DENGUE AND DENGUE HAEMORRHAGIC FEVER OUTBREAK IN LAWAS DISTRICT, SARAWAK, EAST MALAYSIA

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SUMMARY

An outbreak of Dengue and Dengue Harmorrhagic Fever occurred in Lawas District in 1983. A total of 134 cases were notified with 74 cases serologically confirmed. The epidemic which lasted for three months starting from week 20 and peaking in week 24 before being brought under control in week 35 is the first to occur in the district. At the end of the epidemic, 54 localities were affected starting from areas within the vicinity of the town before spreading further inland with the movement of the population.

Entomological investigation in all the infected areas revealed a high density of Aedes albopictus *which was the sole vector present. Effective control of the epidemic was achieved through proper planning, active participation of various agencies and intensive outdoor spraying with malathion 2% or ULV concentrates.*

INTRODUCTION

Dengue and Dengue Haemorrhagic Fever infection are now probably the most important and widespread arthropod-borne virus to affect man as measured in terms of morbidity and mortality.[1] Since the first major South-East Asian outbreak of Dengue Haemorrhagic Fever occurred in Bangkok in 1958, the incidence of the disease has steadily increased.[2] This could be due to the rapid growth and urbanization of the region, and the frequency and ease of human travel.

The first description of Dengue and of Dengue Haemorrhagic Fever in Malaysia was reported by Skae[3] and Rudnick *et. al.*,[4] respectively. In 1973, a major outbreak of Dengue/Dengue Haemorrhagic Fever occurred in Peninsular Malaysia.[5] Endemic classical Dengue in Sarawak was first mentioned by Surtees[6] and that *Aedes albopictus* was the suspected vector. A total of 17 cases were serologically confirmed in the state between the years 1973 to 1980.[7] Sarawak encountered her first epidemic in 1982 with 120 notified cases and 41 serologically confirmed.

A more serious epidemic occurred in 1983 with 156 notified cases of which 243 were serologically confirmed (Medical Department, unpublished data). The 1983 epidemic involved a number of districts of which Lawas District with a total of 134 cases (25.9%) was the first to be affected. The epidemic in the district has both epidemiological and entomological significance and thus this paper

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seeks to describe, and wherever possible, analyse the outbreak and its control.

Description of Lawas district

Lawas district, one of the two districts which form the 5th Division, lies between latitude 4°¾′ north and longitude 115°, 25′ east; bordering Brunei Darusallam to the south, the East Malaysian state of Sabah to the north and Kalimantan, Indonesia to the east (Fig. 1). It has an area of roughly 4,024.8sq. km. Geographically, the district consists of the coastal land, low-lying hills and is mountainous towards its border with Kalimantan.

Inhabited by a number of different ethnic groups, it has a population of 22,913 comprising of 40.8% Muruts, 26.5% Malays, 14.8% Chinese, 14% Kedayans and 3.9% other indigenous groups further inland. Economically, the Chinese are mainly involved in business while the Malays, apart from fishing, are engaged in commercial agriculture such as the planting of pineapple and bananas. The Muruts and other indigenous groups are involved in rice cultivation and livestock rearing.

Description of outbreak

EPIDEMIOLOGY The 1983 epidemic of Dengue/ Dengue Haemorrhagic Fever was the first of its kind ever to occur in the district. The first few cases were reported in weeks 6, 10 and 12 with a single case each week. This was followed by a seven-weeks break where no cases were notified. The disease was again reported in week 20 and reached its peak with 29 reported cases in week 24. From then on, the number of reported cases steadily declined to 22 cases in week 26 before finally ceasing to occur by week 46 (Fig. 2).

The 54 localities affected were mainly the village *(kampongs)* adjacent to Lawas Town from where the first few cases were reported, such as Kampong Temangis and Kampong Banting. Subsequently, the disease began to spread to the villages and schools along the Lawas – Trusan Road such as Kampong Lumut and Trusan Secondary School.

