NOTES ON PHILIPPINE MOSQUITOES, XXII
THE AXIL-BREEDING SPECIES

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Studies by Cabrera and Tubangui(3) and subsequently by Rozeboom and Cabrera(8) have shown that the principal vector of filariasis in Sorsogon Province is an axil-breeding mosquito, *Aedes* (*Finlaya*) *poecilus* (Theobald) 1903.[1] Owing to the presence of numerous abaca in that province, the axils of which harbor *poecilus*, this plant has generally been taken as the index of filariasis in our country. How true and to what extent this assumption might be, the Institute of Malariology tried to determine by means of direct observation on mosquitoes and filariasis in that region.

Abaca (*Musa textilis* Née) is restricted in distribution to Philippine localities with fair distribution of rains throughout the year. Although it is apparently the main source of *poecilus* in Sorsogon Province, there are several other axiled plants to consider. Besides abaca the following were, therefore, included in the investigations:

Anahaw [*Livistona rotundifolia* (Lam.) Mert var. *luzonensis* Becc.]
Banana "saba" [*Musa sapientum compressa* (Blanco) Teodoro]
Biga [*Alocasia machrorrhiza* (Linn.) Schott]
Gabi [*Colocasia esculentum* (Linn.) Schott]
Galiang [*Cyrtosperma merkusii* (Hassk.) Schott]
Nipa (*Nypa fruticans*) Wurmb.
Pandan "bankoang" (*Pandanus simplex* Merr.)
Various small gabilike ornamentals and wild plants.

After several trial collections of mosquito larvæ and pupæ from axils of all these plants, it was decided to restrict the observations to axils only of abaca, banana, biga, gabi, and pandan. *Aedes amesii* (Ludlow) 1903, a harmless species so far as known at present, seemed to be the only mosquito that

[1] The scientific names given in this paper are according to the latest revision in "A synoptic catalog of the mosquitoes of the world (Diptera: Culicidæ)," by Alan Stone, Kenneth L. Knight, and Hellee Starcke. The Thomas Say Foundation 6 (1959) 358 pp.

bred in the numerous nipa palms growing all along the salt water seacoasts and swamps of Sorsogon Province; while breeding of *poecilus* in anahaw, galiang, and gabilike plants was negligible.

Some 400 abaca plants and an equal number of banana (saba) distributed in four different areas (100 in each area), 60 biga (15 in each area), 100 gabi (25 in each area), and 40 pandan (10 in each area) were examined monthly. The study areas selected were those in which the houses had not been sprayed with insecticide as part of the nation-wide malaria eradication project. Malaria was nonexistent or nearly so in these areas, but filariasis was quite prevalent, over 10 per cent of the population being positive for microfilaria larvæ (Baisas, 1957).

COLLECTION PROCEDURE

To determine the extent of selective breeding taking place among the different mosquitoes and to find out breeding densities in an axil and in a plant, the collections were at first made axil by axil and plant by plant. The entire contents of each axil was pipetted into a white enamel dipper. The axil was then flushed again with some of the water. The operation was repeated two or three times to insure collection of all larvæ and pupæ that might be in the axil. The larvæ and pupæ were carefully counted and recorded. The specimens from each axil were placed in a small vial, which was corked tightly (the cork held secure by adhesive plaster) and labelled accordingly. Each plant was then assigned as many vials as there were axils with breeding. Collections from 25 to 50 plants were packed in a carton box and sent to the Institute of Malariology, in Tala, Rizal Province.

When it had become established that an axil or a plant harbored more than one species of mosquitoes, and enough data concerning breeding densities had accumulated, the collections from any number of plants of one kind were placed together in one container and sent to Tala alive or preserved as needed. The records in such cases also showed the findings in each axil and in each plant, but the number of larvæ and pupæ was not indicated because they were not counted to save time.

To provide some measure of comparison with axiled plants in other parts of the Philippines, the entomological team at Kidapawan, Cotabato Province, Mindanao, as well as the team

at Clark Air Force Base, Pampanga Province, Central Luzon, were requested to make monthly collections of larvæ and pupæ from whatever axiled plants present in sufficient numbers in their respective areas.[2] Abaca, banana (saba), and gabi were available in the Kidapawan area, but at Clark Air Force Base only three kinds of bananas were present in good numbers. These were the cultivated variety, the saba; a semi-wild variety, the butuan [*Musa errans* (Blanco) Teodoro var. *botoan* Teodoro]; and a truly wild variety which the Negritoes called *amucao*. The abaca plants at Kidapawan, on the other hand, were only over a year old; they represented new attempts to re-establish the luxuriant abaca plantations that were completely destroyed by mosaic only two or three years earlier.

