DISTRIBUTION AND DENSITY OF *AEDES AEGYPTI* (L) AND *AEDES ALBOPICTUS* (SKUSE) IN SARAWAK

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SUMMARY

A total of 73 localities covering 4,894 premises and 26,712 breeding habitats were surveyed in 1980 to determine and establish the density and distribution pattern of ***Aedes aegypti*** *and* ***Aedes albopictus*** *in Sarawak. A similar pattern has been observed in the density of the* ***Aedes aegypti*** *and* ***Aedes albopictus.*** *The number of houses positive with* ***Aedes*** *larvae were found to be highest in the coastal areas followed by the inland rural areas. The Aedes aegypti Breteau Index (B.I.) of 0-525 in the coastal areas is the highest followed by 0-207.5 in the inland rural areas. The study undertaken has now revealed that both the* ***Aedes aegypti*** and ***Aedes albopictus*** *are widespread in the State.*

INTRODUCTION

Dengue and Dengue Haemorrhagic Fever is an increasing Public Health problem in most of the countries of the tropical areas of Western Pacific and South East Asian Regions. [1] Sporadic cases of Dengue Fever have been known to occur in Sarawak and since 1973, a total of 17 cases were reported and serologically confirmed from the State by Chang *et al.* [2] In view of the lack of up-to-date information on the distribution of *Aedes* species in Sarawak and the presence of confirmed cases of Dengue Fever; it has become increasingly important to study the distribution pattern of the *Aedes aegypti* and *Aedes albopictus* in the State.

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The presence of *Aedes aegypti* in the State was first noted in Sibu by Macdonald *et al.* [3] Subsequent presence as noted in Kuching in 1964 by Macdonald *et al* [4] and Surtees [5] and in Miri by Macdonald and Rajapaksa. [6] Apart from these brief mentions and patchy description of the presence and distribution of *Aedes* mosquitoes in Sibu, Kuching and Miri; no data are available from other parts of the State. The aim of this paper is to provide information on the distribution of the species as related to different environmental conditions of the State. Such information could help in the vector control programme.

MATERIALS AND METHODS

For the purpose of this study, a total of 73 localities in the Seven Divisions of the State were selected and for ease of reference, they are divided into four environmental regions viz; coastal areas, urban areas, sub-urban areas and inland rural areas. The sub-divisions are not delineated sharply and therefore sub-urban merged in places with the coastal and inland rural areas. But nevertheless, these four sub-divisions are the most convenient with which to relate the study.

Trained rural Health Supervisors and in some instances Health Inspector; working in a two man team were used to locate all the breeding places indoor and outdoor in a specified number of houses in each locality (20 percent of total houses in the areas). Single larva per container method devised by Sheppard *et al* [7] was adopted throughout the survey. The term larvae in this paper includes pupae. The larvae were collected and put into a vial measuring 1" x 3". Each vial contains a single larva from a single positive container. The vial is then labelled on which are stated the container

type, house number, housing type and whether found indoor or outdoor. The larvae were then examined in the field on the same day and the species and the details of the information in the label noted on the recording form. The collective results from all the localities surveyed were then compiled to be analysed. For the purpose of this study, only the larvae of *Aedes aegypti* and *Aedes albopictus* were recorded.

DEFINITION

In the context of this study, the following terms are deemed to be used as defined:-

Shophouses : Usually standing in a row adjoining one another, they are brick built and two storied. Business is transacted in the lower front portion, while the remainder serves as living quarters.

Residential : Houses in a built-up area and are either detached, semi-detached or terraced and which are either single, double or multistoreyed.

Quarters : Houses provided for government servants or local authority workers. They are similar to Residential Houses.

Kampong House : Usually detached, in most instances they are temporary and raised on stilts above ground level.

Shophouses, Residential and Quarters are provided with pipe water supply while kampong houses are usually not provided.

House Index : Percentage of houses positive for the larvae.

Breteau Index : Total Number of positive containers per 100 houses.

Coastal Areas : Areas bordering the sea to the South West, Central and North East regions and extending between 8-15 km inland, usually these areas are not provided with pipe water supply.

Urban area : Areas in and around the major towns which are provided with treated pipe water supply.

Sub-urban Areas : Areas within the immediate vicinity of the urban areas and are usually provided with pipe water supply.

Inland Rural Areas: Areas not included in coastal, urban and suburban and which are usually provided with pipe water supply through Rural Health Improvement Scheme.

