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The bionomics of filariasis vectors in Western Samoa

Takeshi SUZUKI* and Fola SONE**

* *World Health Organization, Inter-country Filariasis Advisory Team (WPRO-2201), P.O. Box 113, Suva, Fiji*

** *Health Inspector, Filariasis Control Project, Apia, Western Samoa*

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Abstract: Studies on the biting activities and seasonal prevalence on *Aedes (Stegomyia) polynesiensis* and *Ae. (Finlaya) samoanus*, two main vectors of subperiodic bancroftian filariasis in Western Samoa, were carried out by human bait collection method. The results are summarized as follows: There are two peaks in the biting activities of *Ae. polynesiensis*. The afternoon density is higher than the morning one, and the outdoor biting density is higher than the indoor one. A considerable number of this species also bites man at night, particularly on bright moonlit nights. *Ae. samoanus* has the highest peak of biting activity during the third quarter of the night. No difference was observed between the outdoor and indoor biting density of any mosquito species collected at night. There is no clear relationship between biting activities, temperature and relative humidity. The seasonal prevalence of these two mosquito species correlates mainly with the rainfall.

INTRODUCTION

In Western Samoa, only the sub-periodic form of *Wuchereria bancrofti* occurs. The average microfilaria rate was 19% before the mass drug administration started in late 1965. The known vectors are *Aedes (Stegomyia) polynesiensis*, *Ae. (S.) upolensis* and *Ae. (Finlaya) samoanus* (Ramalingam, 1968). *Ae. (F.) tutuilae* is a suspected vector. *Ae. polynesiensis* and *Ae. samoanus* are considered the important vectors because of their high density and infection rates.

There is little published on the bionomics of these vectors. This paper reports the results of extensive studies on the biting activities and seasonal prevalence of *Ae. polynesiensis* and *Ae. samoanus*.

BITING ACTIVITIES

Methods of mosquito collection

For the collection of day-biting mosquitos, three stations were selected:

(a) a Samoan-type house in the coastal village of Solosolo on Upolu Island;

(b) a bush area under coconut trees in Tuanaimato village, a suburb of Apia town;

(c) an unoccupied semi-European style house in Mulinu'u, near the centre of Apia town.

For the collection of night-biting mosquitos, also three stations were selected:

(a) the same house in Solosolo;

(b) a European-type house in Aleisa, an inland village 300 metres above sea level on Upolu Island;

(c) a ward in Safata District Hospital, near the south coast of Upolu Island.

Mosquito collection was made with human bait in each station during the first thirty minutes of each hour, from 6 a.m. to 6 p.m. for day-biting mosquitos, and from 6 p.m. to 6 a.m. the following day for nightbiting mosquitos.

Results and discussion

Six collections (three each for day- and

* 鈴木　猛：WHO Scientist, 南太平洋フィジー国勤務

night-biting mosquitos) were carried out during the period October 1969 to January 1970.

The average density index of the mosquitos was calculated by the following formula:

$$\frac{\text{Number of mosquitos collected during each period}}{\text{Total number of mosquitos collected during the survey}} \times 100$$

Day-time collection results: The density of mosquitos per man-hour in the three stations, and the temperature and relative humidity are shown in Fig. 1.

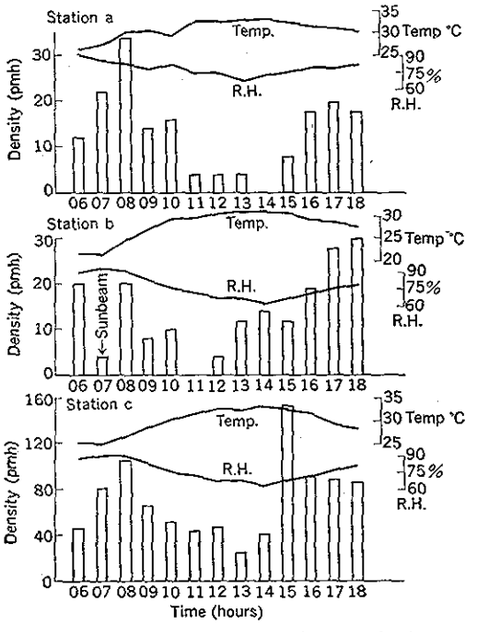

Fig. 1 Density, per man-hour, of *Ae. polynesiensis*, temperature and relative humidity at each hour in day-time survey