The collection technique, recording, etc., employed at Kidapawan and at Clark were the same as those in Sorsogon. But specimens in Kidapawan were preserved immediately after collection and sent to the Institute by ordinary surface mail. Those from Clark were taken to Manila, either alive or preserved, by U. S. Air Force bus.

Contrasts in climatic conditions in these three areas provided a most interesting aspect in relation to the investigations. Clark Air Force Base, just like the rest of Central Luzon, has Type I climate, the main features of which are two sharply defined seasons: dry in November to April, but sometimes prolonged up to May or June, and very wet (typhoon season) during the rest of the year. Sorsogon has Type II climate characterized mainly by rains at all seasons. Kidapawan, in Central Mindanao, has the so-called Type IV climate, which has no pronounced maximum rain period and no dry season. These three types of climate were reflected in the breeding densities.

Trial collections were also made in Tala, Rizal Province, and in San Pablo City, both in Southwestern Luzon.

Axils of bananas (saba), gabi, and pineapple in Tala were investigated in June, July, August, and September, 1957, but breeding was so scarce that the observations were altogether suspended. Out of a total of 338 banana plants, having 1,437

[2] The entomological team at Kidapawan had for its basic assignment the observation of mosquito behavior (specially *flavirostris*) in houses treated with insecticide; while the team at Clark Air Base was assisting the U.S. Air Force entomologist in the study of mosquito fauna in that place.

axils, three hundred seventy-one (371) axils, or 25.12 per cent, had no water; 1,058, or 73.62 per cent, had water but without breeding; and only 8, or 1.26 per cent had breeding. Nine larvæ were collected, consisting of 5 *Aedes albopictus* and 4 *Aedes flavipennis*. Every positive axil had only one larva, except one which had one third-instar *albopictus* and one fourth-instar *flavipennis*.

Three hundred twenty-four (324) pineapple plants were also examined. Each plant had usually over a dozen axils, but almost without exception only one (very rarely two) center axil retained water even during the rainy season. The axils containing no water or no breeding were not recorded in order to save time. Fifteen axils that were positive for mosquito breeding gave a total of 22 *albopictus* larvæ and 9 larvæ of *Malaya genurostris*.

Two hundred fifty-eight (258) axils of 75 gabi plants were similarly examined. None whatsoever had mosquito breeding, although 223, or 86.43 per cent, of them had water and only 35, or 13.57 per cent, had no water.

Over 100 banana plants of various species were examined in San Pablo City during two separate visits. Only one larva of *flavipennis* and one larva of *genurostris* were collected.

RESULTS

FINDINGS IN SORSOGON PROVINCE

The following species of mosquitoes were found breeding in axils of different plants in Sorsogon Province: (*1*) *Aedes* (*Stegomyia*) *albopictus* (Skuse) 1894, (*2*) *Aedes* (*Skusea*) *amesii* (Ludlow) 1903, (*3*) *Aedes* (*Finlaya*) *ananæ* Knight and Laffoon, 1946, (*4*) *Aedes* (*Finlaya*) *flavipennis* (Giles) 1904, (*5*) *Aedes* (*Finlaya*) *medleri* Knight and Laffoon, 1946, (*6*) *Aedes* (*Stegomyia*) *meronephada* (Dyar and Shannon) 1925, (*7*) *Aedes* (*Finlaya*) sp. nov., (*8*) *Aedes* (*Finlaya*) *poecilus* (Theobald) 1903, (*9*) *Armigeres* (*Armigeres*) *baisasi* Stone and Thurman, 1958, (*10*) *Culex* (*Culiciomyia*) *nigropunctatus* Edwards, 1926, (*11*) *Culex* (*Culex*) *quinquefasciatus* Say, 1823, (*12*) *Culex* (*Lophoceraomyia*) sp., (*13*) *Ficalbia* (*Ravenalites*) *deguzmanæ* Mattingly, 1957, (*14*) *Malaya genurostris* Leicester, 1908, (*15*) *Topomyia* spp., (*16*) *Toxorhynchites* sp., (*17*) *Tripteroides* (*Tripteroides*) *dyari* Bohart and Farner, 1944, (*18*) *Zeugnomyia* sp.