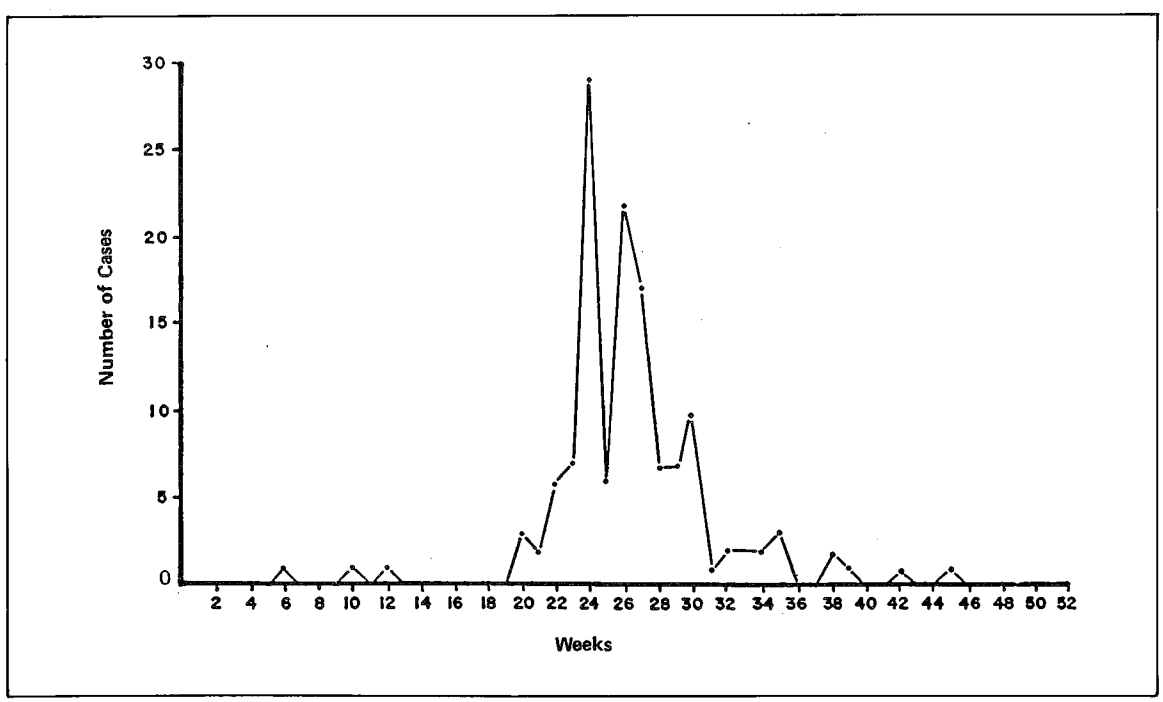

Fig. 2 Weekly incidence of Dengue and Dengue Haemorrhagic fever cases in Lawas District, 1983.

