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Mosquitoes Larval Breeding Habitat in Urban and Suburban Areas, Peninsular Malaysia

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***Abstract*—**Larval survey was carried out in 6 localities in the urban areas (Putrajaya) and suburban areas (Kuala Selangor) from January until December 2010. A total of 520 representative households in 6 localities were selected. Breeding habitats were sampled outdoors in the surroundings of housing areas. The study indicated that the most predominant species found in both areas was *Aedes albopictus* with the gardening utensil as a preferred breeding microhabitat for Putrajaya, in contrast to the artificial containers for Kuala Selangor. From a total of 1083 mosquito larvae species, 984 were *Aedes albopictus* larvae, 67 positive larvae of *Aedes aegypti* and 32 of *Culex* larvae. *Aedes* Index and Container Index were elevated in Putrajaya with 13% and 11% respectively which is higher than the standard given by the Ministry of Health, Malaysia. This results implicating dengue-sensitive skewed to the urban areas. Breteau Index result also above the standard in both study locations.

Keywords*—Aedes albopictus, Aedes aegypti,* Aedes Index (AI), Container Index (CI), Breteau Index (BI)

I. Introduction

MOSQUITOES can be found all over the world and commonly known to pose a significant threat to public health. The biodiversity of mosquitoes is very evident, with many genera having worldwide distribution and some genera with limited or endemic distribution [11].The common fear for mosquitoes is their role as vectors that can spread diseases such as Dengue, Malaria, Filariasis, Yellow fever, and Japanese encephalitis.The most common is the dengue virus which is transmitted to humans by the infected females of *Aedes aegyti* and *Aedes albopictus.* As the effective vaccine for dengue is not yet available, dengue control is limited to reduction of the vector population [5]. In Malaysia the outbreak of dengue cases is one of the major problems which seemed to be a global issue as well. According to [12] the first outbreak occurred in Penang from 1901-1902. Mosquitoes can thrive in a variety of habitats with fresh water, brackish water, or any water (clear, turbid or polluted) except in marine habitats with high-salt concentration [11].Construction techniques and design of construction sites, such as the building of roads, drainage and canal developments, may create artificial breeding sites for mosquitoes and biting midges because of the environmental modifications [4].

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Community areas, particularly residential developments, have been located in close proximity to major mosquito or biting midges major breeding sites. Some construction practices in areas which are being developed have also created new mosquito or biting midge breeding habitats. The presence of vegetation corridors between community areas and mosquito/biting midge breeding sites provide a dispersal route for biting insects to community areas. Trees and shrubs with dense foliage, planted near dwellings, will provide harbourage sites for mosquitoes and biting midges [4]. Urbanization is one of the factor that increase the number of habitat suitable for *Aedes* mosquitoes especially *Aedes aegypti* [18]. In cities where vegetation is abundant both species can occur together. Generally *Aedes aegypti* is the dominant species depending on the availability and type of larval habitat and extent of urbanization [17].

Rooftop gutters which posed a high potential for mosquito breeding have been banned in new developments through the Building Plan approval process [2]. Mosquito breeding places in and around houses can be divided into two main types, breeding sites with clean water: mainly rain-filled receptacles in humid tropical areas which are suitable breeding sites for some *Aedes* species. Breeding sites with polluted water: mainly in on-site sanitation systems and bodies of stagnant and polluted water favoured by *Culex* species [15]. Most accumulations of clean water are only temporary. Rain-filled receptacles in gardens may dry out in a few days or weeks. These habitats are favored by *Aedes aegypti*, which can act as a vector of dengue and yellow fever, and by *Aedes albopictus*, also a dengue vector referred as the Asian tiger mosquito by Americans. These species also breed in containers that are used to store water for drinking or washing. While *Aedes aegypti* commonly found inside houses, *Aedes albopictus* is more common in outside areas, in open spaces with shaded vegetation and suitable breeding sites such as car tyres and garbage dumps. *Anopheles stephensi*, a vector of malaria in some urban areas in south Asia, often breeds in wells, ponds, cisterns and containers used for the storage of drinking water [15]. The objectives of this study were mainly to identify the potential breeding habitats of mosquito and classify mosquito larvae species within residential areas in Putrajaya considered as urban and Kuala Selangor District which here classified as suburban.

