A SURVEY OF FILARIASIS AT WARU VILLAGE AND BABULU DARAT TRANSMIGRATION SCHEME, EAST KALIMANTAN

M. SUDOMO, LIM BOO LIAT,* N. SUSTRIAYU and Y.H. BANG*

National Institute of Health Research and Development, P.O. Box 226, Jakarta, Indonesia.* World Health Organization, Vector Biology and Control Research Unit II, P.O. Box 302, Jakarta, Indonesia.

INTRODUCTION

Comprehensive reviews of human filariasis in Indonesia have been previously reported by Brug (1928), Lie and Rees (1958), Lie (1970) and Joesoef and Cross (1978 a, b). In these reviews, Kalimantan was recorded as an endemic area for brugian filariasis and was based on parasitological surveys of the human populace. To date little is known about the transmission dynamics of the disease. In South Kalimantan brugian filariasis has been studied by the National Institute of Health Research and Development together with the United States Naval Medical Research Unit in Jakarta, (Cross *et al.*, 1975; Van Peenen *et al.*, 1975; Palmieri *et al.*, 1980).

In March 1980, a survey on brugian filariasis was carried out in an indigenous village and in a new Transmigration Scheme in the Regency of Pasir, East Kalimantan. The objective of this survey is to determine the periodicity of the brugian filariasis, its vectors, and whether transmission of brugian filariasis is occurring among the transmigrants.

STUDY AREAS

Waru Village: Waru village (Fig.1) is divided into three sub-divisions, namely RK 1 to RK 3. RK 1 has eight sub-villages, RK 2 has three and RK 3 has six with an overall of 17 subvillages. The sub-villages adjoin each other and are demarcated by either short stretches of roads or by stretches of land with overgrown vegetations. There are many small plots of ricefields varying from 2 to 5 hectares (ha) each which are situated near residential areas. Scrub, tall grass(lalang) secondary growth and mangrove swamps are commonly found between the sub-villages. Secondary and large stretches of palm and mangrove forests are located at the fringe of most of these villages. The total population of the sub-villages is 3,577 (1809 males and 1786 females), 50.2% are over the age of 15 years and 41.8% are under 15 years. The total number of families is 686 with an average of 5.2 members per family.

A random sample of 100 families was selected in these villages and a count was made of the domestic cats (*Felis cattus*) belonging to these families. Forty cats were counted, and a projection is the total cat population of 375 were determined.

Leaf monkeys (*Presbytis* spp.), common macaques (*Macaca fascicularis* and *M. nemestrina*) proboscis monkeys (*Nasalis larvatus*) are common in the mangrove and secondary forest.

Babulu Darat Transmigration Scheme: This scheme is 25 kilometers south of Waru village. Originally, a patch of primary forest which covered an area of 5000 ha, of which 3000 ha have been opened in early 1978 for resettlement. This area is divided into two units, each covering of an area of 1500 ha. Each unit is divided into two sub-units (A + B; C+D) respectively. The population in Unit

