BREEDING OF *AEDES AEGYPTI* (L.) AND *AEDES ALBOPICTUS* (SKUSE) IN URBAN HOUSING OF SIBU TOWN, SARAWAK

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Abstract. An *Aedes* survey using various larval survey methods was conducted in 12 urban housing areas and 29 vacant lands in Sibu town proper. *Aedes albopictus* larvae were found in all areas surveyed while *Aedes aegypti* larvae were present in 10 localities and 4 vacant lands. There were no significant difference in the house index, breteau and larval density index of these two *Aedes (Stegomyia)* species from the survey areas. The proportion of containers positive with *Ae. aegypti* and *Ae. albopictus* in area outside the house compound and near the house fencing were 3.2 times higher than outdoor compound. The indoor/outdoor breeding ratio for *Ae. aegypti* alone is 1.6 : 1. The most preferred breeding habitats outdoor were plastic cups and used tires while indoor habitats were ant traps and flower vases. In the vacant lands, the average number of larvae per containers was significantly higher than in houses and over 51% of the containers inspected were positive. Shared breeding between *Ae. aegypti* and *Ae. albopictus* larvae accounted for 9% in house surveys and 4.5% in vacant land survey. The use of various methods in *Aedes* larval suvey may provide essential information in the study of vector epidemiology in dengue and dengue hemorrhagic fever transmission.

INTRODUCTION

Dengue fever (DF) and dengue hemorrhagic fever (DHF) infections in Malaysia is on the rise since its first report in 1902 (Skae, 1902). In Sarawak, the first reported dengue outbreak was in 1982, after which the disease has become of public health importance (Medical Department, 1992). The major epidemic was reported in 1990 with a total of 1,468 notified cases. Of these cases, 35.5% were reported from Sibu urban center (Medical Department, 1990). The situation in 1991 and 1992 has improved considerably though the proportion of cases from Sibu town remained high. The focal areas of dengue fever and dengue hemorrhagic fever transmission in Sibu town is concentrated in the central housing areas. Routine *Aedes* larval survey using the standard single larval survey method (Sheppard *et al.* 1969) in and around premises in these localities had repeatedly given low *Aedes* indices. Furthermore, the entomological parameters as regard to habitat and breeding site preference, species abundance and absolute larval density were not available from the routine *Aedes* survey records. These parameters are of vital importance for dengue and dengue hemorrhagic fever epidemiology and control. For further study, we decided to carry out an *Aedes* survey in February to March 1993 in Sibu Town.

STUDY AREAS

Sibu is the second largest township in Sarawak with a total population of 170,430 people, many of them being urban dwellers. The *Aedes* surveys carried out were confined to the dengue prone areas, which were identified through the dengue register for the years 1989 to 1992 maintained at the Medical Department, Headquarters. Thus localities encompassing Kampong Nyabor Road and Oya road parallel between Hoe Ping Road and Hua Kiew Road were chosen. These localities are Chinese dominated and housing types are a mixture of terrace, semi-detached and detached. The environmental conditions are generally poor and refuse disposal is un satisfactory. The drainage system in the areas are poorly maintained due to indiscriminate dumping and the low topographical features. The surveys covered 12 localities and 29 vacant lands ranging from 0.5 hectare to 1.5 hectares. All the vacant lands which were private property and found adjacent to the housing units are overgrown with shrubs ranging from 1 meter to 1.5 meters in height. Dumping of containers at the edges of the land are commonly seen.

MATERIALS AND METHODS

All housing units (1,549 premises) within 12 selected localities were inspected for *Aedes* breeding. This represented 10.5% of the total houses in Sibu urban area (Medical Department, 1991). For the purpose of house survey, inspection covered indoor and outdoor compound. Containers found next to the fencing out-side the compound area were also inspected. A housing unit is defined as an independent building structure irrespective of number of family therein.

As for the vacant land, each survey area was pre-inspected by the team leader (Health Inspector) and a sketch map for the land was prepared. Area of 5 meters around the edges of the land was demarcated to facilitate the survey. All visible containers located therein were inspected for *Aedes* breeding.

Throughout the study, all larvae and/or pupae from the containers were collected and placed in each plastic bag measuring 30 cm × 16 cm diameters and labeled. In case of permanent water storage containers, a total of 10 dips (16 cm in diameter) were used and the larvae and/or pupae were pipetted into the plastic bag. All relevant information such as, breeding sites, positive or negative, containers type were recorded on prescribed form. All specimens were then identified in the laboratory using the taxonomy keys developed by Mattingly (1965).