II. Materials And Methods

A. Study Site

Putrajaya (urban area) study site which is a new Administrative Center of the Government and it is set to be a model garden city with sophisticated information network based on multimedia technologies. Putrajaya sits on a magnificent 4931 hectares of land within the Multimedia Super Corridor. It is located 25km south of Kuala Lumpur and 20km north of Kuala Lumpur International Airport (KLIA). It will be the most accessible city in Malaysia, and can be reached by expressways, urban highways and railways. The study locations are the residential areas of Precinct 9BI, Precinct 11A1 and Presinct11A5. Precinct 9 is located on the western edge of Putrajaya at 2 56' N, 101 40' E and with a total site area of 466.4 acres, it is one of the bigger precincts in Putrajaya. The main character of the precinct is defined by the high rise and high density residential blocks. Precinct 11 is located at the north-west corner of Putrajaya at 2 57' N, 101 40' 35.07" E and with a site area of 1049 acres, it is the largest precinct in the Periphery [8]. Kuala Selangor (suburban area) in Figure 2 is the second largest district in the State of Selangor and it is rich in historical relics. Economic resources of the residents are in the fields of agriculture, rearing of livestock, service sector, manufacturing and as well as tourism. It is situated at 67km southeast of KL. The study location is Seri Pagi (Saujana Utama), Kg. Bestari jaya (Mawar and Bunga Raya). Selection of study areas was based on the high incidence of dengue cases for the last 4 years beginning 2006.

Fig.1 Study location urban area

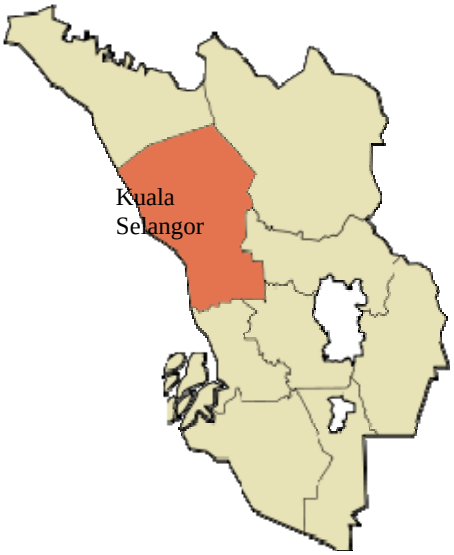

Fig. 2 Study location suburban area

B. Data Collection

Sampling technique was systematic whereby every 3rd house was inspected to detect mosquito breeding in the potential breeding sites. Pipette method was used for the sampling of mosquito larvae. A total of 520 representative households from ten selected localities were carried out for larval surveys in urban and suburban areas. Entomological survey was carried out outdoor areas only from January until December 2010, with assistance from the staffs of Vector Control Unit.

C. Entomological Studies

Mosquito larvae were collected and placed into the universal bottles together with all associated ecological information and brought back into laboratory for further studies. Identification of mosquito larvae was done to species level using the key provided in the guidelines set by Ministry of Health Malaysia [6]. Three larval indices: Aedes Index (AI), Container Index (CI), and Breteau Index (BI) were worked out as per standard WHO guidelines. All specimens were later, preserved in 70% alcohol for storage and in the Zoological Museum, and Institute of Biological Sciences, University Malaya.

III. Results And Discussions

For practical reasons, the most common survey methodologies employed larval sampling procedures rather than egg or adult collections [16]. To evaluate the distribution and density of the mosquito species in the study area, the parameters below were considered.