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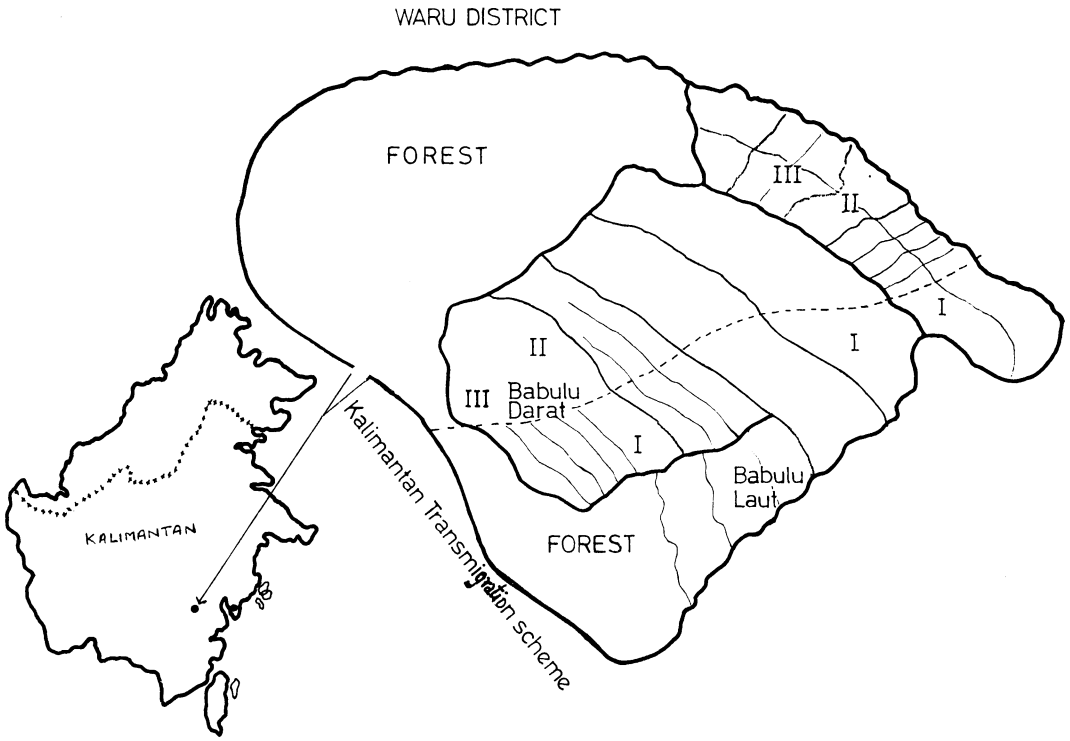

Fig. 1—Map showing the locality of study areas at Waru village and Babulu Darat Transmigration Scheme, Waru District, East Kalimantan.

one is 2,543, consisting of 1,279 males and 1,264 females of 635 families with an average of 4.1 persons per family. Unit two comprising of 1361 people, 683 being males and 676 females of 329 families were settled with an average family size of 4.1 persons. Each transmigrant family was allotted 2 ha of land, one for the house including farming for their daily source of food, the other for cultivation. However, the second ha is still forested and not yet opened. All the transmigrants, originated from Central Java and East Java and have been in the Transmigration area for about 14 months. The scheme is targetted for approximately 2000 families, but to date only 964 families have been settled.

A random count of domestic cats (*Felis cattus*) maintained by 150 families yielded 13 cats. An estimation of the cat population in the scheme is thus approximately 84. Leaf monkeys (*Presbytis* spp.), macaques (*Macaca fascicularis* and *M. nemestrina*), and gibbons (*Hylobates* spp.) are common in the surrounding forest.

MATERIALS AND METHODS

Entomological Surveys: Mosquito surveys were carried out in three villages at Waru village, and Unit 1 + 2 at the Babulu Darat Transmigration Scheme for 3 nights at each area. Six local collectors, three sitting indoors and three outdoors, were used to catch mosquitoes landing on them between 1800-2200 hours. Mosquitoes were kept overnight in a cool moist place, and identified the following morning. All *Mansonia* spp. were individually dissected, *Anopheles* spp. mass dissected and the *Culex* spp. were not dissected.

Parasitological Surveys: Blood surveys of inhabitants from Waru village and Babulu Darat Transmigration Scheme were carried out for 3 nights in each area. In Waru village blood smears were taken from 48.4% (562/1161) in six villages (RK 1 – RK 3). In Babulu Darat Transmigration Scheme 17.3% (676/3904) persons was sampled from Unit 1 (A + B) Unit 2 (C). From each person, a finger prick sample of 20 c.mm of peripheral blood was obtained using a glass capillary tube, between 1930 to 2400 hours. Thick smears made on microscopic slides, were dehaemoglobinized the following morning and stained with Giemsa. Smears were examined under compound microscopes, the microfilariae were identified, counted and recorded.

