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Decrease of vector mosquitoes of bancroftian filariasis in a village on Fukue Island, Nagasaki, southwestern Japan

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Abstract: In 1994, mosquitoes were collected by the human bait method and by a suction tube at cowsheds in a village, Nagasaki prefecture, where bancroftian filariasis was formerly endemic (microfilaria positive rate was 14.0% in 1961) but all inhabitants became free of microfilariae by the control of vector mosquitoes carried out from 1962 to 1971. The abundance of mosquitoes collected in 1994 was compared with that in 1961 in previously published report. A remarkable decrease of the principal vector mosquito, *Culex pipiens pallens,* was noted from 1961 to 1994, and it was considered that the risk of filariasis infection became negligible.

key words: vector, mosquitoes, filariasis, *Wuchereria bancrofti, Nagasaki.*

INTRODUCTION

Bancroftian filariasis was highly endemic still in 1950s particularly in southwestern parts of Japan (Sasa, 1966). According to a report by the health authority of Nagasaki prefecture, there were many persons infected with the bancroftian filarial worm, *Wuchereria bancrofti,* in the prefecture, and the results of blood examination carried out from 1941 to 1960 showed that 1,290 (7.6%) were positive for microfilariae among 16,989 examined.

In Nagate village endemic for bancroftian filariasis (microfilaria positive rate 14.0% in 1961) on Fukue Island, Nagasaki prefecture, ecological stuides on vector mosquitoes were started in 1961 and an attempt of filariasis eradication by vector control was implemented in the next year (Wada, 1966a, b; Omori et al., 1972). The vector control from 1962 to 1971 was proved to be very effective in reducing the number of microfilaria positives and all inhabitants became free of microfilariae in 1971. Vector control for filariasis eradication was discontinued since 1972. We visited Nagate village to collect mosquitoes in 1994, more than 30 years after 1961 when the ecological studies on mosquitoes were started in the village. The abundance of mosquitoes in 1994 was compared with that in 1961, and the difference in abundance was discussed in relation to environmental changes influencing the transmission of filariasis.

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Place and Methods

Nagate village endemic for bancroftian filariasis, in which this study was conducted, was located near the sea coast on Fukue Island and had 126 houses and 577 inhabitants in 1961. Main occupation was agriculture with the sweet potato as a predominant product, but the rice field was not developed within the village. Some villagers were also engaged in fishery.

In 1994, mosquitoes were collected in Nagate village by the human bait method (WHO, 1992), by the light trap (Fujihira Kogyo Co. Ltd., Tokyo) and by a suction tube at cowsheds. The human bait method was applied outdoors from 8 to 10 pm at two sites on June 9 and at 7 sites on July 15. The light trap was operated from 8 to 12 pm at two sites on July 15. Collection by a suction tube was made from 8 to 10 at two cowsheds on June 9.

Results

Table 1 shows the results of mosquito collection on June 9. Seven species were obtained by the human bait method and by a suction tube at cowsheds. The most abundantly collected mosquito was *Aedes japonicus*. It should be noted that the number of *Culex pipiens pallens*, the principal vector of bancroftian filariasis, was small.

The results of mosquito collection by the human bait method and the light trap on July 15 were given in Table 2. Nine species were encountered. The most abundant mosquito was *Ae. togoi* by the human bait method and *Cx. tritaeniorhynchus* by the light trap. The number of *Cx. pipiens pallens* was again small by the human bait method, though fairly large numbers were collected by the light trap.

Mosquitoes were collected by the human bait method and by a suction tube at cowsheds also in 1961 (Wada, 1966a), therefore, the abundance was compared between 1961 and 1994 in Table 3. The mean number of *Cx. pipiens pallens* per collection by the human bait method greatly

Table 1. Mosquitoes collected by human bait method and by a suction tube at cowsheds, Nagate, June 9, 1994.

	Human bait method			At cowsheds		
	1	2	Total	1	2	Total
Aedes togoi	0	0	0	5	0	5
Ae. japonicus	0	1	1	85	0	85
Ae. albopictus	0	2	2	4	0	4
Culex p. pallens	0	2	2	0	0	0
Cx. tritaeniorhynchus	0	1	1	8	1	9
Anopheles sinensis	0	0	0	1	0	1
Armigeres subalbatus	0	0	0	4	0	4

differed, 71.2 in 1961 and 0.6 in 1994. The difference in the percentage to total was also remarkable, 92.7 in 1961 and 5.4 in 1994. At cowsheds, the mean number of *Cx. pipiens pallens* was 1.8 in 1961, but none were collected in 1994.