Out of 646 mosquitos caught in the stations, all were *Ae. polynesiensis* except one *Ae. samoanus* which was caught in station (b) at 7 a.m. In station (c) 468 mosquitos were caught, in station (a) 87, and in station (b) 91.

The findings of Jachowski (1954) and Ramalingam (1968) on the morning and late afternoon biting activities of *A. polynesiensis* in American Samoa were confirmed during the present study. The morning peak was from 8 to 8.30 a.m. and the afternoon peak from 5 to 6.30 p.m. There was no clear relationship between biting activities and the temperature and relative humidity.

Night-time collection results: Of a total of 808 mosquitos collected in all three stations at night, the majority (597 mosquitos) were *Ae. samoanus*, i.e. 100 in station (a), 364 in station (b), and 133 in station (c). In addition, there were 100 *Ae. polynesiensis*, 55 *Ae. (F.) oceanicus*, 55 *Culex pipiens fatigans* and one unidentified specimen.

The density of *Ae. samoanus* and *Ae. polynesiensis* per man-hour in each station, as well as the temperature and relative humidity are given in Fig. 2. Their average density index is shown in Fig. 3.

Ramalingam (1968) reported that the highest peak of biting activity of *Ae. samoanus* in American Samoa occurred at 11 p.m. Our studies show that *Ae. samoanus* bites man throughout the night starting at 7 p.m. with a peak between midnight and 3.30 a.m. Again, there was no distinct relationship between biting activities and the temperature and relative humidity.

Although *Ae. polynesiensis* is a well-known

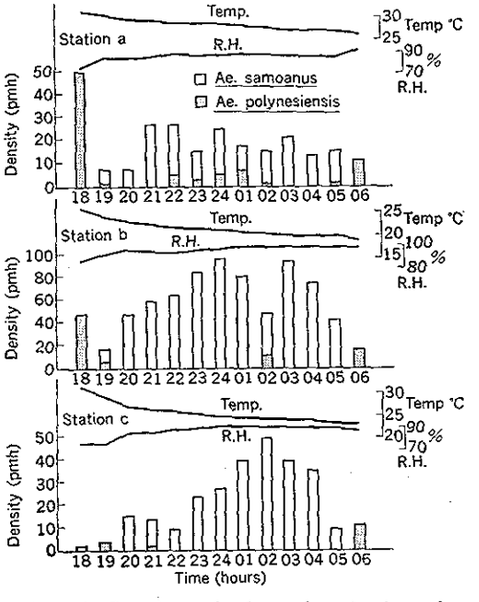

Fig. 2 Density of *Ae. polynesiensis* and *Ae. samoanus*, temperature and relative humidity at each hour in night survey