The periodicity of the microfilariae (Mf) in Waru village was determined by collecting and examining two slides of 20 c.mm blood specimens from each of the 4 microfilarial carriers at 2 hour intervals over a period of 24 hours. The reasons for the experiments were explained to the volunteers, who then readily agreed to cooperate. They were moved from the village to the Health Center under the charge of qualified health personnel.

Blood samples were also taken from the ears of domestic cats in the daytime. In Waru village 14.5% (40/275) and in Babulu Darat Transmigration Scheme 15.5% (13/84) of the cat populations were sampled. The procedures of blood taken from cats followed that of the method carried out for humans.

The identification of Mf *B. malayi* in human blood was based on Sasa (1976), on cat blood was based on Sivanandam and Federicks (1966). For statistical analysis, contingency Chi-square test was used, and for the methods of estimation of median Mf density and determination and statistical calculation of Mf periodicity followed that of WHO method (1967), Sasa and Tanaka (1972, 1974). The determination of *Brugia* larvae in mosquitoes was based on Ramachandran (1970).

RESULTS

Entomological Survey

Waru Village: A total of 1,710 mosquitoes belonging to four genera were collected both indoors and outdoors (Table 1). Of this total, 54.8% were *Mansonia* spp., 19.9% were *Anopheles* spp., 25.3% were *Culex* spp. and a single *Coquillettidia*. Among the *Mansonia* spp., *M. uniformis* was the predominant species occupying 83.7% of the collection. *Mn. dives/bonneae* occupying only16.3%. All *Anopheles* belonged to the 'hyrcanus' group, and of these only 3.5% could be identified as *An.peditaeniatus*, the rest (96.5%) being recorded as 'hyrcanus'. Of the *Culex* spp. collected, *Cx.tritaeniorhynchus* was the predominant species (85.7%) as compared to *quinquefasciatus* (10.4%), *Cx.bitaeniorhynchus* (3.2%) and *Cx.whitmorei* (0.7%).

The total mosquito catch from indoors (55.3%) was significantly higher than outdoors (44.7%) ($p < 0.001$). There was no marked difference observed between indoor and outdoor catches for *Mn.uniformis* (48.2%) and *Mn. dives/bonneae* (41.8%). Among the *Anopheles* the hyrcanus group was significantly higher indoor than outdoor ($p < 0.001$), the rates being 72.9% and 27.1% respectively. For *Culex* spp. indoor catch (61.6%) was also significantly higher as compared outdoor (38.4%) ($p < 0.001$) collections.

Indices of individual species of mosquitoes for indoor and outdoor are presented in Table 1. The ratio (indoor/outdoor) for *Mansonia* spp. was 12.4 and 13.6 per man/hour. *Anopheles* spp. 6.6 and 2.7 per man/hour; and *Culex* spp. 7.4 and 4.6 per man/hour. However, the overall ratio for all mosquito spp. was 26.3 per man/hour from indoor and 21.1 per man/hour from outdoor.

Babulu Darat Transmigration Scheme: The total catch of mosquitoes from indoors and outdoors was 1,709 included only in two

Table 1

Summary of landing mosquitoes trapped at Waru village and Babulu Darat Transmigration Scheme for 3 nights (36 m/h) per area.

