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A STUDY OF BANCROFTIAN FILARIASIS ON THE ISLANDS OF BATAN AND RAPU RAPU, PHILIPPINES

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A STUDY OF BANCROFTIAN FILARIASIS ON THE ISLANDS OF BATAN AND RAPU RAPU, PHILIPPINES

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INTRODUCTION

In the Philippines, two types of filariasis are found in man: *Wuchereria bancrofti* and *Brugia malayi*. Brugian filariasis is found less frequently with foci in Palawan, Samar, Mindanao, and the Sulu islands. Bancroftian filariasis, in addition to the above locations, is also found in Luzon, Mindoro, Leyte, and several other islands (Hinz, 1985). Southeastern Luzon, which is comprised of five provinces that form the Bicol Region, is historically one of the most highly endemic regions for bancroftian filariasis in the Philippines. Within this region are two islands, having a combined population of about 25,000, that had never been surveyed, but from which cases of elephantiasis were reported to have originated (pers. comm. Division of Disease Control, Department of Health, Philippines). These two islands, Batan and Rapu Rapu, were surveyed on three trips from November 1984 to May 1985. The objective was to determine the parasitological and entomological factors dealing with the transmission of filariasis on these islands.

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MATERIALS AND METHODS

Study Area

Batan and Rapu Rapu islands are located in the province of Albay in southeastern Luzon, 35 km and 50 km east of Legaspi, respectively (see Fig. 1). Transportation from Legaspi and between islands is only possible by commercial or private pump boats. Overland travel on the islands is difficult due to the mountainous terrain and absence of roads; therefore, most inter-village travel is

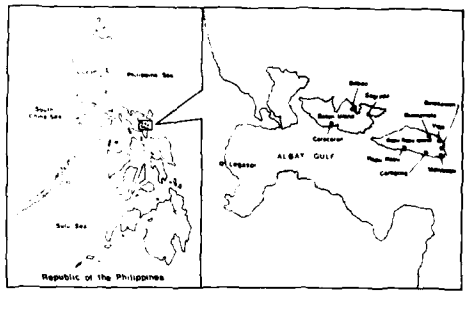

Fig. 1–Location of survey sites on Batan and Rapu Rapu Islands, Luzon, Philippines.

done by sea. The islands receive about 288 cm of rain each year, with the heaviest rains occurring between November (45 cm) and January (43 cm), lowest (7 cm) in April. Strong northerly winds occurring from July to January make fishing or sea travel hazardous. Residents of these islands make their living by selling coconuts, wood, fish, and abaca. Abaca *(Musa textilis)* is a small tree, resembling the banana tree, which produces a tough fiber used to make ropes and mats. The houses are made of bamboo and wood with a roof of thatched palm leaves. The houses are not screened, and few people use bed nets. There is no electrical power supply on either island, and the standard of living is generally very poor. The three primary medical problems on these islands are poor sanitation, parasitism, and malnutrition. Malnutrition is especially severe in villages on the northern side of the islands where fishing is often curtailed due to rough seas.

Surveys were conducted in eight villages throughout Batan and Rapu Rapu islands. Sagrada was surveyed in November 1984; Carogcog, Malobago, Bilbao, and Caracaran in January 1985; and Beunavista, Viga, and Binosawan in May 1985. Survey information included the population of each village and percentage of the villagers examined (Table 1).

In each village, people were asked to gather at the local church or school at 1800. The medical importance and life cycle of filariasis were discussed with them to insure a high degree of cooperation. Beginning at 1900, blood smears were taken from villagers over one year old. Finger-puncture smears of 20 µl were taken from each person along with one thin smear for malaria species identification. The dried blood smears were returned to the laboratory to be stained with Giemsa and examined for parasites.

Man-biting collections were made for 15-minute periods every two hours from 1800–0400 to determine the mosquito vector, biting activity, and infectivity rate. Collections were made at Carogcog, Viga, and Binosawan. The mosquitoes were identified and dissected for presence of filarial worms.

At Carogcog, CDC light traps containing dry ice as an attractant were used to determine their effectiveness in collecting filariasis vectors. Collection bags were changed every two hours to determine times of peak activity. The general mosquito fauna was also sampled using an animal-baited trap whenever a carabao (water buffalo) was available. The traps were set at 1830, and mosquitoes were collected using mechanical aspirators at 0500. Mosquitoes from both the light traps and carabao-baited traps were frozen and returned to the laboratory for identification.

Mosquito larvae were sampled from a variety of habitats in and around the village to determine the vector's preferred oviposition sites. Larvae were returned to the laboratory, reared to adults, and identified.

