RELATIVE ABUNDANCE OF *AEDES AEGYPTI* (LINNAEUS) AND *AEDES ALBOPICTUS* (SKUSE) IN DIFFERENT HABITATS.

An Ovitrap Survey Conducted in Georgetown, Penang Island, Malaysia

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INTRODUCTION

AEDES AEGYPTI (Linnaeus) and *Aedes albopictus* (Skuse) have been involved in the transmission of dengue haemorrhagic fever and classical dengue fever in many urban areas of Southeast Asia (Smith, 1956; Hammon, 1966; Rudnick, 1967). On Penang Island, an ovitrap survey (Yap, 1975 b) conducted on the small towns and villages, excluding the City of Georgetown, indicated that *Ae. albopictus* was ubiquitous, where *Ae. aegypti* was present on the fringe areas adjacent to the City of Georgetown. Information concerning the biology of the two species of mosquitoes in the City of Georgetown is lacking.

The present investigation, concentrating on four selected areas within the City of Georgetown, is a study of the distribution and relative abundance of the two *Aedes* species with particular reference to different types of habitats and dwellings in the urban areas.

MATERIALS AND METHODS

The ovitrap technique (Jacob & Bevier, 1969) with its necessary modifications (Yap, 1975, a, b) was adopted to study the relative abundance of *Ae. aegypti* and *Ae. albopictus* in the urban areas of Georgetown on Penang Island. Four areas within the city limits of Georgetown were chosen for the study. These include: (1) Island Park—Green Lane area, which consists mainly of relatively new concrete double-storey residence houses built within the last 10-15 years, (2) Pulau Tikus—Burmah Road area, with mixture of old shophouses and new residence houses (3) Perak Road—East Jelutong area, with concrete and wooden shophouses lining Perak Road and wooden single-storey residence houses adjacent to the main road, and (4) McNair Street — Bridge Street area, which is the older part of Georgetown consists mainly of old, concrete double-storey shophouse-cum-residences. The first two areas are situated in the fringe of the city limits (Figure 1). Relative abundance of mosquitoes in shophouses versus residence houses (in Perak Road — East Jelutong area) and shophouse-cum-residences versus a school compound (in McNair Street — Bridge Street area) were also studied.

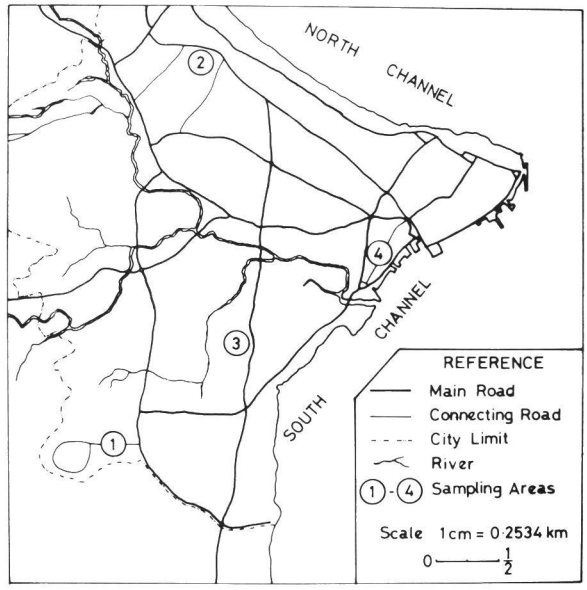

Fig. 1. Ovitrap sampling areas (No. 1-4) for *aegypti* and *Ae. albopictus* within the City of Georgetown, Penang Island, Malaysia.