Breeding in abaca and banana axils.—The highest percentage of axils with breeding in abaca was in October (60.9 per cent) during which the highest breeding densities of *ananæ* (13.2), of *meronephada* (2.48), and of all species taken together (17.52) also occurred. A secondary peak of breeding for *ananæ* was registered in April (11.65) and May (10.43), a phenomenon, which, in the case of *flavirostris* and other ground-water breeding species, indicates a secondary peak of rainfall. Usually heavy breeding follows a series of heavy rains; more often after the regular rainy season.

Among bananas, the greatest number of axils with breeding was in September (57.35 per cent) correlated with the highest breeding density of *poecilus* (17.24) as well as with the peak of density for all species (19.22). In contrast with those in abaca, the breeding densities of *ananæ* and *meronephada* were consistently lower in bananas month by month: the peak of the density of *ananæ* being only 0.48 (July), and of *meronephada,* 0.51 (January and March). On the other hand, *poecilus* was consistently higher in larval and pupal densities in bananas than in abaca month by month.

The predominance of *poecilus* over *ananæ* or any other species breeding in axils of bananas is similarly marked. Out of 44,587 larvæ and 1,589 pupæ, 35,888 or 80.49 per cent larvæ and 1,193 or 75.08 per cent pupæ were *poecilus.* A poor second was *flavipensis,* with 4,295 or 9.63 per cent larvæ and 195 or 12.27 per cent pupæ. Of *ananæ* there were only 1,796 or 4.03 per cent larvæ and 38 or 2.59 per cent pupæ; and *meronephada,* 2,049 or 4.59 per cent larvæ and 148 or 9.31 per cent pupæ.

To *ananæ* was credited 29,262 or 53.93 per cent larvæ and 527 or 36.42 per cent pupæ out of a total collection of 54,285 larvæ and 1,447 pupæ from abaca. *Meronephada* and *poecilus* were nearly equal, but either was only about half as many as *ananæ;* 11,478 or 21.14 per cent larvæ and 516 or 35.66 per cent pupæ were *meronephada;* 12,243 or 22.55 per cent larvæ and 354 or 24.39 per cent pupæ were *poecilus.*

However, there were individual abaca plants which had more *poecilus* larvæ than *ananæ* larvæ, just as there were individual bananas with more *ananæ* and *poecilus.*

Based on collections made axil by axil and plant by plant, Table 1 shows the different axils of 150 abaca plants and 165 banana plants with the corresponding numbers and percentages of *poecilus* larvæ and pupæ.

TABLE 1.—*Number and percentage of poecilus larvæ and pupæ found in different axils.*

Axil number (from lowest to upward)	150 Abaca plants						165 Banana plants					
	Larvæ		Pupæ				Larvæ		Pupæ			
	No.	*Per cent*	♂♂	♀♀	*No.*	*Per cent*	*No.*	*Per cent*	♂♂	♀♀	*No.*	*Per cent*
1	100	10.77	----	----	----	----	269	9.84	11	4	15	13.51
2	175	16.70	2	----	2	8.69	380	13.99	5	6	11	9.91
3	166	17.88	1	1	2	8.69	497	18.15	12	15	27	24.32
4	224	24.14	5	5	10	43.48	530	19.35	8	9	17	15.31
5	152	16.39	----	4	4	17.38	526	19.33	12	7	19	17.20
6	93	10.02	3	----	3	13.04	345	12.56	4	6	10	9.00
7	15	3.42	----	1	1	4.36	157	5.73	5	6	11	9.91
8	3	0.68	----	1	1	4.36	32	0.99	1	----	1	0.84
9	0	----	----	----	----	----	2	0.06	----	----	----	----
Total	928	100	11	12	23	100	2,738	100	58	53	111	100

Larvæ of other species, but no *poecilus*, were found in axil No. 9 of some abaca plants.

As the great majority of the plants had only 5 or 6 axils each, it seems reasonable to assume that *poecilus* prefers breeding mostly in the middle axils: axil No. 4 among abaca plants and No. 4 or No. 5 among banana plants.

The average *poecilus* larvæ per plant in these 150 abaca plants was 6.187, but the average in the 165 bananas was 16.594 or nearly three times as many as in abaca. Average pupæ 0.153 and 0.673, respectively.