RESULTS

A total of 1,546 persons (775 males and 771 females) were examined, and 162 (84 [illegible] and 78 females) were found positive for microfilariae. Of the 162 positive cases, all were identified as *W. bancrofti* infections. The prevalence and intensity of Bancroftian filariasis was studied in each of the eight villages surveyed on Batan and Rapu Rapu islands (Table 1). Microfilarial rates ranged from 7.3% to 15.5%, with a mean average of 10.5%. A comparison of the two islands shows a close similarity in prevalence, with Batan being 9.8% and Rapu Rapu 11.4%. The mean number of microfilariae per 20 µl

Table 1

Prevalence and intensity of Bancroftian filariasis in 8 villages on Batan and Rapu Rapu Islands.

Village	Population	No. exam	No. with Mf*	Mf rate (%)	Mean no. Mf
Batan Island					
Bilbao	600	220	30	13.6	20.4
Caracaran	1,200	405	30	7.4	12.2
Sagrada	675	234	24	10.3	30.7
Rapu Rapu Island					
Binosawan	530	174	11	6.3	91.5
Buenavista	500	144	19	13.2	39.2
Carogcog	375	110	8	7.3	17.5
Malobago	400	130	20	15.4	16.2
Viga	400	129	20	15.5	57.3
Total	4,680	1,546	162	10.5	31.2

*Mf = microfilariae

for positive blood samples ranged from 12.2 in Caracaran to 91.5 in Binosawan. Malaria parasites were not present in any of the slides examined.

The prevalence and intensity of microfilaremia was also examined by age and sex of persons surveyed (Table 2). The microfilaremia rate for males was not significantly higher than for females, with 11% versus 10% positive, respectively. The microfilarial rates increased with age in both sexes, reaching maximum rates in the 56- to 60-year-old age group. The youngest case was a 4-year-old female, and the oldest an 85-year-old female. Intensity of infections was not significantly different between males and females, with 33 and 29 microfilariae per 20 µl of blood, respectively.

During man-biting collections at Carogcog, Viga, and Binosawan, only five mosquito species were collected, with *Aedes poicilius* comprising 96.5%. Other species collected were *Ae. albopictus*, *Ae. flavipennis*, *Culex whitmorei*, and *Armigeres subalbatus*. Nocturnal peak biting activity of *Ae. poicilius* occurred at 2400, with a mean of 24.4 *Ae. poicilius* being collected every 15 minutes (Fig. 2). Dry ice-baited CDC light traps at Carogcog were effective in collecting *Ae. poicilius* which comprised 84.7% of the mosquitoes collected. A mean of 62 *Ae. poicilius* was collected per trap per night,

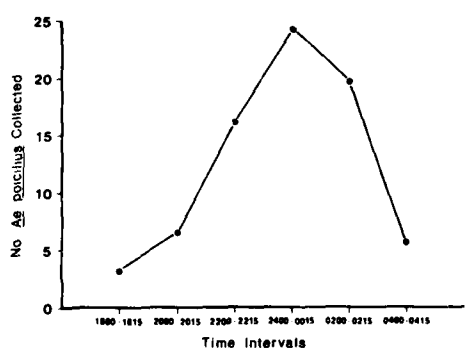

Fig. 2–Mean number of *Ae. poicilius* biting man at 15-minute intervals during the night. Based on 5 man/nights.

Table 2
Prevalence and intensity of microfilaremia by age and sex in 8 villages on Batan and Rapu Rapu Islands.

	Male			Female		
Age in years	No. exam	No. posit. (%)*	Mean Mf per posit.	No. exam	No. posit. (%)	Mean Mf per posit.
1-5	134	0 (0)	0	115	1 (1)	1.0
6-10	172	2 (1)	5.5	160	4 (3)	13.0
11-15	134	8 (6)	17.5	142	10 (7)	53.3
16-20	60	5 (8)	20.2	42	5 (12)	18.0
21-25	35	7 (20)	30.7	40	8 (20)	20.2
26-30	39	5 (13)	75.8	53	5 (9)	4.4
31-34	31	5 (16)	24.2	43	9 (21)	4.9
36-40	32	5 (16)	26.0	37	7 (19)	4.4
41-45	25	7 (28)	53.1	39	5 (13)	6.4
46-50	28	9 (32)	25.0	36	2 (6)	12.5
51-55	28	10 (36)	50.8	25	6 (24)	146.0
56-60	22	10 (46)	29.5	16	8 (50)	31.0
61+	35	11 (31)	27.0	23	8 (35)	18.5
Total	775	84 (11)	33.3	771	78 (10)	29.0

Mf = microfilariae
*Per cent to nearest number

with peak collections occurring during the 2400-0200 period.