RESULTS AND DISCUSSION

This paper reports the first extensive attempt to determine and establish the distribution of *Aedes aegypti* and *Aedes albopictus* and aims at supplementing earlier reports by Macdonald [3,4] Surtees [5] and Macdonald and Rajapaksa [6] besides providing the most recent information on the distribution and density of the *Aedes* mosquitoes in the State. Fig. 1 shows the present distribution pattern of *Aedes aegypti* and *Aedes albopictus* in the State. Of the 73 localities surveyed covering 4894 houses, 16 localities are in the urban areas, 10 in suburban; 10 in coastal and 37 in the inland rural areas. The total number of breeding habitats surveyed was 26,712, 3,046 of which or 11.4 percent were found positive for *Aedes* larvae. The average number of breeding habitats surveyed per house ranged from 1.2 to 13.6 with a mean of 5.4 per house (Table I). Altogether 30.6 percent of the total houses surveyed in the urban areas were found to be positive with *Aedes;* 34.1 percent in the sub-urban areas; 62.5 percent in the coastal areas and 34.3 percent in the inland rural areas. A total of 36 localities were found to be without *Aedes aegypti* and only 2 localities without *Aedes albopictus*. The *Aedes aegypti* and *Aedes albopictus* House and Breteau Indices for each individual locality are also presented in Table I.

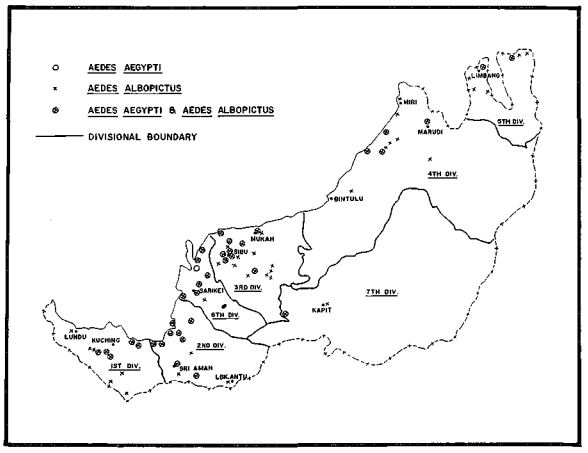

Fig. 1 Distribution of *Aedes aegypti* & *Aedes albopictus* in Sarawak 1980 (73 localities surveyed)

Aedes aegypti

Aedes aegypti, the suspected vector responsible for the transmission of dengue and Dengue Haemorrhagic fever [2] although less widespread than its counterpart, the *Aedes albopictus;* is by no means uncommon. Of the 73 localities surveyed, 37 localities are found to be present with *Aedes aegypti.* Of the localities without *Aedes aegypti,* 5 are in the urban areas, 1 in suburban area, 1 in coastal area