If these *poecilus* larvæ are classified by the instars, the number and percentages, inclusive of the pupæ, will be as shown in Table 2.

TABLE 2.—*Number and percentage of larval instars and pupæ of poecilus.*

Larval instars and pupæ	150 Abaca plants		165 Banana plants	
	Larvæ		Larvæ	
	Total	*Per cent*	*Total*	*Per cent*
First	363	38.17	783	27.47
Second	276	29.02	1,092	38.33
Third	162	17.07	516	18.11
Fourth	127	13.35	347	12.18
Pupæ	23	2.93	111	3.91
Total	951	100.00	2,849	100.00

Measurements of the water contained in 100 abaca axils and 100 banana axils showed a range of from 15 to 33 cc in abaca axils, or an average of 23.95 cc; from 20 to 80 cc in banana axils, or an average of 36.23 cc. In either plant, however, 25 cc was found most often, occurring in 18 abaca axils and in

26 banana axils. Next in frequency was 20 cc for abaca, and 30 cc for banana, 17 axils of either plant having this capacity. The minimum (15 cc) and the maximum (33 cc) for abaca were met only once each; while the minimum for banana (20 cc) was registered by three axils, but the maximum (80 cc), only by one axil. Two axils had the second highest capacity of 70 cc each. The average capacity (36.23 cc) of a banana axil exceeds the average capacity of an abaca axil (23.95 cc) by some 12 cc, and this, together with the greater number of axils bananas usually have, would seem to explain, at least in part, why banana has higher breeding density than abaca.

Breeding in biga axils.—Biga is a wild plant that is now grown in Manila and suburbs in yards and gardens. It thrives in nature in wet places along streams. Our monthly observations of breeding in this plant suffered repeated setbacks because of periodic cuttings by landowers. *Poecilus* and other *Aedes* species found breeding in abaca and banana axils also breed in axils of biga. *Aedes medleri* seems to prefer axils of biga to axils of other plants; but in certain months the water in biga axils becomes "soapy," which does not seem to aid the breeding of *Aedes*. On the other hand, this condition evidently favors the breeding of *Armigeres* to such an extent that all other species seems to be crowded out completely.

Elsewhere, as in Tala, in Laguna Province, and in the Sierra Madre, *Aedes flavipennis* is the predominant, and sometimes the only, species found breeding in biga axils.

Breeding in gabi and gabilike plant axils.—With fewer and smaller axils and the whole plant much smaller than biga, gabi has a relatively short existence because it is planted and harvested in about three months. There are not many gabi plants in Sorsogon. Only a few *poecilus* larvæ and pupæ were found in this plant. More than 90 per cent of the total collections from gabi axils were *Malaya genurostris*, a harmless non-blood-sucking mosquito; *poecilus* was slightly over 3 per cent.

The capacity of gabi axils, based on 100 measurements, varied from 13 to 27 cc, the average being 14.97 cc.

Various kinds of ornamental and wild gabilike plants were also investigated for breeding of mosquitoes. Although *poecilus* larvæ were found in a few of them, they are believed to be of no real importance in connection with filariasis in Sorsogon Province.

Galiang resembles biga, but when full-grown it has broader leaves and longer petioles than biga. Its axils are small, often submerged in mud or water. As a result, *poecilus* larvæ are rarely found in its axils. The tuber of this plant (weighing several kgs when mature) is edible.

In our observation areas, there are very few anahaw plants. But many are found elsewhere in Sorsogon Province. *Zeugnomyia lawtoni* Baisas, 1946, breeds in axils of anahaw in the Sierra Madre, but in those plants tested in Sorsogon, no water and no breeding were found.

The adult poecilus.—To be bitten by *poecilus* outdoor during the day is a common experience among those engaged in mosquito work in Sorsogon Province. However, daytime biting of *poecilus* is relatively less frequent and certainly less persistent than the attacks made by the vicious *Aedes albopictus*, of which there are many in those parts. *Aedes meronephada* also bites during the day, but this mosquito is far less common than *poecilus*.

Night feeding is evidently the overwhelming preference of *poecilus*, but the houses it prefers to frequent at night are as difficult to determine as those favored by *Anopheles flavirostris*. Fortunately, our men in the field hit, at the very start, a house in Barrio Rangas, Juban, that proved to be highly frequented by *poecilus*. Another house, about 100 meters away, was equally well favored; but others in the same locality were not. The many houses tested in different barrios at different times gave no better results.