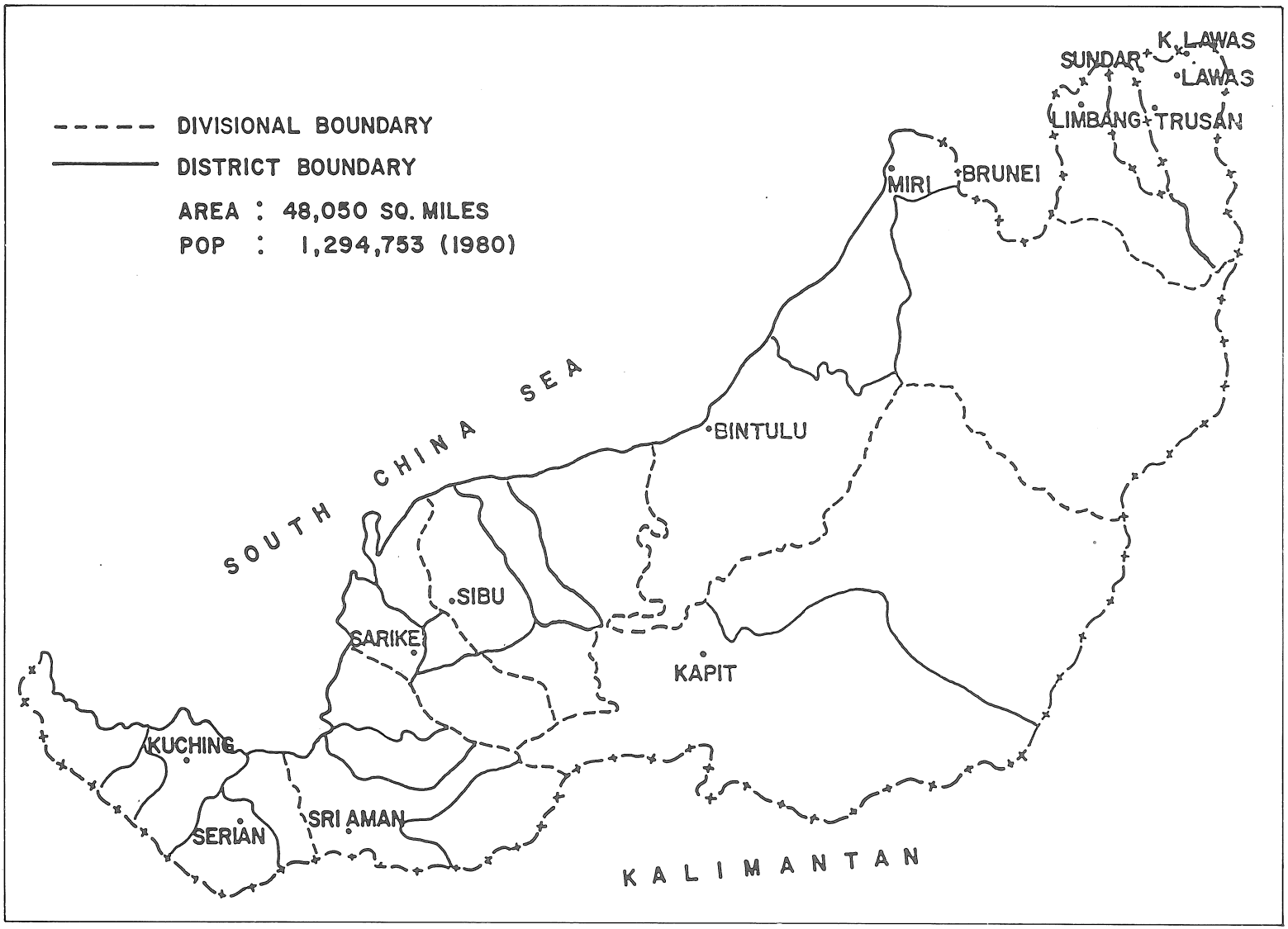

Fig. 1 Map of Sarawak showing Lawas Distirct.

In the later part of the epidemic, cases were also reported from the logging camps and the interior villages. Dengue Haemorrhagic Fever cases were reported from 13 localities as against 51 localities for Dengue Fever (Fig. 3). The most clusters of Dengue Haemorrhagic Fever cases notified from a single locality were three in Kampong Lumut and Kampong Seberang, each.

For the entire period of the epidemic, a total of 134 cases of which 112 were Dengue Fever and 22 Dengue Haemorrhagic Fever were notified with 73 cases (54.4%) being serologically confirmed from the Institute for Medical Research (IMR). The ratio of confirmed cases for Dengue Fever was 0.54 and 0.59 for Dengue Haemorrhagic Fever.

More than 52.3% of the cases reported were below 19 years of age, 41% aged between 20–49 years and the remaining 6.7% aged 50 years and above. The highest incidence of cases occurred in the 20-39 years age group (32.8%). Slightly more males than females were affected (M/F = 1.09) as shown in Table I. The majority of the cases (91 or 68%) were Muruts; 14.2% were Malays; 9.7% Chinese and the remainder being other indigenous groups (Table II).

TABLE I

SEX AND AGE GROUP DISTRIBUTION OF 134 DENGUE (DF) AND DENGUE HAEMORRHAGIC FEVER (DHF) IN LAWAS, DISTRICT, SARAWAK, 1983

Age group (yrs)	Number of cases notified		Total cases (%)
	Male	Female	
< 1	1	–	1 (0.75)
1 – 4	3	2	5 (3.7)
5 – 9	6	9	15 (11.2)
10 – 14	12	12	24 (17.9)
15 – 19	12	13	25 (18.6)
20 – 39	26	18	44 (32.8)
40 – 49	7	4	11 (8.2)
>50	3	6	9 (6.7)
	70	64	134 (100)

ENTOMOLOGY. The *Aedes* vector control programme involved routine, monthly house inspection and, quarterly abate larvicidal application. It was initiated in 1978, covering 505 premises in Lawas Town and the nearby Kampong Punang. Every three months, inspection was also carried out in rural coastal towns – Kuala Lawas, Sundar and Awat-Awat areas. The results indicate that *Aedes aegypti* occurs only in the above three coastal towns whereas *Aedes albopictus* is widely distributed in all the above areas. The initial baseline *Aedes aegypti* Breteau Index in 1977 ranged from 8 in Sundar to 36 in Awat-Awat and declined to 3, and 18 in the respective localities in 1983.