The ovitrap used in the study consists of a drinking glass (rim diameters : 7.5 cm; height : 15 cm) coated outside with glossy black paint. A hardboard paddle (12.5 cm × 2 cm × 0.3 cm) was used as the oviposition substrate in each glass each half-filled with tap water. The ovitraps were arranged according to a grid system with distance of approximately thirty meters. The survey was conducted for a period of five weeks for each of the four designated areas. Ovitraps were set both 'indoor' and 'outdoor' for comparative studies. Procedures for

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weekly servicing of the ovitraps, handling of exposed paddles, and identification of adult mosquitoes have been described earlier (Yap, 1975b).

Appropriate statistical analysis (e.g. standard errors and student — t tests) were done on the data collected with respect to the relative abundance of the mosquitoes at different habitats.

RESULTS

Results from the five-week ovitrap survey conducted at the four sampling areas within the city of Georgetown (Figure 1) indicated that the oviposition rates of the two *Aedes* species were higher in areas 3 and 4 with mean numbers of 71.94 and 61.98 eggs per trap per week respectively (Table I). Percentages of ovitraps with positive egg deposition ranged from 54.25 (Area 1) to 79.42 (Area 2). Based on the identification of hatched mosquitoes both at the larval and the adult stages, Area 1 has the smallest percentage of *Ae. aegypti* present when compared with the other three areas (Table I).

Relative abundance of *Ae. aegypti* and *Ae.*

TABLE 1: Ovitrap survey of *Ae. aegypti* and *Ae. albopictus* in four selected areas within the City of Georgetown, Penang Island. The survey was conducted over a period of five weeks.

	Sampling Area in Georgetown	Total No. of traps per week	Total No. of eggs collected	% trap with positive oviposition	No. of eggs per trap eggs per trap per week (Mean-S.E.)	% of *Ae. aegypti* from egg hatched
1.	Island Park — Green Lane	73	4,614	54.25	12.64 ± 3.42	1.20
2.	Pulau Tikus — Burmah Road	69	11,683	79.42	33.86 ± 4.21	9.58
3.	Perak Road — East Jelutong	30	10,791	79.34	71.94 ± 6.63	11.98
4.	McNair Street — Bridge Street	32	9,917	76.88	61.98 ± 6.24	15.76

TABLE II: Relative abundance of *Ae. aegypti* and *Ae. albopictus* at different habitats of Georgetown, Penang Island.

Week NO.	Mean No. of *Ae.* eggs/trap/week			
	McNair St. — Bridge St. Area (No. 4)		Perak Rd. — East Jelutong Area (No. 3)	
	School	Shophouses	Shophouses	Residence Houses
1	89.33	33.05	35.71	36.75
2	84.67	50.45	94.71	32.38
3	116.83	44.15	141.50	77.25
4	106.92	38.30	135.00	51.13
5	96.25	29.45	65.07	64.06
Overall Mean ± S.E.	98.80 ± 5.86	39.08 ± 3.77	94.40 ± 20.21	52.31 ±8.37
t p value P = 0.05	6.8960 0.005>P>o.oo1 Highly significant		2.3915 0.10>P> 0.05 Not significant	

TABLE III: Relative 'indoor' and 'outdoor' abundance of *Ae. aegypti* and *Ae. albopictus* based on the hatched mosquitoes from eggs collected in sampling areas 3 and 4.

Week No.	Mean No. of mosquitoes hatched/trap/week			
	Ae. aegypti		*Ae. albopictus*	
	indoor	outdoor	indoor	outdoor
1	3.38	6.43	8.88	20.83
2	7.91	12.10	16.16	28.50
3	11.50	12.17	23.38	42.37
4	17.75	8.20	40.66	35.20
5	6.69	5.67	17.25	28.10
Overall Mean ± S.E.	9.45 ± 2.45	8.91 ± 1.38	21.27 ± 9.18	31.00 ± 3.64
t P value P = 0.05	0.2180 P > 0.10 Not significant		2.4025 0.10 > P > 0.05 Not significant	

albopictus under different habitats were studied in areas 3 and 4. In area 4 (McNair Street — Bridge Street area), when comparisons were made between a school compound and adjacent old concrete shophouses-cum-residences, the mosquito population were definitely higher in the school compound (Table II). Comparison of shophouses versus residence houses in area 3 gave mean values of oviposition of 94.40 and 52.31 respectively. However, due to variability of the weekly results, the differences were not significant at 95% confidence level (Table II). Similarly, comparison of oviposition rates with ovitraps situated 'indoor' versus 'outdoor' (definitions see Yap, 1975b) in areas 3 and 4 gave no significant differences (Table III).