Hour-by-hour catching of mosquitoes at night, usually on Fridays, was done in that house in Rangas. Three men lived there, sleeping on the floor at night without mosquito net. Two of our men were detailed there every catching night. Between times when they had caught all mosquitoes they could find every hour, they rested under a mosquito net. Attached to this was a larger net with slits which served very successfully as mosquito trap during the first days of observation. Three hundred ninety-eight (398) *poecilus* were captured in this trap on January 24, 1958; 383 on January 15, 1958 and 275 on January 18, 1958. Along with them were 9 *Aedes* (*Stegomyia*) *albopictus* (Skuse) 1894, 13 *Aedes* (*Finlaya*) *ananæ* Knight and Laffoon, 1946, 1 *Anopheles* (*Cellia*) *vagus limosus* King, 1932, 4 *Armigeres* (*Armigeres*) *baisasi* Stone and Thurman, 1958, 2 *Armigeres* (*Armigeres*) *malayi* (Theobald) 1901, 2 *Culex* (*Culex*) *gelidus* Theobald, 1901, 1 *Culex* (*Lutzia*) *hali-*

faxii Theobald, 1903, 1 *Culex* (*Culex*) *incognitus* Baisas, 1938, and 16 *Mansonia* (*Mansonioides*) *uniformis* (Theobald) 1901, were also caught in this mosquito-net trap. The highest number entered the trap around midnight with a resurgence of late comers between 5:00 and 6:00 a.m.

For some unknown reasons, the trap became less and less attractive to *poecilus;* more and more were caught outside the trap: on the walls and other parts of the room. The house had only one room and the net-trap was set in this room. Consequently, catching was done both within and without the trap, but inside the house. Those that entered the trap had very limited chances to bite; the few that were blooded had probably already fed before entering the trap or had bitten the mosquito catchers when those entered the trap. Many of those caught outside the trap were blooded; presumably they had feasted on the sleeping men without mosquito net. There were also some chickens and a dog outside the house which might have attracted or diverted some mosquitoes.

Other species were caught with *poecilus* at different hours of the night, but none in significant numbers. However, some insight into the nocturnal behavior of certain species is indicated. For instance *Aedes albopictus,* a decidedly daytime-biting mosquito, showed a certain degree of night activity.

Daytime indoor catches in several villages, including Barrio Rangas, yielded very few *poecilus,* which fact strongly indicates that this species is not an indoor-rester. Daytime outdoor catches in the same localities also yielded few *poecilus.* There were many *poecilus* outdoor during the day; but freshly emerged adults were roosting mostly on top of abaca and bananas, where they were inaccessible to collectors. The older ones were dispersed over vast areas, often resting singly and at wide intervals on all kinds of living and dead vegetation: under fallen leaves, twigs, and debris of all kinds on the ground.

Over the years, in various places in the Philippines daytime indoor catches have consisted of a thin sprinkling of *poecilus.* The same is true in catches from carabao-baited traps at night. The cow-baited trap at the College of Agriculture in Los Baños showed the same results. But there were months, even in Sorsogon Province, when no *poecilus* was caught in carabao-baited traps at night.

Twice during all-night trial catching of *flavirostris* in dieldrin-sprayed houses in Kidapawan, a fairly large number

of *poecilus* were caught in one house in Barrio Malasila: 64 on January 15, 1959; and 31 on January 29, 1959. The number of *poecilus* caught represented the highest record in the Philippines outside Sorsogon Province. From the same house, 96 *flavirostris* (50 engorged and 46 unfed), 1 blooded *limosus*, 1 blooded *uniformis* and 1 unfed *Aedes* (*Aedimorphus*) *vexans nocturnus* (Theobald) 1903, or a total of 99 mosquitoes, were caught on the night of March 12, 1959. This catch of *flavirostris* was the largest made during one night in a single house in the Philippines, the second highest being 72 (39 blooded and 33 unfed) taken by the WHO team in an all-night collection in an insecticide-sprayed house at Barrio Capirpiran in Isabela Province.

For a better understanding of the feeding preferences of *poecilus*, blood meals from caught wild specimens are now being prepared for precipitin tests abroad.