A total of 54 localities were affected by the epidemic and as part of the epidemiological investigation, *Aedes* larval surveys were conducted in all but one of the infected areas including place of work and residence of the patient. The number of houses surveyed was determined as to include all the houses within approximately 200 metres radius of the target house. The single larvae per container method devised by Sheppard *et. al.*,[8] was adopted in all the localities surveyed. The results obtained were analysed as House Index (%) and Breteau Index. The survey results revealed only the presence of *Aedes albopictus* with a House Index range of 0% in Kampong Belimbing to as high as 100% in three different localities. The Breteau Index ranged from 0 to 220 in Kampong Sebarang (Table III). Of the 53 localities surveyed, eight have a Breteau Index of less than 10. The breeding habitats of *Aedes albopictus* are mainly discarded containers including broken bottles and tins; natural habitats such as leaf axils of banana trees and pineapple; and domestic containers (Table IV).

Control of the epidemic

As the outbreak began to worsen towards the end of May 1983, a Dengue Operation Room was set up in the district hospital to monitor and coordinate all the activities pertaining to control,

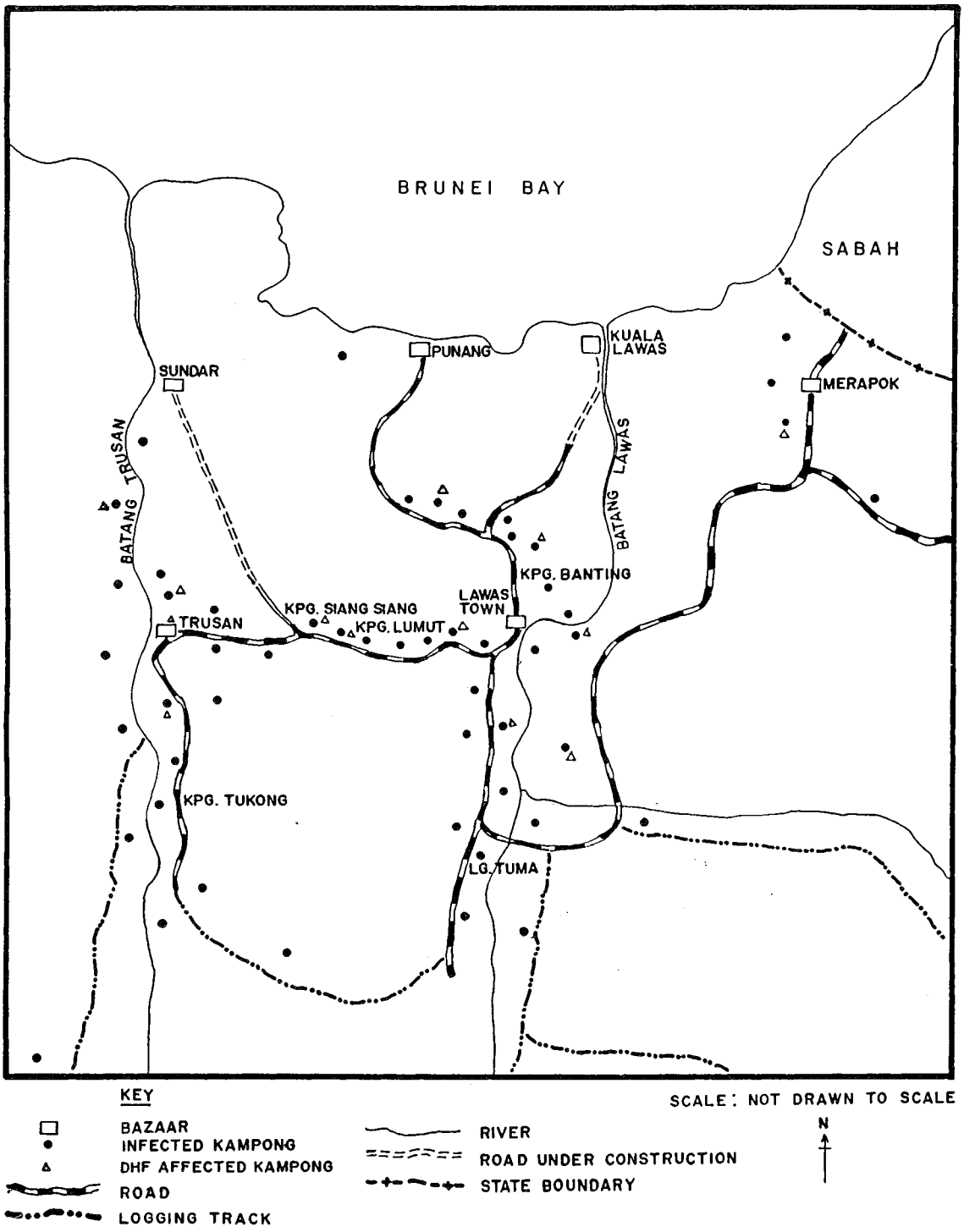