RESULTS

Of the total 1,664 premises in the 12 selected localities, 1,549 were surveyed. The premises surveyed varied from 34 in Rambutan Lane to 236 in Hua Kiew Road. *Ae. aegypti* larvae were detected in 10 localities with the house index ranging from 3.8% in Mui Huong Road to 9.3% in Lai Chee Lane. *Aedes albopictus* larvae were present in all localities with the house index ranging from 2.4% to 11.5% (Fig 1). There were no significant difference in the House Index ($t = 1.45$, $df = 22$; $p > 0.1$) and Breteau Index ($t = 1.5$, $df = 22$; $p > 0.1$) for the two *Aedes* species in all the localities surveyed.

The mean number of larvae per house for *Aedes* was relatively high (Fig 2). The average number of *Ae. aegypti* larvae per house in the localities surveyed were not significantly lower than *Ae. albopictus* ($t = 1.8$, $df = 22$; $p > 0.$). Of all the localities surveyed, Hoe Ping road had the highest *Ae. aegypti* larvae density index with 9 per positive house; while Hua Kiew Road had the highest for *Ae. albopictus* with 15 per positive house. There were no significant difference in the number of *Aedes* larvae per house ($t = 0.89$, $df = 22$; $p = > 0.1$).

Of the breeding habitats, 230 out of a total 2,369 water holding containers surveyed were found positive with *Ae. aegypti* and *Ae. albopictus*. The mean number of *Aedes* larvae collected varies from 17 in storage tanks to 43 in tins. There was no direct correlation between number of containers sampled and number containers positive with *Aedes* larvae ($r = 0.52$, $df = 7$; $p > 0.1$; Fig 3). The main containers

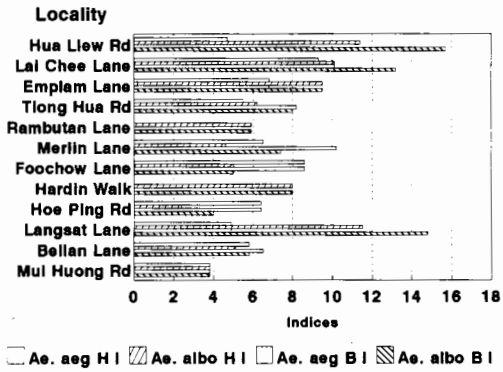

Fig 1–House index (HI) Breteau index (BI) of *Aedes aegypti* and *Aedes albopictus* in 12 localities surveyed.

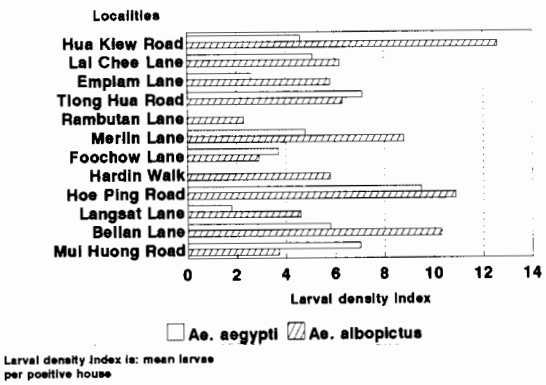

Fig 2–Larval density index in 12 localities surveyed.

found breeding with *Aedes* were: Discarded plastic containers (cups and pails) old tires, ant traps, flower vases and drums. The three commonest breeding habitats for *Ae. aegypti* in order of preference were: drum, ant traps, and storage tanks (Table 1). Shared containers accounted for 9% of the total breeding for two *Aedes* species. There were no significant difference in the type of containers found breeding with *Aedes aegypti* larvae ($p = 0.096$; $df = 9$).

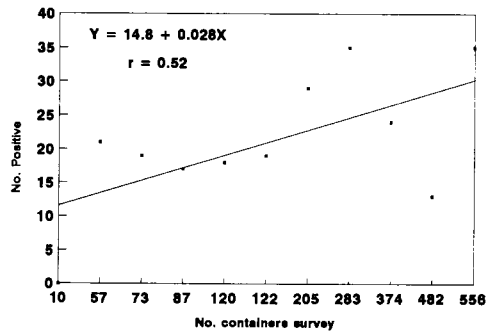

Fig 3–Correlation between number of containers survey and number of container positive with *Aedes* larvae in houses.