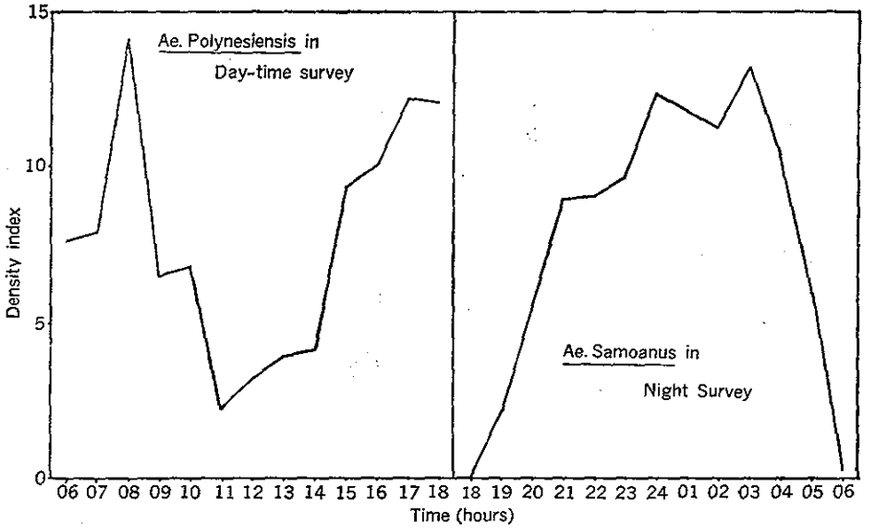

Fig. 3 Average density index of *Ae. polynesiensis* in day-time survey and of *Ae. samoanus* in night survey

"day-biter", it was also caught in considerable numbers at night, as shown in Fig. 2. The number of the mosquitos caught at station (a) around midnight (five mosquitos per man-hour) was even slightly higher than those caught around noon (three mosquitos per man-hour).

Seasonal Prevalence

Jachowski (1954) reported that no evidence of seasonal prevalence of *Ae. polynesiensis* was observed in American Samoa. There has been no previous study on the seasonal prevalence of *Ae. samoanus*.

Methods of mosquito collection

Day-time collection: Systematic collection was made for an entire year, from November 1968 to October 1969.

There were four fixed catching stations located in Apia and in its suburbs, utilizing human bait. Each station included two localities: a Samoan-type house for indoor collection and a nearby bush area for outdoor collection. During the survey period, collections were made in each locality for 10 min once a week; in the morning between 8 and 9.30 a.m. and on alternate weeks in the afternoon between 3 and 4.30 p.m.

Night-time collection: Three fixed stations were selected in Moamoa, a village located at the foot of a mountain about 5 km away from the centre of Apia town. The first station was an open verandah of a school; the second station, a Samoan-type unoccupied house, about 200 metres from the first house; the third station was an open space under a big mango tree, about 10 metres away from the second station.

Mosquito collection was made with human bait for 30 min in each station from 5 to 11 p.m. The collection was made fortnightly throughout 1970.

Results and discussion

Seasonal prevalence of Ae. polynesiensis: Of a total of 2,092 mosquitos collected in the daytime from all stations, 2,011 were *Ae. polynesiensis*, 76 *Ae. aegypti*, 3 *Ae. samoanus* and 2 *C.p. fatigans*.

The weekly density of *Ae. polynesiensis* is given in Fig. 4, with the weekly precipitation. The highest density peaks were observed in the months of March and September. There was no relationship between the mosquito density and the temperature and relative humidity. During the survey period, the monthly average temperature was highest (27.6°C) in March and lowest (24.4°C) in September, and the

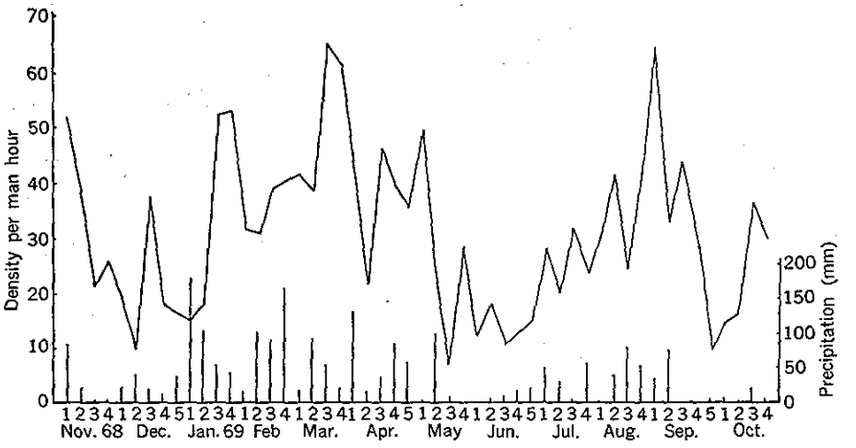

Fig. 4 Weekly average density of *Ae. polynesiensis* in day-time survey and weekly precipitation