FINDINGS IN KIDAPAWAN, COTABATO

Before mosaic devastated the abaca plantations in Kidapawan and many other parts of Cotabato Province, one would reasonably assume that there had been numerous *poecilus* in these places, judging from the impressions obtained in Sorsogon Province. Likewise, when abaca declined some three years previously, *poecilus* would logically be expected to concentrate breeding in banana axils, of which there were quite a considerable number in those parts. If *poecilus* were actually present in large numbers when the abaca plants were numerous, there ought to be much higher *poecilus* breeding densities in bananas at Kidapawan at the time of our observations than in Sorsogon. However, such was not the case. The reverse was true. That fact seems to indicate that abaca is not as intimately linked with *poecilus* and filariasis as previously thought. Of course, there are other factors to consider: the climate, other vector mosquitoes which seem to be more often encountered in Mindanao than in Luzon, etc.

Monthly collections from axils of, and densities of breeding in, 50 abaca at Barrio Lamitan and 50 bananas (saba) in the town center of Kidapawan were taken and compared with collections from the same plants in Sorsogon. Fifty gabi plants in Barrio Malasila were also examined monthly for a comparison with similar examinations on 50 gabi plants in Sorsogon Province. The results showed there were fewer species(7)

and lower densities registered in the Kidapawan-Lamitan area. Only *Malaya genurostris* bred with some degree of monthly continuity in gabi axils at Kidapawan, the break occurring in February when the axils became dry. In both Kidapawan and Sorsogon *poecilus* was very scanty in gabi plants, much more so in Kidapawan.

Anahaw, gabi and pandan were also found in the Kidapawan study area, but not in sufficient numbers to meet the requirements of comparative studies.

FINDINGS IN CLARK AIR FORCE BASE

Before the extension of sugar-cane plantings in the 1920's most of the agricultural lands in Pampanga Province were covered with lush growth of grasses (cogon, etc.) with considerable admixture of wild bamboos and wild and semi-wild bananas, a condition now still obtaining in parts of Clark Air Base, Pampanga Province. Cultivated bananas of different kinds are grown to a very limited extent, specially in the surrounding communities. In the Base proper 50 saba and 50 amucao, in Lilly Hill 50 butuan, and at Forest Hill another 50 butuan banana plants were examined monthly.

The results of 12 months' operations showed breeding in the axils of cultivated and wild bananas from October through the month of March of the following year. The species found were predominantly *Aedes poecilus, Aedes flavipennis* and *Malaya genurostris* with a few *Aedes medleri* and *Aedes meronephada.* There was no breeding in the succeeding dry months of April and May as well as in June, when the early seasonal rains had just begun to refill the axils with new water.

The monthly percentages of abaca and banana axils with breeding and the monthly densities of *Aedes poecilus* compared with findings in Sorsogon and Cotabato are shown in Tables 3 and 4, respectively.

DISCUSSION

The relatively heavy rainfall throughout the year in Sorsogon Province is reflected in the high percentage of abaca and banana axils with mosquito breeding (Table 3). No distinct peak, however, was recorded: the highest being in October (60.9 per cent); the lowest, in July (36.43 per cent). But the records for certain other months almost equalled that for October. The highest for bananas was in September (57.35 per cent); the lowest, in April (18.62 per cent). Abaca in Kidapawan registered a peak of 63.51 per cent in December,

TABLE 3.—*Comparative monthly percentages of axils with breeding (abaca and banana: Sorsogon, Cotabato, and Pampanga).*

Year and month	Abaca		Bananas					
			Saba			Amucao	Butuan	
							Clark Air Base	
	Sorsogon	Kidapawan	Sorsogon	Kidapawan	Clark Air Base	Clark Air Base	Forest Hill	Lilly Hill
1957	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
July	36.43	No breeding	45.19	----------	----------	----------	----------	----------
August	50.84	3.94	39.19	11.57	----------	----------	----------	----------
September	55.83	10.59	57.35	26.38	----------	----------	----------	----------
October	60.90	26.13	52.14	37.06	8.53	27.57	45.23	42.29
November	49.73	48.24	35.74	45.91	24.26	36.18	61.03	57.10
December	59.54	63.51	44.80	40.66	13.02	21.84	58.08	41.90
1958								
January	55.57	25.23	51.15	28.48	all dry	8.71	25.53	29.31
February	56.48	19.19	25.80	24.60	9.58	7.34	14.57	24.56
March	57.96	0.22	32.34	2.60	13.86	7.42	13.04	19.90
April	42.87	dry	18.62	0.25	dry	dry	dry	dry
May	56.20	dry	29.20	dry	dry	dry	dry	dry
June	36.67	No breeding	28.63	No breeding	No breeding	No breeding	No breeding	No breeding