TABLE I

DENSITY OF *AEDES AEGYPTI* AND *AEDES ALBOPICTUS* IN 73 LOCALITIES SURVEYED — 1980

Environmental Condition	Division	Locality Surveyed	No. of Houses Surveyed	No. of houses + ve with Aedes larvae	No. of Containers + ve with aedes larvae	Total No. of Containers Examined		Average No. of Containers Examined/ House	House Index		Breteau Index	
						Indoor	Outdoor		*Aedes aegy.*	*Aedes albo.*	*Aedes aegy.*	*Aedes albo.*
Urban	I	Lundu	25	6	6	38	26	2.2	0	24.0	0	24.0
	II	Simanggang	200	27	33	744	265	5.0	5.8	8.5	6.5	10.0
		Betong	119	40	55	237	203	3.7	14.3	25.2	16.8	29.4
		Engkilili	50	13	14	101	77	3.6	12.0	14.0	12.0	16.0
		Lubok Antu	25	6	6	30	78	4.3	0	24.0	0	24.0
		Saratok	126	28	43	153	496	5.2	11.1	17.5	13.5	20.6
	III	Mukah	150	73	87	582	321	6.0	25.3	18.7	36.0	22.0
		Sibu	1231	497	709	4344	3391	6.3	22.4	19.9	31.8	25.8
		Kanowit	60	12	12	138	90	3.8	10.0	10.0	10.0	10.0
	IV	Marudi	75	6	7	87	20	1.4	1.3	6.7	1.3	8.0
		Miri	243	57	70	674	927	6.6	0	25.9	0	28.8
	V	Limbang	170	29	31	326	134	2.7	1.2	15.9	1.2	17.1
		Lawas	50	13	17	179	26	4.1	0	26.0	0	34.0
	VI	Sarikei	200	24	41	421	164	2.9	0.5	11.5	1.0	19.5
		Binatang	30	12	34	71	93	5.5	26.7	23.3	66.7	50.0
	VII	Kapit	90	27	38	221	184	4.5	0	30.0	0	42.2
Sub-urban	I	Tebakang	25	3	4	56	32	3.5	0	12.0	0	16.0
		Siburan	30	7	14	77	21	3.3	10.0	16.7	20.0	30.0
		Beratok	30	13	35	52	46	3.3	16.7	26.7	40.0	60.0
		Tapah	30	6	17	64	37	3.4	16.7	16.7	23.3	33.3
	III	Sg. Merah	40	22	31	119	79	5.0	27.5	30.0	40.0	37.5
		Bawang Assan	40	22	49	170	75	6.1	52.5	10.1	107.5	15.0
		14th Mile Army Camp	50	21	21	63	8	1.4	38.0	4.0	38.0	4.0
	IV	Batu Niah	75	15	23	190	196	5.1	1.3	18.7	5.3	25.3
		Bekenu	75	25	55	185	225	5.5	5.3	29.3	5.3	68.0
	VII	Song	60	21	31	208	165	6.2	5.0	31.7	5.0	46.7
Coastal	I	Sebangan	30	29	120	107	298	13.5	90.0	66.7	286.7	113.3
		Sambir	40	34	102	146	137	7.1	75.0	37.5	210.0	45.0
	II	Sibuyau	80	31	61	312	418	9.1	30.0	18.8	53.8	23.8
		Meludam	50	27	45	290	321	12.2	42.0	26.0	62.0	30.0
		Pusa	60	49	100	238	410	10.8	65.0	40.0	115.0	53.3
		Kabong	50	40	143	347	331	13.6	68.0	56.0	200.0	94.0
		Tanjong Kunjit	20	16	38	70	142	10.9	0	80.0	0	190.0
	III	Dalat	86	36	46	376	287	7.7	27.9	18.6	33.7	19.8

TABLE I (cont'd)

DENSITY OF *AEDES AEGYPTI* AND *AEDES ALBOPICTUS* IN 73 LOCALITIES SURVEYED — 1980

Environmental Condition	Division	Locality Surveyed	No. of Houses Surveyed	No. of houses + ve with Aedes larvae	No. of Containers + ve with Aedes larvae	Total No. of Containers Examined		Average No. of Containers Examined/ House	House Index		Breteau Index	
						Indoor	Outdoor		*Aedes aegy.*	*Aedes albo.*	*Aedes aegy.*	*Aedes albo.*
	VI	Kuala Matu	25	12	13	29	65	3.8	36.0	12.0	40.0	12.0
		Daro	50	33	274	272	108	7.6	64.0	12.0	528.0	22.0
Rural	I	Mongkos	5	4	7	13	7	4.0	0	80.0	0	80.0
		Tebadu	12	4	5	43	17	5.0	0	8.3	0	8.3
		Buso	20	5	7	45	57	5.1	0	25.0	0	35.0
		Krokong	5	0	0	4	3	1.4	0	0	0	0
		Tondong	17	5	5	95	4	5.8	0	29.4	0	29.4
	II	Skrang Scheme	50	4	4	28	32	1.2	0	8.0	0	8.0
		Melagu Scheme	60	10	15	43	50	1.6	0	16.7	0	25.0
	III	Penakup	30	21	34	199	92	9.7	0	70.0	0	113.3
		Durin	19	8	12	79	61	7.4	0	42.1	0	63.2
		Sg. Lengan	60	40	54	191	73	4.4	63.3	1.7	86.7	3.3
		Pasir	40	40	88	188	90	7.0	100.0	10.0	207.5	12.5
		Kpg. Igan	60	29	38	145	116	4.4	25.0	25.0	31.7	31.7
		Rantau Panjang	30	5	9	80	32	3.7	0	16.7	0	30.0
		Bukit Lan	20	12	25	71	113	9.2	0	60.0	0	125.0
		Machan	20	7	9	55	53	5.4	0	35.0	0	45.0
		Ngemah	16	6	9	70	60	8.1	0	37.5	0	56.3
		Dap	25	10	12	119	88	8.3	0	45.0	0	48.0
		Ng. Wak	20	12	22	60	32	4.6	0	45.0	0	80.0
		Pakan	25	3	4	67	7	3.0	0	8.0	0	8.0
		Sg. Kut	20	14	22	174	58	13.2	60.0	10.0	100.0	10.0
		Ng. Tamin	20	4	7	44	37	4.0	0	20.0	0	36.0
		Sebintek	15	9	14	58	76	8.9	0	60.0	0	43.3
		Sekuan	60	14	15	29	225	4.2	0	23.3	0	25.0
		Stapung	30	6	7	49	66	3.8	0	20.0	0	23.0
	IV	Long Lama	30	6	6	60	37	3.2	0	20.0	0	20.0
		Ladang 2	25	5	7	23	70	3.7	0	20.0	0	28.0
		Ladang 3 CDC Oil Palm Scheme	25	2	2	20	21	1.6	0	8.0	0	8.0
		Lambir	30	2	2	18	68	2.9	0	6.7	0	6.7
			60	4	4	51	54	1.8	0	6.7	0	6.7
	V	Batu Danau	40	5	8	15	144	4.0	0	12.5	0	20.0
		Kubong	20	4	5	8	65	3.7	0	20.0	0	25.0
		Punang	25	11	26	94	125	8.8	40.0	16.0	80.0	24.0
		Merapok	30	4	13	28	99	4.2	0	13.3	0	43.3
		Medamit	20	4	7	10	99	5.5	0	10.0	0	35.0
	VI	Selalang	50	29	62	191	35	4.5	50.0	12.0	106.0	18.0
		Jakar	20	11	27	102	5	5.4	45.0	10.0	125.0	10.0
		Ng. Semah	50	20	28	238	21	5.2	40.0	0	56.0	0