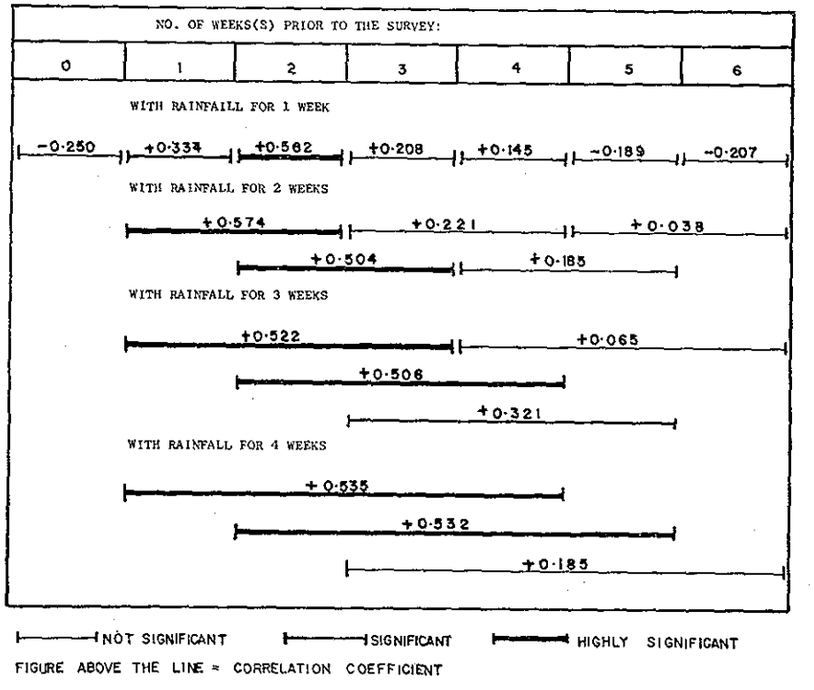

Fig. 5 Correlation coefficients between density of *Ae. polynesiensis* in day-time survey and precipitation prior to the survey

monthly average relative humidity was highest (88%) in February and lowest (77%) in September. On the other hand, the high density of *Ae. polynesiensis* usually occurred in association with higher precipitation. Figure 5 shows that the density of the mosquitos was positively correlated with rainfall; high density of mosquitos tended to occur two weeks after a heavy rainfall.

The main breeding sites of *Ae. polynesiensis* in the survey areas are tree holes, coconut shells and discarded tins. These are usually

small but hold enough rain water to permit oviposition and larval development.

The length of immature stages of *Ae. polynesiensis* was reported to be 9.4 days by Jachowski (1954) and 8.4 days by Ingram (1954). Female mosquitos take the first blood meal three to four days after emergence.

Results of human bait collection outdoors and indoors in the day-time showed a significant difference (Table 1). In general, the outdoor biting density of *Ae. polynesiensis* was higher than the indoor biting density. It was also observed that the morning density of the biting activity of this mosquito was lower than the afternoon density in general (Table 2). Similar results were obtained by Jachowski (1954).

As mentioned earlier, considerable numbers

Table 1 Density of *Aedes polynesiensis* collected in the daytime at the indoor and outdoor catching stations, November 1968–October 1969

Station	Indoors			Outdoors			Significance of difference in density between indoor and outdoor collections
	No. of collections	No. of mosquitos caught	Density per man-hour	No. of collections	No. of mosquitos caught	Density per man-hour	
(a)	50	224	26.9	50	413	49.6	Highly significant ($P<0.01$)
(b)	50	152	18.2	50	287	34.4	Highly significant ($P<0.01$)
(c)	48	138	17.3	48	222	27.8	Highly significant ($P<0.01$)
(d)	49	281	34.4	49	294	36.0	Not significant
Total	197	795	24.2	197	1216	37.0	Highly significant ($P<0.01$)