Table 2. Mosquitoes collected by human bait method and by light traps, Nagate, July 15, 1994.

	Human bait method								Light trap		
	1	2	3	4	5	6	7	Total	1	2	Total
Aedes togoi	3	11	3	9	7	1	2	36	4	20	24
Ae. japonicus	1	1	0	4	4	0	6	16	5	9	14
Ae. albopictus	0	0	1	4	3	5	1	14	2	1	3
Ae. nipponicus	0	0	0	0	0	0	3	3	2	1	3
Culex p. pallens	1	0	0	1	0	0	1	3	80	70	150
Cx. tritaeniorhynchus	0	1	0	0	0	0	3	4	447	656	1103
Anopheles sinensis	0	0	0	0	0	0	0	0	15	7	22
Armigeres subalbatus	0	0	2	4	1	0	1	8	17	10	27
Mansonia uniformis	0	1	0	0	0	0	0	2	0	0	0

Table 3. Comparison of mean number of mosquitoes per collection and % to total in parentheses between 1961 and 1994, Nagate.

	Human bait method		At cowsheds	
	1961*	1994	1961*	1994
Month	5−11	6−7	5−12	6
No. of collections	13	9	48	2
Aedes togoi	2.3(3.0)	4.0(39.1)	0.5(15.2)	2.5(4.7)
Ae. japonicus	0	1.9(18.5)	0	42.5(79.4)
Ae. albopictus	0.4(0.5)	1.8(17.4)	0.1(2.5)	2.0(3.7)
Ae. nipponicus	0	0.3(3.3)	0	0
Ae. vexans nipponii	0.1(0.1)	0	0	0
Culex p. pallens	71.2(92.7)	0.6(5.4)	1.8(55.7)	0
Cx. tritaeniorhynchus	0.9(1.2)	0.6(5.4)	0.0(0.6)	4.5(8.4)
Cx. halifaxii	0.2(0.3)	0	0	0
Anopheles sinensis	0.3(0.4)	0.9(8.7)	0.1(2.5)	0.5(0.9)
Armigeres subalbatus	1.4(1.8)	0	0.8(23.4)	2.0(3.7)
Mansonia uniformis	0	0.2(2.2)	0	0

*Data in 1961 are from Wada (1966a).

Discussion

Exact comparison of mosquito abundance between 1961 and 1994 was difficult, because seasons and sites of collection were not the same in the two years. Reduction in the mean number per collection of the principal vector, *Cx. pipiens pallens,* from 71.2 in 1961 to 0.6 in 1994 by the human bait method may be a little underestimated, because collections were made throughout the year in 1961 but only in active seasons of the mosquito in 1994. For the same reason, decrease in the number of *Cx. pipiens pallens* at cowsheds seems evident.

From the above, it is clear that the principal vector, *Cx. pipiens pallens,* decreased markedly during 33 years from 1961 to 1994. This was apparently due to the reduction in the breeding place of this mosquito. The main breeding place in 1961 was standing water in drains collecting household waste water (Wada, 1966a), but most drains in 1994 were found to be laid with concrete, thus scarcely holding water.

In contrast to *Cx. pipiens pallens, Ae. togoi* does not seem to have decreased. This is probably because *Ae. togoi* breed almost exclusively in water pools in the rocky seashore. Any big change in the environment of the seashore was not noted in 1994. *Ae. togoi* is as susceptible to *W. bancrofti* as *Cx. pipiens pallens* (Nakamura, 1964), and is said to be the secondary vector in Japan. However, it was demonstrated that the role of *Ae. togoi* in transmitting bancroftian filariasis is far smaller than *Cx. pipiens pallens* at least in Nagate village, mainly owing to rather zoophilic behavior in blood feeding (Wada, 1966a).

It can be said from the above that a remarkable decrease of the principal vector, *Cx. pipiens pallens,* changed the infection of bancroftian filariasis to be much more difficult. Moreover, the living style of inhabitants was improved so as to reduce the chance of mosquito bites, thus it is considered that the risk of filariasis infection became negligible.

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