**	**56 (35.4)**	**1 (0.6)**	**7 (4.4)**	**14 (8.9)**	**18 (11.4)**	**16 (10.1)**	**42 (26.6)**	**4 (2.5)**

N = total number of larvae in respective habitats

and is an avid biter of human mainly before dusk. Domestic animals such as cats that are present in the zoo can be the host for *B. pahangi*. Rohela *et al.* (2006) and Tan *et al.* (2011) reported the occurrence of *B. pahangi* microfilariae in cats from Kuala Lumpur city, Malaysia. *Armigeres* spp. found in the zoo can be considered as potential natural transmitters of *B. pahangi* from animals to humans. In addition, if animals in the zoo harbour *B. pahangi*, transmission to humans is possible.

The abundance of mosquito species found in the National Zoo is also associated with meteorological conditions such as high rainfall and temperature which are often referred as the precipitating factors for epidemics. The presence of ponds in the zoo environment serves as source for some of the species to oviposit. Although there is a natural source of running water from Kemensah and Pandang Rivers situated inside the zoo, no mosquito larvae were detected due to the presence of fish and tadpoles which feed on the larvae (Blaustein & Kotler, 1993).

Control activities including fogging and larviciding have been employed by the management of the National Zoo. However, both methods have limitations. As fogging was done once a week, it may not be sensitive enough to control the mosquito population. Meanwhile, larviciding using abate is only effective and sensitive for *Aedes* spp. and *Anopheles* spp. and not for *Culex* spp. and *Mansonia* spp. (Yap *et al.*, 1988). Abate can be replaced by fenitrothion, permethrin or cyfluthrin as these larvicides are useful for any conditions of water (i.e., clean, clear and polluted) (Yap & Foo, 1984). Surveillance using ovitrap should be considered by the management of the National Zoo as it can be used consistently in detecting and monitoring the distribution and abundance of mosquito population (Tham, 2000).

In conclusion, the presence of discarded plastic bags, containers, tires, animal foot prints and bamboo stumps contribute to the breeding sites resulting in the increased mosquito population in National Zoo. Mosquito borne infections have been under control in many countries, but the danger of new and devastating outbreaks is always present as the pathogens carried by mosquitoes are able to develop resistance to chemical pesticides and drugs. Hence, continuous surveillance is necessary with the incorporation of integrated control measures including physical, chemical, biological and social measures to prevent and reduce the risk of mosquito-borne diseases among human population.

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