Aedes Index (AI): *percentage of houses infested with larvae and/or pupae.*

$$AI = \frac{\text{Number of houses infested}}{\text{Number of houses inspected}} \times 100$$

Container index (CI): percentage of water-holding containers infested with larvae or pupae.

$$CI = \frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \times 100$$

Breteau index (BI): number of positive containers per 100 houses inspected.

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

From the survey that has been conducted in six localities which involved both urban and suburban areas, it was found that breeding habitats for mosquito were different between urban and suburban areas. In urban area (Putrajaya) major breeding habitats for mosquito were gardening utensil with 54% and other breeding habitats in lower percentages were found to be comprised of, artificial containers, building design, tires, rubbish bins, discarded items, natural habitat, and water storage (Figure 3). Building design which included sand trap, floor and floor trap. Besides gardening utensil as a major breeding habitat in Putrajaya, the building design of houses in Putrajaya also contributed to the potential breeding of mosquitoes. It was apparent that every house in Putrajaya was designed with sand traps available for prevention of drainage clogging. In suburban area (Kuala Selangor) the major breeding habitat was artificial containers comprised of 48% and other breeding habitats were gardening utensil, water storage, tires, discarded items and rubbish bin in smaller proportions.

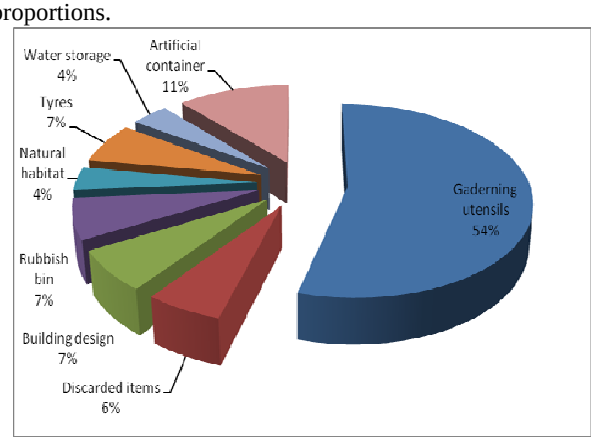

Fig. 3 Types of breeding habitats detected during the larvae survey in Putrajaya

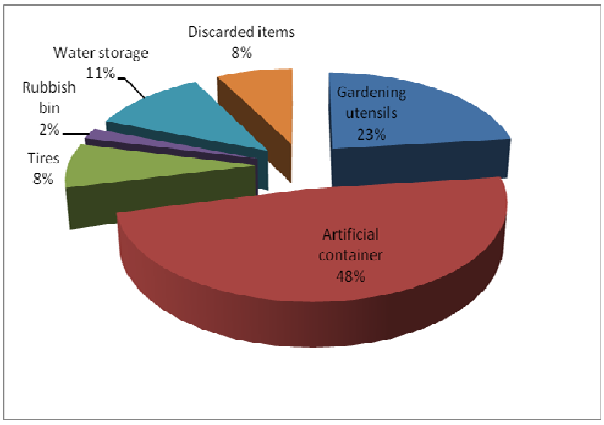

Fig. 4 Types of breeding habitats detected during the larvae survey in Kuala Selangor

Habitat	Number and (%) of mosquitoes species for urban and suburban area from Jan 2010- Dec 2010		
	Ae.albopictus	*Ae.aegypti*	*Culex*
Urban	695(71%)	37(55%)	27(84%)
Suburban	289(29%)	30(45%)	5(16%)
Total	984(100)	67(100)	32(100)