From the analysis of positive breeding sites, a highly significant difference was noted in the mean positive containers found indoor, outdoor and outside house's compound ($F = 7.6$, $df = 33$; $p = 1.91$). As for type of containers, 2% of indoor water storage were found to be positive with *Ae. aegypti* and *Ae. albopictus* larvae as compared to 10.1% of the same category outdoor. In the domestic category, the positive for indoor and outdoor were 7.9% and 10.9% respectively. 17.1% of the discarded containers found outdoor within compound areas were positive compared to 44.3% outside the compound. This findings indicated that 84.7%, mainly *Ae. albopictus* larvae, breed outdoor. As for *Ae. aegypti* the ratio of indoor : outdoor breeding is 1.6 : 1 (Table 2).

The survey results also revealed that a large proportion of the positive houses harbored only one breeding container. Houses with two or more breeding containers only represent 23.5% (Table 3) of the house surveyed.

In the vacant land survey, a total of 260 containers of various sizes were sampled and 133 were positive with *Aedes* (Table 4). Of the positive containers, 9 were positive with *Ae. aegypti*, 6 containers were found mixed breeding with *Ae. albopictus*, and 130

Table 1

Major breeding habitats of *Aedes aegypti* and *Aedes albopictus* in Sibu Town, Sarawak.

Container type	No. sampled (% positive)	Proportion positive with *Aedes aegypti*	Mean *Aedes* larvae ± SD
Storage tank	482 (2.7)	0.46	17 ± 13
Daum	205 (14.1)	0.65	38 ± 30
Jar	556 (6.3)	0.42	21 ± 18
Ant trap	122 (15.6)	0.47	29 ± 26
Flower vase	120 (15.0)	0.33	19 ± 13
Bucket/basin	374 (6.4)	0.29	26 ± 19
Tin	283 (12.3)	0.14	43 ± 45
Tire	73 (26)	0.47	24 ± 28
Bottle	10 (0)	0	0
Plastic container	57 (36.8)	0.38	32 ± 21
Others	87 (19.5)	0.35	27 ± 19
Mean ± SD	215 ± 175	0.35 ± 8	25 ± 11

Table 2

Comparison of indoor and outdoor breeding of *Aedes aegypti* and *Aedes albopictus* larvae and pupae.

Breeding sites	Container category				
	Water storage	Domestic container	Discarded container	Natural container	Total
Indoor					
No examined	650	280	-	-	930
No postive (%)	13 (2.0)	22 (7.9)	-	-	35
% positive with *Aedes aegypti*	53.8	36.3	-	-	42.8
Outdoor					
No examined	585	386	392	-	363
No postive (%)	59 (10.0)	42 (10.9)	67 (17.1)	-	168
% positive with *Aedes aegypti*	27.1	21.4	19.4	-	14.9
Outside fencing area					
No examined	-	-	61	6	67
No postive (%)	-	-	27 (44.3)	0	27
% positive with *Aedes aegypti*	-	-	11.1	0	11.1

Table 3

Number of premises in relation to positive containers.

No. of positive container/house	No. of premises	Total positive containers
0	1,379	0
1	130	130
2	28	56
3	9	27
4	2	8
> 5	1	6

containers or 88.7% were breeding with *Ae. albopictus* alone. Over 60.7% of these containers were discarded tins. Others were bucket, plastic containers cups, pails, drum, jar, tires, coconut shells and other household containers. There was highly significant correlation between the containers surveyed and containers being positive with *Aedes* larvae ($r = 0.99$, $df = 14$; $p > 0.001$; Fig 4). Mean number of *Ae. albopictus* larvae per containers was significantly higher in vacant lands than in the premises ($t = 2.3$, $df = 26$, $p \leq 0.05 > 0.02$).

DISCUSSION

There has been a little documented information on the breeding of *Ae. aegypti* and *Ae. albopictus* in

Table 4

Major breeding habitats of *Aedes aegypti* and *Aedes albopictus* in vacant land, Sibu Town.

Container type	No. sampled (% positive)	Proportion positive with *Aedes aegypti*	Mean *Aedes* larvae ± SD
Drum	6 (50)	0.30	14 ± 6
Jar	6 (50)	0.60	14 ± 3
Bucket/basin	22 (36.4)	0.25	20 ± 23
Tin	158 (48.1)	0.03	62 ± 7
Tire	9 (66.7)	0.16	17 ± 6
Plastic container	20 (65.0)	0.07	14
Coconut shell	8 (12.5)	0	18 ± 12
Others	31 (74.5)	0	0
Mean ± SD	32 ± 51		21 ± 15

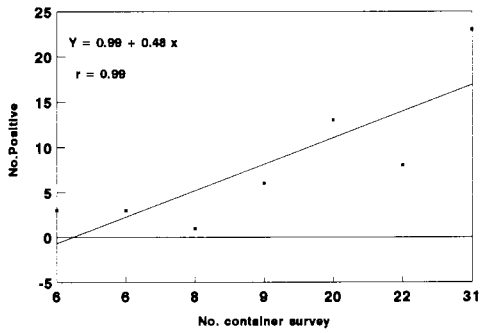

Fig 4–Correlation between containers surveyed and containers positive with *Aedes* larvae in vacant lands.