A variety of species was collected in carabao-baited traps from three of the villages surveyed, plus the town proper of Rapu Rapu (Table 3). Mosquito catches from animal-baited traps often show larger numbers and a much greater diversity of species compared with those obtained by man-biting. *Ae. poicilius* was commonly collected in carabao-baited traps from villages located near the foothills where abaca is grown; it was not common in the town of Rapu Rapu which is surrounded by rice fields.

Dissections of *Ae. poicilius*, which was surveyed in seven of the villages, were conducted (Table 4). All 706 mosquitoes were obtained using man-biting collections. Sixten mosquitoes were infected (having larvae of any stage present); and of these, seven were infective (having third-stage larvae present). The number of third-stage larvae collected from each of the seven mosquitoes ranged from 1 to 15, with a mean of 5.6.

Breeding habitats of *Ae. poicilius* were located only in leaf axils of abaca and banana trees. In January, abaca trees having water in their leaf axils contained a mean of 8.8 *Ae. poicilius* larvae per tree. Banana trees having water present in their axils averaged 2.0 *Ae. poicilius* larvae per tree. The only other mosquito species found sharing this habitat was *Ae. flavipennis*, which averaged 4.2 larvae per abaca tree and 0.3 larvae per banana tree.

Table 3

Species and numbers of mosquitoes collected by carabao-baited traps. Numbers for each village represent one trap night.

Species	Rapu Rapu	Binosawan	Buenavista	Viga	Total
Aedes poicilius	1	46	246	429	722
Ae. vexans	83	0	0	0	83
Ae. lineatopennis	17	0	0	0	17
Ae. albopictus	3	0	3	9	15
Ae. flavipennis	0	0	1	5	6
Anopheles subpictus	287	219	29	15	550
An. philippinensis	221	198	1	0	420
An. maculatus	0	14	107	43	164
An. annularis	84	44	0	1	129
An. indefinitus	27	0	0	0	27
An. tesselatus	27	0	0	0	27
An. peditaeniatus	16	4	0	0	20
An. flavirostris	0	2	0	0	2
An. kochi	2	0	0	0	2
An. vagus	1	0	0	0	1
Culex vishnui	1,469	468	154	29	2,120
Cx. gelidus	1,436	20	6	0	1,462
Cx. tritaeniorhynchus	1,127	28	9	0	1,164
Cx. fuscocephala	392	70	125	19	606
Cx. whitmorei	1	260	0	0	261
Cx. pseudovishnui	50	16	27	0	93
Cx. nigropunctatus	0	0	14	0	14
Cx. sitiens	9	0	0	0	9
Cx. bitaeniorhynchus	5	0	0	0	5
Cx. annulirostris	3	0	0	0	3
Armigeres subalbatus	0	0	182	37	219
Mansonia uniformis	58	0	0	0	58
Total	5,319	1,389	904	587	8,199

DISCUSSION

The distribution of Bancroftian filariasis in the Philippines was shown to be closely associated with the growing of abaca (Cabrera and Tubangui, 1951). *Ae. poicilius*, an important vector of filariasis in the Philippines, breeds in the leaf axils of a variety of plants including the abaca tree. Since abaca is an important crop on the two islands surveyed, and all eight villages had this tree present, it

Table 4
Dissections of *Ae. poicilius* from 7 villages.

Village	No dissected	No infected/ infective	Total 3rd instar larvae
Batan Island			
Bilbao	12	0/0	0
Caracaran	71	1/0	0
Sagrada	55	2/1	2
Rapu Rapu Island			
Binosawan	200	2/2	17
Buenavista	45	1/0	0
Carogcog	241	3/2	16
Viga	82	7/2	4
Total	706	16/7	39

was not surprising to find Bancroftian filariasis endemic here. Two other vectors of Bancroftian filariasis in the Philippines, *Cx. quinquefasciatus* (Ishii *et al.*, 1983; Suguri *et al.*, 1985) and *Anopheles flavirostris* (Rozeboom and Cabrera, 1964), were either rarely collected or not collected at all here. Brugian fiariasis, in contrast, usually is found close to freshwater swamps where *Mansonia bonneae* and *Ma. uniformis* breed (Hawking, 1976). No species of *Mansonia* were collected biting man, and *Ma. uniformis* was collected biting carabao only in the village of Rapu Rapu. Due to the rarity of *Mansonia* on these islands, the absence of Brugian filariasis is not surprising. Although malaria has historically not been a problem in southern Luzon, there have been unconfirmed reports of it being introduced into the village of Carogcog on Rapu Rapu. No malaria was found in any of the eight villages surveyed. It is unlikely that malaria will become established on these islands due to the extreme rarity of the primary malaria vector, *An. flavirostris*, and because no *Anopheles* were collected biting man.