TABLE 4.—*Comparative monthly densities of Aedes poecilus.*

Year and month	Larvæ						Pupæ					
	Sorsogon		Kidapawan		Clark Air Base		Sorsogon		Kidapawan		Clark Air Base	
	abaca	saba	abaca	saba	butuan	saba	abaca	banana	abaca	banana	butuan	saba
1957												
July	0.52	12.96	----------	----------	----------	----------	0.04	0.60	----------	----------	----------	----------
August	2.16	12.55	0.075	0.68	----------	----------	0.02	0.40	0.01	0.099	----------	----------
September	3.08	17.24	0.130	2.50	----------	----------	0.04	0.68	0.02	0.23	----------	----------
October	1.25	9.89	0.64	3.58	2.12	0.79	0.01	0.29	0.04	0.24	0.17	0.08
November	6.17	9.22	5.50	6.38	6.98	3.06	0.09	0.15	0.42	0.62	0.28	0.18
December	5.97	9.59	5.35	5.09	9.88	1.28	0.13	0.20	0.10	0.32	0.45	0.06
1958												
January	1.77	9.41	1.77	3.42	6.00	all dry	0.02	0.30	0.05	0.42	0.25	all dry
February	1.76	3.05	0.87	2.72	3.05	n b *	0.02	0.06	0.04	0.33	0.05	all dry
March	0.78	5.13	0.007	0.09	1.20	n b *	0.01	0.11	0.00	0.05	0.30	all dry
April	1.08	3.65	all dry	0.11	all dry	all dry	0.04	0.34	all dry	all dry	all dry	all dry
May	0.49	7.09	all dry	all dry	all dry	all dry	0.01	0.21	all dry	all dry	all dry	all dry
June	0.19	6.20	n.b.*	n.b.*	n.b.*	n.b.*	n.b.*	0.07	----------	----------	----------	----------

* No breeding.

but the percentages for the succeeding months dropped rapidly: 0.22 per cent in March; zero (that is, the axils became dry or a few had water but without breeding) in April, May, June and July. Banana axils in Kidapawan reached a peak of 45.91 per cent with breeding in November, but the percentages also dropped rapidly during the next months, becoming zero in May, June and July. In Clark Air Base, the peak was 24.26 per cent (November) for saba, 36.18 per cent for amucao, 61.03 per cent and 57.1 per cent for butuan at Forest and Lily Hills, respectively. Breeding was maintained for six months (October to March, inclusive), becoming absent during the other six months.

Density of *poecilus* breeding (in this case, density means the average number of *poecilus* larvæ or pupæ per plant at any given time): 6.17 (November) for abaca in Sorsogon Province, followed closely by 5.97 (December). The lowest was in June (0.19). (Table 4.) For bananas, the highest was in September, 17.24; followed by 12.96 and 12.55 in July and August, respectively. The lowest was 3.05 in February. In Kidapawan, the highest density for abaca was 5.50 (November) and 5.35 in December. The lowest, besides zero, was 0.007 in March. For bananas, 6.38 in November was the highest density, the next highest being in December (5.09). The lowest, apart from zero, was 0.09 in March.

Potential transmitters of filariasis in the sense that they were found with noninfective microfilaria larvæ, *Aedes ananæ*, *Aedes meronephada* and *Armigeres baisasi*, are other axil-breeding species which should be carefully watched in Sorsogon Province. *Ananæ* breeds heavily at all seasons while *baisasi* attains very high peak of density (in biga axils) in certain months. *Meronephada* breeds moderately, but seems to be more prone to visit houses than either *ananæ* or *baisasi*. *Aedes flavipennis* also breeds quite heavily (more so than *meronephada*), but its adults are very rarely caught indoors. *Uranotænia tubanguii* and the new form, "near-*ananæ*," are also seldom caught in houses at night or during the day.

SUMMARY

1. Preliminary findings on mosquito breeding in axils of plants in various parts of Sorsogon Province; in Kidapawan, and its barrios of Lamitan and Malasila, Cotabato Province; and at Clark Air Base, in Pampanga Province, are presented.