Hatching of *Aedes eggs* collected from individual ovitrap gave the following additional information concerning the biology of the two *Aedes* species: (1) Overall hatching rate of the eggs collected for the five week period was 54.27%, (2) Sex ratios of the mosquitoes hatched were very close to 1. Male mosquitoes constituted 49.55 and 49.46% of the total population for *Ae. aegypti* and *Ae. albopictus* respectively, (3) Sharing (cohabitation) of ovitraps by the two *Aedes* species appeared to be common. Percentage of positive ovitraps with both *Ae. aegypti* and *Ae. albopictus* present were 55.4%, and (4) In area where *Ae aegypti* population was low (as was found in Area 1), the mosquitoes were consistently found in only a few ovitraps from the same spots over the survey period.

Throughout the five week survey, missing paddles from ovitraps and missing or broken ovitraps represent 7.40 and 2.10% of the total ovitraps used respectively.

DISCUSSION

Results from the ovitrap survey in Georgetown indicated that the *Aedes* mosquitoes studied were more abundant in the crowded poorer central districts of the City (Table I; Figure 1, areas 3 and 4). These areas consisted of slum houses as well as old concrete houses with poor sanitation facilities. The ovitrap survey also demonstrated that *Aedes* density were significantly higher in a school compound when compared with the adjacent shophouses (Table II). Although the survey is of a preliminary nature only, the implication that schools, with the possibility of a higher mosquito population as indicated here, can serve as a focus for the transmission of dengue and dengue haemorrhagic fever among young children cannot be neglected.

Results obtained from hatching *Aedes* eggs collected from ovitraps gave no significant differences concerning the 'indoor' and 'outdoor' distributions of the two *Aedes* mosquitoes (Table III). The findings are in contradiction to the results obtained from the conventional larval inspection method in Singapore City (Chan, *et al.*, 1971a) and the whole island ovitrap survey conducted on Penang Island (Yap, 1975b). The discrepancy in the two ovitraps surveys may be due to the fact that in the present survey 'in-

door' vs 'outdoor' ratios were calculated from the hatched mosquitoes from eggs collected, whereas, in the whole island survey, comparisons were based on the total number of eggs collected.

Extensive surveys of the larval habitats in Singapore City (Chan, *et al.,* 1971b) showed that the sharing of natural breeding habitats by the two *Aedes* species was uncommon (7.1% of total number of breeding habitats). In contrast, the present survey indicated extensive sharing of ovitraps (55.40% of total positive ovitraps) by *Ae. aegypti* and *Ae. albopictus.*

In the Island Park — Green Lane area (figure 1, Area 1), *Ae. aegypti* constituted only 1.20% of the total *Aedes* hatched from the eggs collected. This *Ae. aegypti* population was obtained consistently from a few ovitraps set in the same spots over the period of time studied. This lack of movement for oviposition may be related to the limited dispersal ability of the species in the field (Morlan & Hayes, 1958; Schoof, 1967).

The present survey and the whole island survey conducted earlier (Yap, 1975b) indicated that ovitrap technique can be an effective, inexpensive sampling device for studying distribution of *Ae. aegypti* and *Ae. albopictus* in suburban as well as urban areas. The technique can be considered complementary to the conventional larval inspection method, especially in situations, where field experimentations are needed in order to obtain additional information concerning the bionomics of *Aedes* species in the field in relation to the transmission of dengue and dengue haemorrhagic fever in endemic areas.

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