Mosquito species	Waru Village				Babulu Darat Transmigration Scheme			
	Indoor		Outdoor		Indoor		Outdoor	
	Total No. (%)	Mean m/h	Total No. (%)	Mean m/h	Total No. (%)	Mean m/h	Total No.(%)	Mean m/h
Mansonia								
Mn.uniformis	378 (39.9)	10.4	406 (53.2)	11.2	28 (4.5)	0.8	50 (4.6)	1.4
Mn.dives/bonneae	64 (6.8)	1.8	89 (11.7)	2.4	524 (83.3)	14.6	949 (87.9)	26.4
Mn.annulata	0 0	0	0 0	0	0 0	0	3 (0.2)	0.08
Anopheles								
An.hyrcanus group	239 (25.2)	6.6	89 (11.7)	2.4	0 0	0	0 0	0
An.peditaeniatus	0 0	0	12 (1.6)	0.3	0 0	0	0 0	0
Culex								
Cx.quinquefasciatus	35 (3.7)	1.0	10 (1.3)	0.3	12 (1.9)	0.3	13 (1.2)	0.4
Cx.tritaeniorhynchus	224 (23.7)	6.2	146 (19.1)	4.1	37 (5.9)	1.0	45 (4.2)	1.3
Cx.bitaeniorhynchus	7 (0.7)	0.2	7 (0.9)	0.2	25 (3.9)	0.7	18 (1.7)	0.5
Cx.whitmorei	0 0	0	3 (0.4)	0.08	3 (0.5)	0.08	2 (0.2)	0.05
Coquilletidia								
Coq.crassipes	0 0	0	1 (0.1)	0.02	0 0	0	0 0	0
Total	947 (100)	26.3	763 (100)	21.2	629 (100)	17.5	1080 (100)	30.0

genera (Table 1). The bulk of mosquitoes were species of *Mansonia* (90.9%) and the remaining 9.1% were*Culex* spp.The *Mansonia* consisted of *Mn.dives/bonneae* were(94.8%): *Mn.uniformis* was (5.0%) and *Mn.annulata* was (0.2%). Thus, *Mn.dives/bonneae* were the predominant mosquitoes in this area, followed by *uniformis* with occasional *Mn. annulata.* Among the *Culex*, *Cx.tritaeniorhynchus* (52.9%) and *bitaeniorhynchus*(27.7%) were most abundant where *Cx.quinquefasciatus* (16.1%) and *Cx.whitmorei* (3.3%) were least abundant.

The outdoor catches of mosquitoes occupying 63.2% of the total collection which was significantly higher than 36.8% from indoor collection ($p < 0.001$). *Mn.uniformis* collected indoor was small (28 mosquitoes) as compared to outdoor (50) showing no marked statistical difference. *Mansonia dives/bonneae* collected outdoors (64.4%) was significantly higher than indoors (35.6%) ($p < 0.001$). Only 3 of *Mn.annulata* were caught from outdoors. There was no marked difference observed of *Culex* spp. caught outdoors and indoors the rates being 51.3% and 49.7% respectively.

The ratio (indoor/outdoor) of *Mansonia* species for indoor was 15.4 per m/h as compared to 27.8 outdoor, and for *Culex* spp. was 2.0 for indoor and 7.3 outdoors per m/h. The overall ratio for all mosquito species was 17.5 for indoor and 30.0 for outdoor. Indices for individual mosquito species are presented in Table 1.

Natural infection of mosquitoes with filarial worms: Only two (0.2%) out of 862 *Mn.uniformis* dissected were found with 25 and 15, 2nd stage *Brugia* larvae from Waru village. Both the infected individuals were caught indoors. The other *Mansonia* spp. dissected were not infected, and also no infection found in the mass dissection for *Anopheles* spp. from both study areas.

Parasitological Survey

Waru Village: In the six subvillages at RK 1 - RK 3 in Waru village, 562 persons (326 males and 236 females) were examined. The Mf rate in males was 7.7% (25/326), 11.4% (27/236) in females and 9.3% (52/562) for both the sexes combined. The highest count was 83 per 20 c.mm blood sample in a female 41 years old. All the Mf were identified as *B.malayi.* The Mf rate in the age group of Mf carriers is presented in Table 2. The oldest persons found infected with Mf were three women aged 60, 60 and 75 years old with 7.1, 7, and 7 Mf each respectively. The median Mf density (Mfd) of the whole sampled population was 4.5.

In April 1978, filarial survey in the same village was carried out by the Provincial Health Authority at Samarinda. Data is available of the positive cases only. They examined 726 persons, and 6.3% (46/726) consisting of 63% males and 37% females were infected with Mf. Of these, one positive was shown in the 5-9 years age-group, 8 in the 10-14 years age-group, and 35 were in the age-group 15 and above. The oldest man with Mf was 54 years old and he showed a low count of one Mf in 20 c.mm. The highest microfilariae count was 52 per 20 c.mm in a male child of 12 years old. The Mfd of the whole sampled population was 4.5 Mf per 20 c.mm.