and 29 in the rural areas. The *Aedes aegypti* House Index ranged from 0 - 26.7 percent in the urban areas; 0 - 52.5 percent in the suburban areas; 0 - 90 percent in the coastal areas and from 0 - 100 percent in the rural areas. The Breteau Index ranged from 0 - 66.7 in the Urban areas; 0 - 107.5 in the suburban areas; 0 - 528.0 in the coastal areas and from 0 - 207.5 in the rural areas (Table I)

Surtees noted that *Aedes aegypti* larvae were not found more than 16Km (10 miles) south of Kuching. However our survey revealed that in three suburban localities of Siburan, Beratok and Tapah which are situated more than 27 Km (17 miles) South of Kuching town, the *Aedes aegypti* House Index ranged from 10 percent to 16.7 percent. It can be deduced that the introduction of *Aedes aegypti* is largely due to the active movement of people and regular traffic plying between Kuching and these suburban localities.

It is interesting to note that the *Aedes aegypti* density is much higher in the coastal and rural areas, while in the urban and suburban areas the density is comparatively similar. This is expected and could be due to the fact that in the coastal areas where the housing type is mainly kampong houses and where proper water supply systems are not provided for, the inhabitants tend to collect rainwater into containers and drums for storage and these drums are neither covered nor is the water changed regularly. This in turn provides an excellent breeding ground for *Aedes aegypti* which is mainly an indoor breeder. In the rural areas, although the housing type is similar to kampong houses, the environmental differences could be the factor which results in the difference of indices. In the rural areas, proper water supply is provided via the rural water supply scheme and where water supply system is not available, the inhabitants depend largely on river water. As such less water storage containers are kept indoors and even if available, the water is changed and replenished daily as there is abundant supply of water available within easy reach; thus making them not suitable for the breeding of *Aedes aegypti*. Another possible factor which contributes to the uneven distribution of *Aedes aegypti* in the rural areas is the communication barrier. Being situated in the interior of the State there is no proper means of transportation from the urban areas or between the villages and this could affect the migration of *Aedes aegypti*. The above factors may contribute in one way or another to the distribution of *Aedes aegypti* in the rural areas where it was absent in 29 of the 37 localities surveyed.

In the urban and suburban areas, the distribution is somewhat similar although densitywise, it is much higher in the suburban localities. The similarity in their geo-physical and socio-environmental set up could be the influencing factor. Both areas are provided with water supply and have mostly shophouses, residentials and government quarters. The fact that the density of *Aedes aegytpi* is much lower and that 5 of the 16 localities surveyed in the urban areas are without the particular species as against 1 out of 10 in the suburban areas could be attributed to the active vector control measures being implemented in the urban areas. *Aedes aegypti* had been eliminated in the 5 urban localities since 1978 after 3 years of control measures. In the suburban areas, no active vector control measures were instituted besides monitor survey. Another influencing factor could be the better scavenging services provided in the urban areas as compared to that in the suburban areas. However in suburban Tebakang in the First Division, *Aedes aegypti* was not detected even though no active vector control programme was instituted in the locality.