Table 2 Density of *Aedes polynesiensis* collected in the morning and in the afternoon at the four fixed catching stations

Station	Morning collection			Afternoon collection			Significance of difference in density between morning and afternoon collections
	No. of collections	No. of mosquitos caught	Density per man-hour	No. of collections	No. of mosquitos caught	Density per man-hour	
(a)	52	243	28.0	48	394	49.3	Highly significant ($P<0.01$)
(b)	58	169	17.5	42	270	38.6	Highly significant ($P<0.01$)
(c)	48	141	17.6	48	219	27.4	Highly significant ($P<0.01$)
(d)	44	215	29.3	54	360	40.0	Significant ($P<0.05$)
Total	202	768	22.8	192	1,243	38.8	Highly significant ($P<0.01$)

Table 3 Density of mosquitos collected at night with and without moonlight, 1970

Night	No. of collection	Species/Density per man-hour			
		Ae. samoanus	*Ae. oceanicus*	*Culex p. fatigans*	*Ae. polynesiensis*
With moonlight[1]	11	123.6	6.7	6.2	6.8
Without moonlight[2]	14	144.6	6.2	3.4	2.3
Significance of differences in density		Not significant	Not significant	Not significant	Significant ($P<0.05$)

[1] During the period one week before and after the full moon.

[2] The rest of the nights in a lunar calendar.

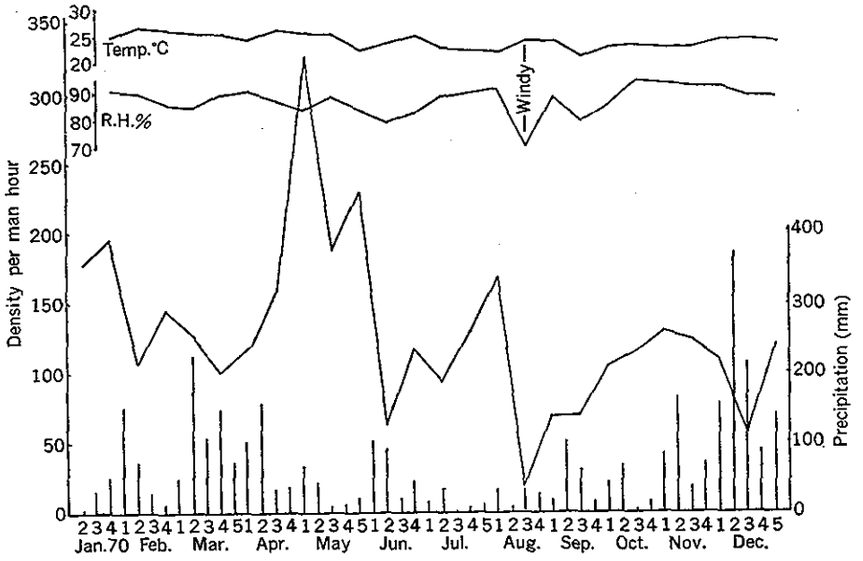

Fig. 6 Density of *Ae. samoanus* in night survey, weekly precipitation, and temperature and relative humidity during the survey