In Catanduanes Province (40 km north of Rapu Rapu), other investigators have found both higher microfilarial rates and intensity of infection among males (Grove *et al.*, 1978). This might be explained by the male villagers' habit of sleeping near their abaca plantations as they are usually a long distance from their homes. In Sorsogon Province (30 km south of Rapu Rapu), males were also found to have higher rates, while the intensity of infection was the same as females (Nissen, 1984). From the two islands surveyed in this study, no significant difference was detected between male and female microfilarial rate or intensity of infection. In each village, abaca grew abundantly both on the outskirts and frequently within the villages. Males and females appear equally at risk of being bitten by infective mosquitoes. Also in the Catanduanes study, investigators noted that the prevalence of microfilaremia increased progressively with age, with the highest rate occurring among the 51- to 60-year-old men, but not changing with age in women (Grove *et al.*, 1978). The present study on Batan and Rapu Rapu islands showed that the prevalence of microfilaremia increased with age in both men and women, with the highest rates in the 51 years or older age groups.

Ae. poicilius is a strongly anthropophilic feeder. Although it was collected in carabao-baited traps (8.8% of the total number caught), it comprised 96.5% of the species biting man. In the study conducted on Catanduanes Island, *Ae. poicilius* comprised 58% of all mosquitoes collected biting man (Valeza *et al.*, 1979). The infectivity rate in the Batan-Rapu Rapu studies was 1.0% compared to the Catanduanes island study of 2.3%. Also, the former study had an average third-stage larvae per infective mosquito rate of 5.6 compared to 3.9 in the latter study. In Sorsogon Province *Ae. poicilius* comprised 93% of the collection from man, and the

infectivity rate was 1.5% (Nissen, 1984).

The man-biting rate for three of the villages (based on 15-minute collections every two hours) averaged 75.7 *Ae. poicilius*. Multiplying by eight to get an estimate of the number biting for the entire night gives 605.6. Using and infectivity rate of 1.0%, an exposed person would receive about six infective bites per night.

In the Bicol Region of the Philippines, Bancroftian microfilariae in the peripheral blood show a rhythmic pattern, with peak concentration between 2400 and 0100 (Nissen, 1984). The biting activity of *Ae. poicilius* corresponds very closely with the microfilariae rhythmic pattern, with peak biting occurring around 2400. Also, considering this mosquito's strong anthropophility, high biting rate, and use of a larval habitat that has been abundantly provided by man, this species is ideally suited to be a vector of Bancroftian filariasis.

Controlling filariasis within an area such as that studied poses several problems. First, providing vector control and/or periodic medical surveillance in such a remote area would be a financially expensive undertaking. In its present economic situation, the Philippine Department of Health has understandably placed filariasis at a lower priority than more serious diseases such as malaria. Second, few people within this area know anything about filariasis or how it is transmitted. For example, several members in each village exhibited elephantiasis. The local people attributed the cause to walking in cool water after hard work or lifting heavy objects. Third, people who have microfilaremia and are given diethylcarbamazine (DEC) rarely take the medication past the first few days. The side effects experienced during the first few days of treatment are often severe enough to cause loss of work days, and thus loss of income to already poor families. Therefore, medication is often discontinued before completion of treatment. Also, the people do not understand why they should take medicine for a disease which usually exhibits only mild symptoms, when taking the medication for treatment makes them feel worse. Providing DEC-medicated salt would probably be ineffective on these islands since salt is so readily available.

Perhaps the best chance of controlling filariasis in the Philippines lies in educating the people about the disease, and promoting the use of mosquito bed nets. Since *Ae. poicilius* bites mostly during the hours of sleep, bed nets should be successful in reducing its transmission.

SUMMARY

The islands of Batan and Rapu Rapu in southeastern Luzon, Philippines, were surveyed for filariasis from November 1984 to May 1985. Microfilariae of Bancroftian filariasis were detected in 10.5% of the people over one year of age. Microfilarial rates and intensity of infection were the same for males and females. The highest rates for both sexes were in the 56- to 60-year-old age group. *Aedes poicilius*, which breeds in abaca and banana plants, was found to be very anthropophilic, comprising 96.5% of the mosquitoes biting man. This mosquito bites most frequently in the middle of the night. Dissections showed that 1.0% of *Ae. poicilius* were infective with third-stage larvae, and each infective mosquito contained a mean average of 5.6 larvae.

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