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Structure of Larval Associations of Mosquito Found in Bannosawa, Sapporo¹⁾

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(With 1 Text-figure)

In a series of recent studies on the origin of insect pests, Kato and his collaborators (1954, 1956) made it clear that larval associations of mosquito in mountainous water are changed by gradual steps, though their forms seem apparently very complex and in disorder. In connection with these studies, the present writer in his another paper (1957) divided larval habitats of mosquito into six groups according to the types of water bodies and pointed out that the so-called ground pool may serve as a favorable habitat for various mosquito larvae. In this paper, the structure of larval associations in such ground pools and their relation to each other will be described.

Locality and method

The locality here investigated is an area called Bannosawa, a hilly region to the southwest of Sapporo City; the area extends over about 6 km along a road from the Horomi Pass (ca. 300 m above sea-level) to Fukui village (ca. 180 m above sea-level). As the traffic is rather light, numerous ruts in the road present breeding places for various larvae of mosquito. On both sides of the road, there are various larval habitats such as swampy grounds, small marshes and rice nurseries and among them, human dwellings are scattered. A branch of the Hassamu river runs along the road and joins with the main stream near Fukui village. To measure the abundance of mosquito larvae, ten dippings with a metallic dipper (diam. 4 cm) were made at each station.

Results and discussion

Sampling was undertaken 3 times, namely on August 21st, 27th and Sept. 17th: five species of mosquitoes were found from 47 stations covering six kinds of water bodies (Tables 1 & 2). As is clear from Table 2, the distribution of mosquito larvae is closely related to the types of water. Ruts, depressed grounds and swampy grounds belong to the category of ground pool: in such ruts bred four species, *Aedes vexans nipponii*, *Culex vagans*, *C. rubensis* and *C. orientalis*, in depressed grounds *A. vexans nipponii* and *C. vagans*, and in swampy grounds

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C. vagans and *C. rubensis*. On the other hand, in rice nurseries *C. orientalis* alone was found, and in small marshes *C. orientalis* commonly and *C. vagans* very rarely. In contrast to the species stated above, *Aedes japonicus* was collected only in rocky crevices at a confluence of the Hassamu river. This corresponds with the fact that in this area *A. japonicus* inhabits exclusively stone vases and stone basins in graveyards among artificial receptacles.

Table 1

Water bodies	Number	Stations
Swampy ground	4	No. 21, 22, 23, 34
Depressed ground	2	No. 29, 30
Rut	32	No. 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 25, 27, 33, 35, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47
Rice nursery	3	No. 31, 32, 44
Small marsh	4	No. 24, 26, 28, 43
Rocky crevice	2	No. 9, 10
Total	47	

Table 2

	Rocky crevice	Rut	Depressed ground	Swampy ground	Rice nursery	Small marsh	Total
<i>Aedes vexans nipponii</i>		14	1				15
<i>Culex vagans</i>		17	1	3		1	22
<i>Culex rubensis</i>		15		2			17
<i>Culex orientalis</i>		3			3	3	9
<i>Aedes japonicus</i>	2						2
Total	2	49	2	5	3	4	

Figure shows frequency of each species.

Relations among larval associations of mosquitoes: In the first survey (August 21st), the monospecific association of *Aedes vexans nipponii* was remarkable amongst those of other species but decreased gradually in number in parallel with the season. That is to say, out of 9 monospecific associations of *A. vexans nipponii*, 7 associations were obtained on August 21st and only 2 associations on August 27th. On September 17th, *A. vexans nipponii* were found to occur mixedly with *Culex orientalis* and *C. rubensis*. On the contrary, the monospecific association of *C. vagans* and *C. rubensis* occurred from August 21st to 27th. In the last survey (Sept. 17th), separate monospecific associations of the two species, *C. rubensis* and *C. orientalis* were each found abundantly. From this fact, it is surmised that there is a close relation amongst these associations. Except two

larval associations of low density (St. Nos. 24, 25), the relations among other 45 associations are illustrated in Figure 1 by the occurrence probability method (Kato et al., 1952). As is clear in the figure, there can be seen two main processes in gradual changes of larval associations; one from *A. vexans nipponii* assoc. to *Culex orientalis* assoc. (Process I), and the other from *A. vexans nipponii* assoc. to *Culex rubens* assoc. (Process II).