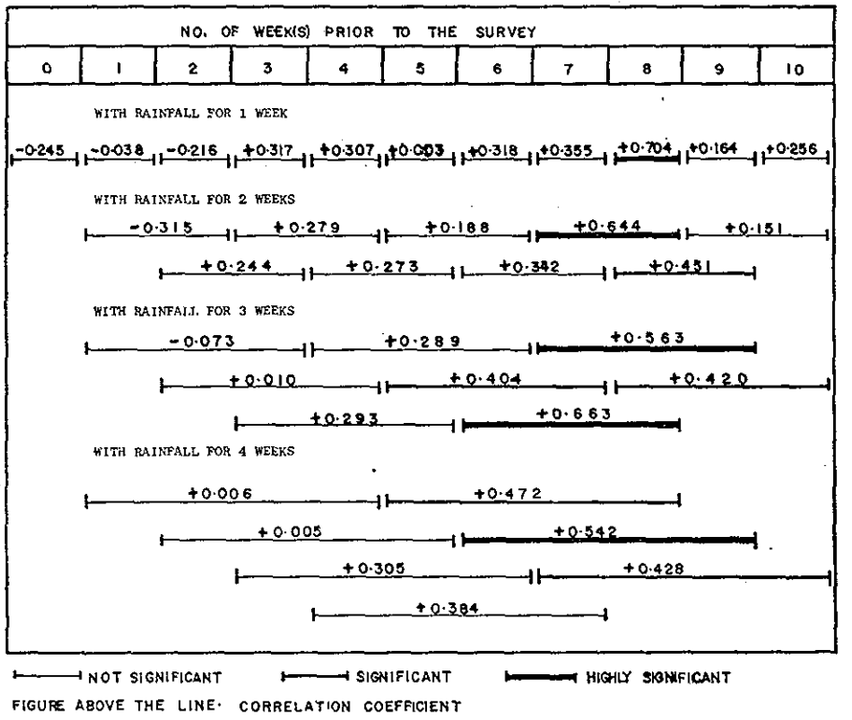

Fig. 7 Correlation coefficients between density of *Ae. samoanus* in night survey and precipitation prior to the survey

of *Ae. polynesiensis* bite man also at night, particularly on bright moonlit nights (Table 3). It may be mentioned here that other species such as *Ae. samoanus*, *Ae. oceanicus* and *C.p. fatigans* showed no difference in biting activities during a night with or without moonlight.

Seasonal prevalence of Ae. samoanus: Of 5,643 mosquitos caught during the entire period of collection, 5,094 (90.3%) were *Ae. samoanus*, 243 (4.3%) *Ae. oceanicus*, 161 (2.9%) *Ae. polynesiensis*, 144 (2.6%) *C.p. fatigans* and one unidentified specimen.

Figure 6 shows the results of the density of *Ae. samoanus*, and the weekly rainfall, average temperature and relative humidity. The highest density peak of *Ae. samoanus* occurred during May. There was again no relationship between the density, temperature and relative humidity. There appeared to be some relationship with rainfall (Fig. 7), but it was not as distinct as in the case of *Ae. polynesiensis*.

The breeding sites of *Ae. samoanus* in Western Samoa were confined to leaf axils of two kinds of plants: the common *Pandanus* and *Freycinetia*. It was noted that even during the dry season most of the *Pandanus* axils usually still held some water.

The life cycle of *Ae. samoanus* is still unknown. Preliminary observations in the laboratory show that it may take longer than that of *Ae. polynesiensis*.

No difference was observed between the outdoor and indoor human biting density of any mosquito species collected at night.

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摘　要

西サモアのフィラリア病媒介蚊の日週期活動と季節消長

西サモアのバンクロフト糸状虫による弱週期性フィラリアの主要媒介蚊，*Ae. polynesiensis* および *Ae. samoanus* について，日週吸血活動と季節消長の研究をおこなった．*Ae. polynesiensis* の日週活動には2つのピークが認められ，午後のピークは，午前のピークよりも高い．また，屋外での吸血蚊数は，屋内のそれよりも大きかった．この種は，通常昼間吸血性といわれているが，夜間にもかなりの吸血蚊がみとめられ，これは月明の夜に特にいちじるしかった．*Ae. samoanus* は夜間吸血性で，夜間の第三四半期に吸血活動のピークがみとめられる．両種とも，吸血活動と温湿度の間に顕著な関係はみとめられなかった．この両種の季節消長は，いわゆる季節や，他の気候条件とは関係なく，ただ降水量のみと相関が認められた．