Fig. 3 Sketch map of Lawas District showing Dengue infected villages.

TABLE II

ETHNIC GROUP DISTRIBUTION OF 134 DENGUE (DF) AND DENGUE HAEMORRHAGIC FEVER CASES IN LAWAS DISTRICT, SARAWAK, 1983

Ethnic group	Mid – 1980 Population		DF/DHF Cases		Morbidity rate (Per 1,000 Population)
	No.	(%)	No.	(%)	
Murut	9,348	40.8	91	68.0	9.7
Malays	6,072	26.5	20	14.9	3.3
Chinese	3,391	14.8	13	9.7	3.8
Kedayan	3,208	14.0	–	–	–
Others*	894	3.9	10	7.4	11.2
Total	22,913	100.0	134	100.0	5.8

*Including Tagal, Iban, Bidayuh and Kayan.

TABLE III

AEDES ALBOPICTUS (SKUSE) IN DENGUE AFFECTED AREAS IN LAWAS DISTRICT, SARAWAK, 1983

Village	No. of cases (Per 100 population)		*Aedes albopictus*	
			House Index (%)	Breteau index
Kg. Bangango, Trusan	1	(4.3)	100.0	100.0
Pelait Camp	5	(4.2)	36.8	147.0
Mission Lawas	2	(0.75)	6.7	6.7
Kg. Banting	3	(1.4)	50.0	75.0
Melawan Camp	1	(3.6)	15.0	23.0
Kg. Lumut*	8	(9.2)	45.5	54.5
Gov't Quarters, Airport Road	3	(3.3)	7.9	12.2
Kg. Gaya*	6	(1.5)	12.0	20.0
S.M.K. Trusan*	5	(0.5)	42.8	48.1
Jalan Trusan	16	(5)	33.4	33.4
Kg. Pa'Kapulu	1	(1.3)	22.3	33.4
Kg. Seberang*	6	(2.5)	100.0	220.0
Kg. Pa'putih	1	(1.6)	6.3	8.9
Punang Rd.	3	(1.0)	28.6	57.1
Kg. Belimbing	1	(0.4)	0.0	0.0
Lg. Tuma	8	(1.7)	66.7	100.0
Kg. Gelapas	5	(2.3)	55.6	122.3
Kg. Pangi	1	(0.4)	3.8	5.5

TABLE III (CONTINUATION)