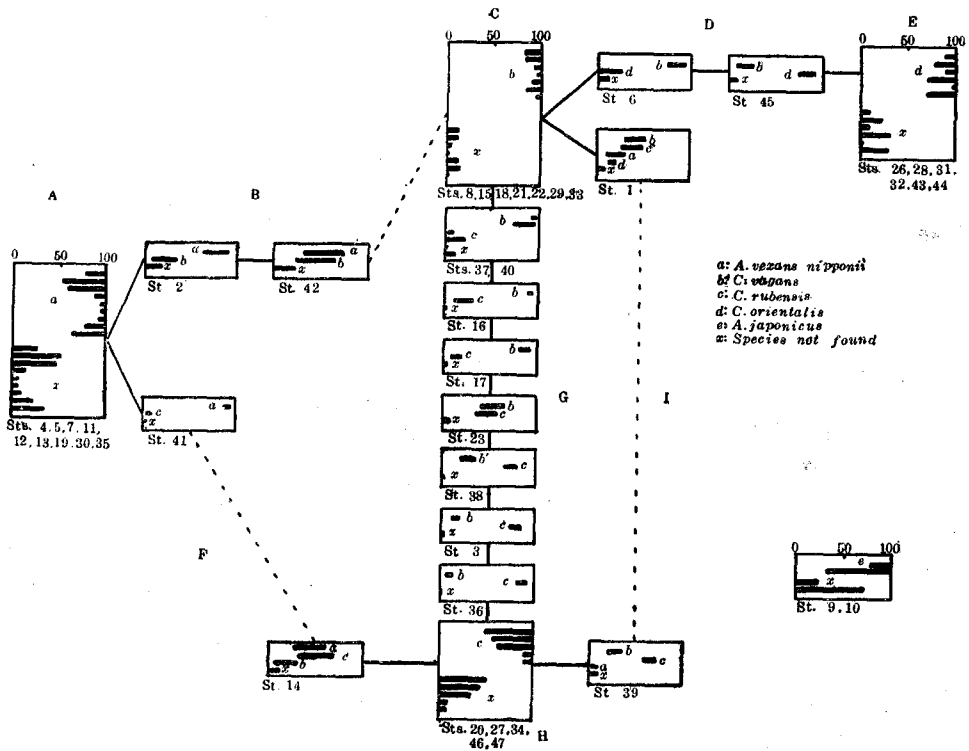


Fig. 1. Solid lines show the cases in which a sequence in larval constitution was directly seen. Dotted lines show the cases in which the sequence is well conceivable from the constitution of species.

Process I: *Aedes vexans nipponii* assoc. → *Culex orientalis* assoc. *Aedes vexans nipponii* first lived together with *Culex vagans* showing the majority in number. However, in the last survey (Sept. 17th), the ratio turned inversely and finally the monospecific *Culex vagans* assoc. remained alone in ground pools. In parallel with the succession of larval associations just mentioned, water bodies changed from muddy to transparent water. In the plain of Sapporo and its

vicinity, the inhabitation of *Aedes vexans nipponii* is restricted mainly to paddy fields and swampy grounds, and in Bannosawa in the muddy water of ruts. On the other hand, *C. orientalis* appeared only in transparent clean water. According to Kato et al. (1956), larval associations of mosquito in mountainous ground pools of northern Japan Proper, follow two courses: *Anopheles hyrcanus sinensis*→*Aedes esoensis*→*Culex vagans* or *Anopheles hyrcanus sinensis*→*Culex orientalis*; in the former, water bodies are changed gradually from clean to foul, containing organic matter. Thus in northern Japan Proper, *C. vagans* assoc. seems to be one of the climax associations formed in fairly polluted natural water, while in the present survey, they were found rather indiscriminately in both muddy and clean waters but seldom appeared in foul water. *C. vagans* in Bannosawa is therefore considered as an association standing in a transitory condition of habitat from muddy to clean water. *C. orientalis* in northern Japan Proper, living together with *Anopheles hyrcanus sinensis* and *Aedes esoensis*, follows a different course from *C. vagans*. But in Bannosawa, mixed associations of *C. orientalis* and *C. vagans* were repeatedly found. Thus it is noticed that the divergent processes of larval associations are fairly due to localities. The fact seems to show that the adaptability of ovipositing habit in mosquitoes is higher than it has been considered to be.

Process II: *Aedes vexans nipponii* assoc.→*Culex rubensis* assoc. Here three minor courses are conceivable. The first course is the case of direct change from *A. vexans nipponii* assoc. to *C. rubensis* assoc. (A-F-H). In this case, these two species occasionally accompanied *C. vagans*. In the second course (A-B-C-G-H), as previously stated, *A. vexans nipponii* assoc. first gave the way to *C. vagans* assoc. Then, after striving furiously with *C. rubensis* for superiority in number, *C. vagans* assoc. was finally replaced by *C. rubensis* assoc. In the progress from *C. rubensis* assoc. it was occasionally observed that a few *A. vexans nipponii* and *C. orientalis* took part in the two associations just referred to. The case may be considered as the third course (A-B-C-I-H). In the three courses briefly described, the change of water bodies was not so remarkable as in the course from *A. vexans nipponii* assoc. to *C. orientalis* assoc. However, it was noticeable that *C. rubensis* as well as *C. vagans* inhabited both clean and muddy water without a marked difference of density.

This research was conducted under the direction of Prof. Tohru Uchida, and the writer dedicates this paper to him in the honour of his 60 th birthday.

Summary

From the structure of larval associations of mosquito occurring in Bannosawa, a hilly region of Sapporo, two major processes of change were assumed; 1. *Aedes vexans nipponii* assoc.→*Culex vagans* assoc.→*Culex orientalis* assoc. 2. *Aedes vexans nipponii* assoc. → *Culex rubensis* assoc. Furthermore, the second process could be subdivided into three minor courses according to trifling changes

in the constitution of the species-number.

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