Fig. 5 Total number and percentages of mosquito species

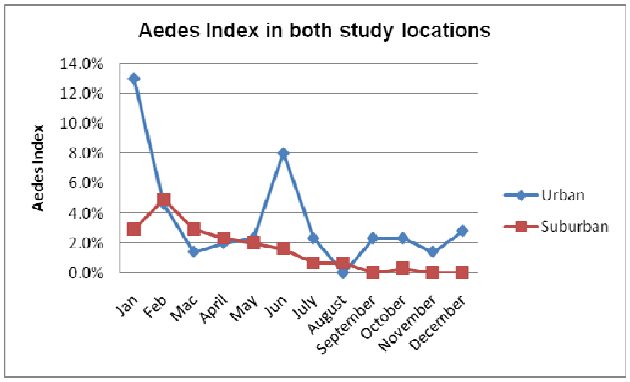

Fig. 6 *Aedes* Index in Putrajaya and Kuala Selangor

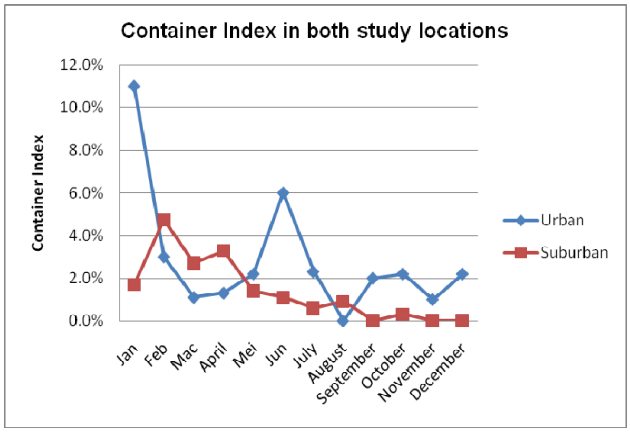

Fig. 7 Container Index in Putrajaya and Kuala Selangor

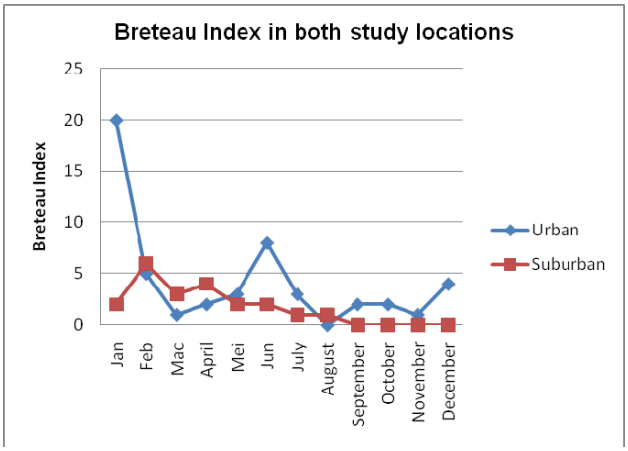

Fig. 8 Breteau Index in Putrajaya and Kuala Selangor

Three entomological indices were calculated such as Aedes Index (AI), Container Index (CI) and Breteau Index (BI). During one year of sampling, the Aedes Index was higher in January in Putrajaya (Urban) with 13% and 4.9% in Kuala Selangor (suburban area). Container index was higher in January in Putrajaya with 11% and 4.8% in Kuala Selangor (suburban area). In Breateau Index reading was higher in Putrajaya with a value of 20 and 6 for Kuala Selangor.From a total of 154 of positive containers, 1083 mosquito larvae species were collected and from this total, 984 were *Aedes albopictus* larvae, 67 larvae of *Aedes aegypti* and 32 of *Culex* larvae. Studies on the distribution and relative abundance of mosquitoes in urban/suburban housing areas indicated that *Culex quinquefasciatus* (Say), *Aedes albopictus* (Skuse) and *Aedes aegypti* (Linnaeus) were the most abundant [14]. From this study *Aedes albopictus* was found to be predominant when the survey was carried out in the outdoor areas. *Aedes albopictus*, is known to be a container breeder and mostly found in outdoor areas as supported by studies done by Bhaskar [1] who found that *Aedes albopictus* is a container breeder and it breeds in both natural and manmade habitats. While *Aedes aegypti* commonly breeds and feed inside houses, *Aedes albopictus* is more common outside, in open spaces with shaded vegetation and suitable breeding sites such as car tyres and garbage dumps [15]. *Ae. albopictus* is more likely to be found in natural containers or outdoor man-made habitats containing a greater amount of organic debris [10]. All containers containing *Aedes albopictus* were found outdoors, while three out of four containers positive for *Aedes aegypti* were also found outdoors [7].This study also indicated that the *Aedes albopictus* was the most dominant mosquito species that was found in both study areas and other species that found outdoors such *Aedes aegypti* and *Culex* species. Previous work had shown that *Aedes aegypti* larvae was always found in indoor conditions in contrast with what is revealed in this current work where *Aedes aegypti* was found outdoors together with *Aedes albopictus* and *Culex*. This finding is supported by [9] where *Aedes aegypti* was found breeding in natural receptacles such as tree holes, but always near human habitation. A similar result was found by [13] where both species Aedes albopictus and Aedes *agypti* was found to breed outside, rather than inside home dwellings. From the survey that has been conducted in the six localities which involved both urban and suburban areas it was found that the main breeding habitats for mosquito were different between these two areas. In urban area (Putrajaya) major breeding habitat for mosquito was gardening utensil and in suburban area (Kuala Selangor) the major breeding habitat was artificial containers. The gardening utensils include flower pots, flower pot plates, and watering cans. The habits of Putrajaya residents in keeping and maintaining mini gardens outside their houses