In the present surveys, 40 domestic cats were also examined, and only a single cat (2.5%) was positive with a count of 10 Mf per 20 c.mm. The Mf were identified as *B.malayi,*

Babulu Darat Transmigration Scheme: In this transmigration scheme 676 persons (401 males and 275 females) were examined. The Mf rate in males was 0,5% (2/401) and 0.4% (1/275) in females, and the combined infection rate was 0.4% (3/676). The Mf in the two positive males aged 4 and 25 years were

Table 2

Age and sex distribution of *Brugia malayi* microfilaria carriers in Waru village and Babulu Darat Transmigration Scheme at Waru District, East Kalimantan.

Age-group (years)	Waru Village				Babulu Darat Transmigration Scheme			
	Males		Females		Males		Females	
	No. exam.	% pos.	No. exam.	% pos.	No. exam.	% pos.	No. exam.	% pos.
0-4	20	0	19	21.0	32	3.1	22	0
5-9	64	1.6	34	2.9	41	0	46	0
10-14	52	9.6	54	1.7	58	0	30	0
15-19	34	14.7	22	1.4	47	0	36	0
20-29	43	2.1	44	4.5	72	1.4	80	0
30-39	39	2.6	29	10.3	93	0	51	1.9*
40-49	23	0	33	6.1	53	0	7	0
50+	36	1.1	16	18.8	5	0	3	0
Total	311	8.0	251	10.8	401	0.5	275	0.4

* Wuchereria bancrofti.

identified as *B.malayi*, and the count was 9 and 14 microfilariae per 20 c. mm respectively. The positive female aged 34 years was infected with *Wuchereria bancrofti* with a count of 32 Mf per 20 c.mm. The age-groups of populations sampled is shown in Table 2. All 13 domestic cats examined were negative.

Periodicity: The periodicity study was carried out during the same time interval on three individuals with Mf of *Brugia malayi*. In all the three cases the Mf demonstrated a nocturnal subperiodic peaks at 2400, 2000 and 1800 hours respectively. The results of these were pooled together. The mean count (m) was 173.30, periodicity index (D) 21.10, and peak hour (k) 20.67 hours and the sum squares of the difference between the observed and theoretical ratios (MSQ) was 6059. The form of periodicity was nocturnally subperiodic and the observed and theoretical curves of periodicity are plotted in Fig.2.

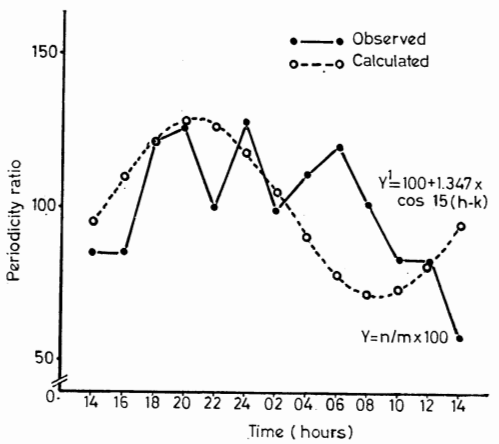

Fig. 2—Observed and theoretical curves of periodicity of *Brugia malayi* microfilariae in Waru village, Waru district, East Kalimantan.

The fourth individual whose Mf was examined during a different time period was also found to be infected with subperiodic *B.malayi*. The Mf mean count was 27.45, periodicity index 32.22, and peak hour was 20.0 hours, and MSQ was 14083. The form of periodicity was identical to the former three persons being nocturnally subperiodic, the

observed and theoretical curves are plotted in Fig. 3.