Aedes albopictus

Aedes albopictus are more widespread and were detected in all except 2 localities, that is Krokong in the First Division and Nanga Semah in the Sixth Division. It must be mentioned here too that Krokong is also not detected for *Aedes aegypti*. Although more widespread throughout the State; densitywise, it is highest in the coastal areas with a House Index range of 12.0 - 80.0 percent; from 0 - 80.0 percent in the rural areas; 4.0 - 31.7 percent in the suburban areas and from 6.7 - 30.0 percent in the urban areas. The Breteau Index range for *Aedes albopictus* is from 12.0 - 190 in the coastal areas; 0 - 125.0 in the rural areas; 4.0 - 68.0 in the suburban areas and from 8.0-50.0 in the urban areas. This pattern is similar to that observed for *Aedes aegypti* where the highest density is recorded in the coastal areas and lowest in the urban areas.

The differences in the density of the *Aedes albopictus* from one environmental region to another can possibly be the result of a difference in the geo-physical and socio-environmental set up of

the region. This refers to the differences in the location, the availability of basic amenities such as communication routes, water supply and refuse disposal. Looking at these differences; it may then be possible to explain why there is such a high density of *Aedes albopictus* in the coastal and rural areas and why it is comparatively lower in the urban and suburban localities.

In the majority of coastal and rural areas; unlike in the urban and suburban areas; the basic amenities such as road communication, water supply and refuse disposal systems are not available. The absence of these amenities especially proper water supply system and refuse disposal has given rise to the keeping of a large number of water storage containers both indoors and outdoors. This in turn becomes the major breeding ground for the *Aedes albopictus*. The absence of proper refuse disposal system has led to indiscriminate disposal of refuse and those water bearing containers especially empty tins, coconut shells, split bamboos etc. become a major source of breeding ground for *Aedes albopictus*. Another factor which results in the high density of *Aedes* in the coastal and rural areas is the absence of active vector control programme.

In the urban and suburban areas; the availability of the basic amenities has somehow managed to keep the density of *Aedes albopictus* at a comparatively low level. Furthermore active vector control measures being carried out in the urban areas has helped in further reducing the density of *Aedes albopictus* in the localities.

It is not fully understood as yet why *Aedes aegypti* has failed to establish itself well in the rural areas when compared to *Aedes albopictus*. The survey carried out revealed that in 29 of the 37 localities surveyed in the rural areas, *Aedes aegypti* was not detected as against only 2 localities for *Aedes albopictus*. However, in all the other localities *Aedes aegypti* has been able to adapt and establish itself equally well if not better than its counterpart, the *Aedes albopictus* except in certain urban localities where active vector control measures have eliminated the *Aedes aegypti*. Another interesting observation made is the absence of both species of *Aedes* in Krokong in the First Division. However this could be due to the inadequate number of houses surveyed; only five (5) surveyed. But in the rural area of Nanga Semah in the Sixth Division, the absence of *Aedes albopictus* is still a mystery.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. Tan Yaw Kwang, Director of Medical Services, Sarawak for allowing publication of this paper. Thanks are also extended to all the Vector Control field staff for carrying out the *Aedes* larval survey.

REFERENCES

[1] WHO 1980 Guide for diagnosis, treatment and control of Dengue Haemorrhagic Fever (Second edition) Technical Advisory Committee on Dengue Haemorrhagic Fever for the South East Asian and Western Pacific Regions World Health Organisation 1980.

[2] Chang M S, Rubis P, Jute N and Lim T W (1981) Entomological Aspects of endemic Dengue Fever in Sarawak 1973-1980. *Med. J. Malaysia* Vol. 36 2, 79-82.

[3] Macdonald W W, Smith C E G, & Webb H E (1965) Arbovirus infections in Sarawak: Observations on the mosquitoes. *J. Med. Ento*, 1, 335-347.

[4] Macdonald W W, Smith C E G, Dawson P S, Ganapathipillai A and Mahadevan S (1967) Arbovirus infections in Sarawak: Further observations on mosquitoes. *J. Med. Ent.*, 4, 146-157.

[5] Surtees G (1970) Mosquito breeding in the Kuching area, Sarawak, with special reference to the epidemiology of Dengue Fever *J. Med. Ent.*, 2, 273-276.

[6] Macdonald W W and Rajapaksa N (1972). A survey of the distribution and relative prevalence of *Aedes aegypti* in Sabah, Brunei and Sarawak *Bull. Wld. Hlth Org.*, 46, 203-209.

[7] Sheppard P M, Macdonald W W and Tonn R J (1969) A New method of measuring the relative prevalence of *Aedes aegypti*. *Bull. Wld Hlth Org.*, 40, 467-468.