Village	No. of cases (Per 100 population)	*Aedes albopictus*	
		House Index (%)	Breteau index
Kg. Siang-Siang*	8 (6.7)	66.0	77.0
Lg. Luping	1 (0.74)	29.0	33.0
Kg. Serugang*	3 (2.4)	17.0	28.0
Lg. Tukong	4 (3.2)	100.0	100.0
Lg. Temarub*	2 (1.0)	15.0	21.0
Kg. Lintang, Trusan*	3 (1.7)	75.0	100.0
Kg. Ladang, Bahru	1 (0.5)	12.0	12.0
JKR Barracks	1 (2.0)	7.5	9.2
Lawas Bazaar	1 (0.08)	13.9	18.8
Kg Temangis*	4 (2.9)	9.0	18.2
Lg. Lengaban Merapok	1 (0.68)	15.0	15.0
Federal Qtrs.	1 (1.2)	7.0	13.0
Kg. Bangkatan, Merapok	1 (0.8)	4.3	7.7
Kg Belipat Baru	2 (1.0)	5.8	11.2
Lg. Sunang	1 (1.4)	14.0	18.0
Trusan Bazaar*	1 (0.34)	16.0	25.0
Tang Lipi, Trusan	1 (1.7)	15.0	19.0
Lg. Suang Camp	1 (0.86)	71.0	82.0
Sembo Camp	1 (10)	12.0	25.0
Kg Purusia	1 (0.6)	39.0	51.0
Kg. Patrikan*	1 (0.65)	46.0	73.0
Police Barracks, Lawas	1 (0.48)	18.0	22.0
Kg. Buduk Bui, Bakalalan	1 (1.1)	0.9	0.9
Kg. Luagan*	1 (1.2)	72.0	80.0
Punan Brayong	1 (1.6)	69.0	87.0
Punan Beriwan	1 (0.69)	53.0	66.0
Kg. Dibang Tang Lapadan	2 (0.97)	40.0	51.0
Kg. Baru Sundar	1 (0.34)	28.0	39.0
Kg. Gayak Lama	1 (0.6)	17.0	25.0
Siang Lama Trusan	1 (0.17)	11.0	19.0
Kg. Natad Musu Dayak	1 (0.52)	35.0	63.0
Lg. Temarop Trusan	2 (1.4)	47.0	66.3
Lg. Pakon Trusan*	1 (0.81)	57.0	86.0
Kg. Pengalih Lawas	2 (1.7)	23.0	53.0
Kg. Masjid Lama	1 (0.86)	7.0	7.0
Kg. Kaban Mlaman Sipitang	1 (0.48)	Not surveyed	

*Indicates Dengue Haemorrhagic Fever-affected area.

including notification of cases, up-dating of statistics, preparation of daily fogging schedule, request and planning for logistic support and organization of health education activities. Logistic support in the form of additional man-power, fogging equipment and insecticides arrived

TABLE IV

MAIN *AEDES ALBOPICTUS* (SKUSE) BREEDING HABITATS IN 53 LOCALITIES/VILLAGES SURVEYED DURING DENGUE OUTBREAK IN LAWAS DISTRICT, SARAWAK, 1983

Breeding habitats	No. of habitats inspected	No. of habitats positive	(%) positive
Jar	129	37	28.7
Drum	93	28	30.1
Flower vase	41	13	31.7
Ant Trap	20	8	40.0
Bucket	19	4	21.0
Tins	224	138	61.6
Bottles	131	91	69.4
Tyres	44	17	38.6
Leaf axils	52	23	44.2
Others	18	5	27.8
Total	771	364	47.2

*Number of pineapple plants or number of banana leaf axils inspected.

from the Medical Headquarters, Kuching, and the Divisional Office in Miri. With the availability of additional manpower and equipment, a total of six control teams comprising of one public health inspector, one rural health supervisor/ public health overseer, one anti-malaria worker plus a driver were formed.

Realizing the importance of community participation in the control of Dengue Fever, the District Action Committee (DAC) comprising various departmental heads under the chairmanship of the District Officer was activated upon request by the District Medical Officer. The committee was made responsible for mobilising and coordinating community efforts and active participation in the anti-dengue clean-up campaign. Besides, the committee also provided the necessary logistic support and participation such as the Public Works Department was responsible for providing vehicles; the Education Department being responsible for the anti-dengue campaign in schools; and the Information Department providing the mobile information unit to participate in public health education.

Upon receiving notification on the occurrence of Dengue Fever from the hospital, the Dengue Operation Room would mobilize the control teams. The control teams would then proceed to carry out epidemiological investigation to establish the possible source of infection. Entomological investigation would then be carried out simultaneously so as to establish the species of *Aedes* involved and their density. Source reduction in the form of destruction of breeding habitats were instituted and wherever possible this was complemented with abate larvicidal treatment.