aggravated the problem of *Aedes* breeding. According to [7] in their study they also found the main potential breeding sites for *Aedes* spp. consisted of garden accoutrements such as flower pots, flower pot plates, vases and watering cans. The unused flower pot that contained water provided suitable places for mosquitoes breeding which were worsened by the residents not consistently manage their garden to discard unused containers in proper ways. According to Isaacs [3], in tropical countries, anything that retained water would be potential breeding sites for *Aedes* mosquitoes which are within human dwellings. Containers that retained water for long periods of time will make good or suitable breeding habitats for mosquitoes such as the artificial containers found in the study locations of Putrajaya and Kuala Selangor. It is suggested that the Kuala Selangor residents should have proper waste management system and not discard unused containers outside their houses which can lead to habitat for mosquito breeding. The source reduction program should be implemented to solve the mosquito problem in these areas. *Aedes* Index (AI) was higher in January in Putrajaya (urban) with 13% along with the other readings which were also above the standard value of 1% starting from January until December except for August where the result is 0%. *Aedes* Index (AI) was higher in February in Kuala Selangor (suburban) with 4.9% and starting from July until December the results of *Aedes* Index were below the standard. The standard of Aedes Index (AI) set by Ministry of Health

Malaysia is 1%, Breateau Index (BI) is 5 and Container Index (CI) is 10%. The Breateau Index (BI) was higher for January in Putrajaya with an index of 20 and in Kuala Selangor the reading was 6 in February which was above the standard. All the results of Container Index (CI) in study locations were below the standard set by Ministry of Health Malaysia except in the urban area where the Container Index was 11% in January above the standard. These findings should caution both the authorities and communities to the necessary control measures in order to avoid the possibility of future outbreak of Dengue fever. The readings of the three indices were influenced by the awareness of the residents and environmental factors such as rainfall, humidity and temperature which could contribute to the dynamic fluctuations of indexes.There are many control measures that can be applied for the mosquito breeding prevention. One example which should be promoted is the public participation and change of habits in minimizing the breeding sites by elimination of the unused containers within the vicinity of their houses, drainage clearing and maintaining the garden areas. The authority should provide proper waste management system for all housing areas. The health education is one of the important ways to educate residents. Residents should be alert and concerned about their housing areas especially when these can contribute to mosquito breeding. The authority should educate and advise the residents on the potential mosquito breeding habitats, about the outbreak of diseases as a consequence of mosquito populations presence, the dangers of these diseases, how to control and awareness of the control measures at the same time promoting 'prevention is better than cure'.

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