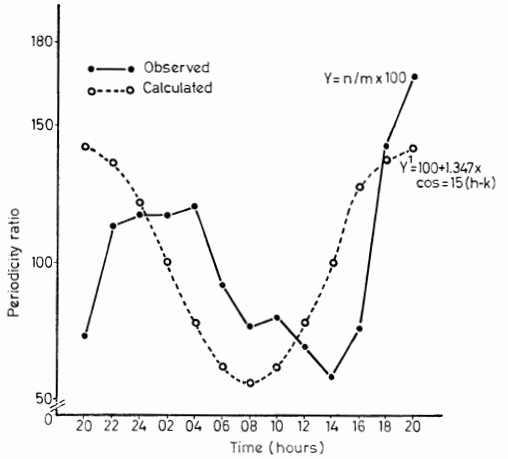

Fig. 3—Observed and theoretical curves of periodicity of *Brugia malayi* microfilariae in Waru village, Waru district, East Kalimantan.

DISCUSSION

The results of the entomological surveys showed that the mosquito density was relatively high being 47.5 per m/h each in both the study areas. In Waru village, 9 species of mosquitoes and included in 4 genera was obtained as compared to 7 species of 2 genera from Babulu Darat Transmigration Scheme. Among the *Mansonia* spp., *Mn.uniformis* was the predominant species in Waru village while in Babulu Darat Transmigration Scheme *Mn.dives/bonneae* were the dominant ones. Two species of anopheline mosquitoes were found in Waru village while none was caught from the transmigration scheme. In both the study areas *Culex* spp. were abundant in Waru village (25.3%) than in the transmigration scheme (9.1%) among the mosquitoes examined. The high density of *Mansonia* mosquitoes in both these areas was probably associated with the presence of favourable habitats. Although in the transmigration scheme, the diversity of mosquito species have been found to be relatively lower than Waru village (the latter being an old village where more conducive man-made habitats are created for varied mosquito species) but it is envisaged that in due time with greater influx of human population, the increase of the mosquito fauna is inevitable, due to favourable habitats created through environmental changes.

The Mf rate of 9.3% among the inhabitants sampled in Waru village was found to be slightly higher than 6.3% taken in 1978 by the Provincial Government. The Mfd of the sampled population was the same in both the surveys. There was no marked difference observed in the Mf rates between children under 14 years old and the adults, the rates being 8.3% and 10% respectively. This indicates that either the biting frequencies of vector mosquitoes were equally high in both these age-groups, or there was no biting preference exhibited by the vector mosquitoes. There was also no marked difference shown in the frequency of infection between males and females.

The Mf rate for *B.malayi*, among the transmigrants, was 0.4%. Transmigrants were either from Central and East Java, and post survey reports have shown these areas are not endemic for *B.malayi* (Lie and Rees, 1958; Lie, 1970). The findings of brugian filariasis among the Javanese transmigrants suggest that they area readily susceptible to infection inspite of the short period of residence in the area. The high prevalence of filariasis among transmigrants compared to indigenous population has also been reported from the Transmigration settlements of Wonosobo, South Sumatera (Lie and Winoto, 1960), and in Margolembo, South Sulawesi (Partono *et al.*, 1972). The case of *Wuchereria bancrofti* was undoubtedly an old infection from Java, as this disease is endemic in many parts of Java (Joesoef and Cross, 1978 a,b; Lie, 1970).

The low Mf rate in domestic cats at Waru village, and the absence of *B.malayi* in cats at Babulu Darat Transmigration Scheme was probably reflected by the low infections of the inhabitants in both these areas. Partono *et al.*, (1977a) found 13 of 51 domestic cats with *B.malayi* microfilariae in South Kalimantan. They also found *Dirofilaria repens* in the blood of cats, and an unknown microfilaria of one cat. Cross *et al.*, (1975) also found *B.malayi* and *D.repens* in 6 of 56 cats examined in South Kalimantan. Masbar *et al.*, (1980) found 4 of 57 cats positive for *Brugia* spp. in a rubber plantation area near South Kalimantan while Palmeiri (pers, comm.) found 50% of 40 cats from a coastal village (S. Kalimantan) positive with *B. pahangi.*