2. Located as they are in different types of climate, these areas are not strictly comparable, and they were not chosen for comparative purposes. Studies at Clark Air Base were primarily an over-all appraisal of the mosquito fauna; the investigation done in Kidapawan and its barrios was in connection with insecticide-spraying of houses; whereas observations on mosquitoes breeding in plant axils formed only a part of the activities undertaken by the Filaria Pilot Project in Sorsogon Province.

3. The type of climate appears to be the most important factor that determines the density and duration of mosquito breeding in plant axils. Because of the more abundant and more evenly distributed rains in Sorsogon, a good portion of the axils contains water at all seasons and so mosquito breeding continues the year round. This seems to be also the reason why more species breed in plant axils in Sorsogon than in Cotabato or Pampanga: 18 were found in Sorsogon, only 7 in Cotabato, and 5 in Pampanga. The climate in Sorsogon is wet throughout the year with very pronounced maximum rainfall from November to January. Rainfall in Cotabato is more or less evenly distributed throughout the year, but usually the rains during summer are so light that the axils become dry and mosquito-breeding ceases. The definitely dry months of November to April in Pampanga restrict breeding in axils to a greater extent than in Cotabato.

4. The axils of abaca and banana are the most important breeding receptacles of certain mosquitoes, but specially of *Aedes poecilus,* the principal transmitter of filariasis in Sorsogon Province. The saba (*Musa sapientum compressa*) harbors, as a general rule, more *poecilus* than abaca when considered axil by axil or plant by plant. A close relative of *poecilus, Aedes ananæ* breeds more abundantly than *poecilus* in the axils of abaca. However, because of the enormous predominance of abaca in Sorsogon, the total *poecilus* output necessarily comes more from abaca than from bananas.

5. Other kinds of cultivated bananas in the observation areas are relatively few. Moreover, their axils do not retain water because of their loose attachment. Wild and semiwild bananas outnumber saba at Clark Air Base; and these are the main sources of *poecilus* in that place. Wild bananas abound in many newly opened agricultural lands in the Philippines, where they may become sources of trouble in relation to filariasis.

6. Though biga, pandan, anahaw, galiang, and other gabi-like wild and ornamental plants harbor *poecilus*, they may be considered unimportant unless present in large numbers. Nipa, which abounds along salt-water seacoasts and swamps, seems to afford nursery only to the apparently harmless *Aedes amesii*.

7. For more than one year, the collections from plant axils were done and identified separately axil by axil and plant by plant. This was to determine whether particular species bred only in particular axils or in particular plants. While certain species are evidently strict in their choice of axils (for instance, *Uranotaenia tubanguii* and an undescribed form very close to *ananæ* breed only in axils of *Pandanus* sp.; and *Aedes amesii*, only in axils of nipa), *poecilus* breeds in almost all kinds of axils, although highly preferring the axils of abaca and banana (saba).

8. Normally, there were more first-instar larvæ than second-instar; more second-instar than third; and more third-instar than fourth. This may not be the case when the collection comes from only one or a few plants, but when a large number of plants are investigated and the total collections analyzed as a whole the proportion just mentioned holds. It seems reasonable to assume that the percentage of pupæ in relation to the first-instar larvæ of each species at the time of collection represents what is actually happening in nature. Hence, the figures given for abaca have only about 6 per cent reaching the pupal stage while those for bananas have 14 per cent.

9. Once a week, for more than one year, all-night catching of *poecilus* was done hour-by-hour in a small house highly frequented by this mosquito in a barrio of Sorsogon. The results indicate the highest numbers entered around midnight. There was a slight resurgence from 5:00 to 6:00 a.m., but this might represent late comers, although some of them might have missed being caught earlier.

10. Very few other species were caught with *poecilus* in that house; *Anopheles flavirostris*, the malaria vector in the Philippines, was very poorly represented. The place may appropriately be called a "*poecilus* territory." On the other hand, Kidapawan, Cotabato Province, may be considered a "*flavirostris* territory" because this mosquito is more often caught in these houses and in larger numbers than elsewhere in the Philippines. A house in Barrio Malasila holds the dis-

tinction of having the highest number of *flavirostris* taken in an all-night catching, 96, on March 12, 1959. It also holds the highest record of *poecilus* caught in one night outside Sorsogon Province, 64, on the night of January 15, 1959. But this is much lower than the highest number, 398, caught in Sorsogon in one night, on January 24, 1958.

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