Sarawak. Chang and Jute (1982) study the distribution and abundance of these species in urban and rural areas and confirmed the presence of high density of these two *Aedes* species in Sibu urban areas. The present study revealed that there is an overall reduction of *Aedes* breeding notably *Ae. aegypti* in the premises surveyed (Macdonald and Rajapaksa, 1972). This reduction is due probably to the effect of the control measures carried out by the Health Authority vector control program. Despite the reduction of *Aedes* density in these localities, persistent dengue transmission recurred frequently since 1989.

In our survey, the average number of larvae per house was used to express the severity of *Aedes* breeding. This index as introduced by Chan *et al* (1971) is probably the best for measuring the absolute larval density is relation to house found positive with larvae. In areas where the House and Breteau indices has been maintained to an extremely low level, this larval density index should be used in *Aedes* surveillance program. However in the application of all larval survey technique, there is a tendency to underestimate the *Aedes* larval density breeding in huge storage tank, drum and jar as it is not practical to collect all larvae found breeding in these containers. In this containers, number of dips used should be standardized throughout. In our study, 10 dips were arbitrarily set for the survey teams.

This survey is the first to apply the all larval survey technique in an *Aedes* survey in Sarawak. It confirmed the presence of *Ae. aegypti* in human dwelling habitats and to some extent, the vacant lands. The proportion of shared containers with *Ae. albopictus* in house survey accounted for 9%, which were mainly outdoor containers. Containers found co-breeding with *Ae. aegypti* and *Ae. albopictus* was also found in Singapore city (Chan *et al,* 1971) and the proportion of shared containers is comparable to our present survey. Since in routine *Aedes* survey for control purpose, single larval survey method was applied, the information of relative abundance of *Aedes* species is not available.

Outdoor compounds and areas outside house fenc-

ing are the main contributors to harboring *Aedes* larvae. Giving the same number of water containers in these three locations, the probability of breeding in areas outside house compound along the fencing is 3.2 times higher than outdoor compound and this in turn is 3.2 times more than indoor. In term of the availability of potential breeding habitats, outdoor compound area is most abundance than indoor. The small number of containers sampled in area outside the compound near house fencing is limited by the availability of the areas, as this portion is only found in the corner terrace houses, detached and semi-detached houses.

Though breeding of *Ae. albopictus* in rural forest fringe and secondary forest has been documented (Macdonald, 1957; Macdonald and Traub, 1960), there is no quantitative study made as regard to the *Aedes* breeding in vacant lands in urban areas. This information is essential as it is linked to epidemiology and control of DF/DHF. The lack of information is partly due to the tedious process of conducting the survey in these breeding sites. The process involved initial inspection and mapping of vacant lands and specific location of containers. We have adopted the inspection strategy of confining to 5 meters along the edges of the vacant lands as most of the dumping were there. In the *Aedes* larval survey, it also has to cover the tree holes (Macdonald *et al,* 1965; Gould *et al,* 1968, Jumali *et al,* 1979) and bamboo stump (Macdonald *et al,* 1965; Gould *et al,* 1968). Since all vacant lands selected for our survey are in urban center and are overgrown with only shrubs and vegetations, our focus was only on the discarded items.

It is clear that control of *Aedes* breeding in this urban housing areas should focus on outdoor including the adjacent vacant lands. The presence of unsanitary condition with abundance of discarded containers outdoor will continue to support the breeding of *Ae. albopictus* and to some extent *Ae. aegypti.* Even if the respective houseowners could manage to eliminate containers indoor and within their house compound areas completely, dengue epidemics will continue to pose a problem in Sibu town as long as problems assocaited with vacant land remained unsolved.

ACKNOWLEDGEMENTS

This survey was carried out by the Vector Borne Diseases Control teams, Sibu Division together with the staff from the Sibu Municipal Council. The administrative support from the Divisional Medical Officer, Dr R Meganathan, the Chairman and Secretary of the Sibu Municipal Council and the Director of Medical and Health Services, Sarawak are gratefully acknowledged.

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