The periodicity of Mf of four carriers at Waru village, was determined as nocturnally subperiodic strain of *B.malayi.* Although no microfilarial periodicity study was carried out in Babulu Darat Transmigration Scheme, examination of the morphological characteristics of Mf in positive cases suggest that the strain could also be subperiodic. Joesoef and Cross (1978b), studied the Mf periodicity of five carriers in Amuntai, SouthKalimantan and found that the strain of *B. malayi* was also nocturnally subperiodic. Partono *et al.*, (1977 a,b,) studied the periodicity of Mf of *B. malayi* of 11 carriers from Kakap, West Kalimantan and 9 carriers from Telang, South Kalimantan which were determined as nocturnally subperiodic. In the current entomological surveys at Waru village and the transmigration area, *Mansonia* spp. were the predominant mosquitoes. The presence of 2nd stage *Brugia* larvae in two of the *Mn. uniformis* detected at Waru village, indicates that *Mn.uniformis* is a likely vector of *Brugia.* Other species of *Mansonia* mosquitoes may also be involved as vectors. *Mansonia uniformis* and *Mn. dives/bonneae* are natural vectors of *Brugia* spp. in South Kalimantan. Experimentally, *Mn.uniformis* was shown as a good laboratory host for *Brugia* infection (pers. comm. Palmeiri, NAMRU-2, Jakarta). In Telang, South Kalimantan, Partono *et al.*, (1977a) examined *Mn.uniformis, annulifera,* and *An.barbirostris.* They recovered 1st stage larva in one *Mn.annulifera,* and 1st, 2nd and 3rd stages larvae from *Mn. uniformis,* the latter was collected while the mosquito was feeding on a volunteer carrier. In Kakap, East Kalimantan, Partono *et al.*, (1977b) dissected 39 *Aedes butleri,* 1 *Ae.aegypti,* 1 *Mn.uniformis* and 142 *Cx. tritaeniorhynchus* and *Cx.gelidus* for developing filarial larva, but none was found. In Malaysia, *Mn.uniformis, Mn.dives* and *Mn.bonneae* were also found to be good experimental hosts for *B. malayi* infection (Turner and Edeson, 1957; Wharton, 1962). Further studies, particularly the Babulu Darat Transmigration Scheme are needed to elucidate the reservoir hosts with reference to the non-human primates which are common there. It is also equally important that parasitological Mf should be re-surveyed in this Transmigration area a year from now to find out the transmission dynamics of brugian filariasis, and to establish the suitable vector hosts.

SUMMARY

A survey of an indigenous village (Waru village) and a newly established Babulu Darat Transmigration Scheme at Waru District, East Kalimatan, Indonesia has shown that the brugian filariasis Mf rate in sampled populations of Waru village was 9.3% with a MfD of 4.5 microfilariae per 20 c.mm blood. In the Babulu Darat Transmigration Scheme, the Mf rate was 0.4% of the sampled population examined. Periodicity studies with four carriers reveal that *B.malayi* was nocturnally subperiodic with the peak numbers of Mf in the blood at 20.67 hours and 20.00 hours. The *B.malayi* infections in the transmigration scheme was provisionally

determined as subperiodic. Entomological studies revealed that *Mansonia* mosquitoes were the predominant species in both the study areas. The ratio (indoor/outdoor) catches of *Mansonia* spp. in Waru showed indoor was 12.4 per m/h as compared to 13.6 m/h for outdoor, while in the Transmigration Scheme indoor was 15.4 m/h and outdoor was 27.8 m/h. *Mn. uniformis* was found to be the dominant species in Waru village, while *Mn. dives/bonneae* was the predominant one in the Transmigration Scheme. Of 862 *Mn. uniformis* dissected, 0.2% were found with 2nd stage *Brugia* larvae in Waru village, while no infection was found in all *Mansonia* species dissected in the Transmigration Scheme. Of the 40 domestic cats examined in Waru village 2.5% was positive with *B. malayi*, while cats examined in the Transmigration Scheme were all negative.

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