Subsequent to the completion of epidemiological and entomological investigations, insecticidal application commenced immediately. Swing fogging with 0.2% bioresmethrin from Reslin 10/10 at one week interval was carried out both indoors and outdoors in all the premises in the infected areas. In view of the exophagic and exophilic behaviour of *Aedes albopictus,* outdoor swing fogging was supplemented by malathion spraying at a dosage of 2% using Fontan Backpack Sprayer (R11) collaborated with a discharge rate of 65–80 ml/minute. In areas accessible to motorised vehicles, such as the villages along. Trusan Road, Malathion ULV spraying by LECO HD machine mounted on land-rovers were carried out instead of using Fontan machines. The dosage of malathion technical grade applied was at the rate of 6 fl oz/acre obtained by having a flow rate of 3 fl oz/minute and vehicle speed of approximately 5 km/hour.[9]

DISCUSSION

The current epidemic in Lawas District is the first of its kind ever to occur in the area though a few cases were already reported in 1982. Prior to 1982 there was no report of the occurrence of the disease. The absence of reported cases could possibly be due to it being under-reported or that endemic dengue could have occurred but these were subsequently diagnosed as pyrexia of unknown origin. It was noted that presence of

endemic dengue in the rural communities can be maintained in the human population by *Aedes albopictus.*[6] The present epidemic could be due to a change in the strain and serotype of virus as the strain and serotype are important determining factors in an epidemic[10] although the vectors remain as *Aedes albopictus.* As no attempt was made to isolate the dengue virus from the acute sera obtained from acute patient, the prevalence of dengue serotype in this epidemic is still unknown.

An analysis of the progression of epidemic revealed a transmission pattern as beginning in the vicinity of Lawas town before spreading to the easily accessible areas along Trusan Road and thence to the remote rural villages and logging camps. This could be attributed to the movement of people especially those from the rural areas who have to come down to the town for their domestic provisions. Further assistance in the transmission was rendered by the exodus of students who had to go back to the rural kampong for the week long Gawai Holidays in the first week of June, which thus explained the sudden increase in cases in week 24. At the end of the epidemic, the total number of student cases was 47 from nine different schools.

The role of *Aedes albopictus* in the transmission of endemic Dengue has been well defined[6,11–13] and the field entomological data obtained in relation to the epidemic in Lawas added further credentials to the finding as in all the infected areas only *Aedes albopictus* were found breeding. In areas where breeding of *Aedes aegypti* was positive, no cases of dengue were reported and as at present there is no explanation to this phenomenon. Observations of the 1973 outbreak of Dengue Haemorrhagic Fever in Singapore associated *Aedes aegypti* as the primary, if not the sole, vector.[14] However, in Lawas where both Dengue and Dengue Hemorrhagic Fever occurred, *Aedes albopictus* was the sole vector. It can therefore be concluded that *Aedes albopictus* is an efficient vector of both Dengue and Dengue Haemorrhagic Fever. A study of more than 300 species of mosquitoes in 20 genera revealed the isolation of dengue virus only from *Aedes aegypti and Aedes albopictus*[12] and as such, it is concluded that there is no doubt that no other species of *Stegomyia* are involved in the transmission of Dengue in Lawas District.

Though there are probably over 70 species of *Aedes* in Sarawak, most of them may not bite man or come in contact with man (Ramalingam, personal communications). During the *Aedes* survey, a small proportion of *Aedes (Stegomyia) albolineatus was* also discovered to co-exist with *Aedes albopictus* in leaf axil, but were never found in containers near houses. The role of this species in Dengue transmission has not been defined. Members of the *Scutellaris* group of the subgenus *Stegomyia* Theobald besides *Aedes aegypti* and *Aedes albopictus,* such as *Aedes cooki* in Niue Island, *Aedes tongae tabu* in Ha'apai have been incriminated as vectors of Dengue-2 or Dengue -1 virus.[15]

The epidemic lasted for a three-month period before being successfully brought under control. The success of the control can definitely be attributed to good organisation, public cooperation and proper coordination of all control activities. Due to the peculiar nature of the epidemic and its rural setting whereby the sole vector is *Aedes albopictus,* the adoption of proper control strategies are of utmost importance. The outdoor strategy employed was aimed at suppressing the population of the target species which are exophilic and exophagic in behaviour. Source reduction has little significance in the control of the epidemic as breeding is also noted in natural habitats such as the axils of pineapple and banana trees which are of economic importance to the local population. Furthermore, the infected areas are surrounded by thick undergrowth and jungles which add to the difficulty of locating the breeding habitats which are mainly discarded items.

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