Drosophila Survey of Hokkaido, XXXV. Further Study on Microdistribution of Drosophilid Flies in the Vicinity of Streams

By

Katsura Beppu

Zoological Institute, Hokkaido University

(With 3 Text-figures and 2 Tables)

In the previous papers (Beppu 1976, Beppu and Momma 1977), characteristic microdistribution patterns of the *robusta* group species and *D. ezoana* belonging to the *virilis* species group in the vicinity of streams were reported. The distribution patterns of these species were divided into two types; the first type was represented by four species, *D. okadai*, *D. neokadai*, *D. lacertosa*, and *D. ezoana*, and the peculiarity of this type was that these species were collected in abundance only in the vicinity of streams, whereas the second type was represented by three species, *D. moriwakii*, *D. sordidula*, and *D. pseudosordidula*, and the peculiarity of this type was their abundance not only in the vicinity of streams but also in the forest far from streams.

However, the number of collected flies of each species in the vicinity of streams varied owing to differences in the stream or streamside environments (e.g. *D. ezoana*, *D. okadai* and *D. neokadai* were abundant at Jozankei but not at Moiwa and Nopporo *etc.*. cf. Beppu 1976, Beppu and Momma 1977). So the habitat preferences of these species seemed to vary from species to species.

The characteristics of their microdistribution are therefore dealt with in this paper.

Before going further, I wish to express my sincere thanks to Prof. Eizi Momma for his pertinent guidance in the course of this study and for critical reading of the manuscript. Cordial thanks are also due to Messrs. Masahito T. Kimura, Masanori J. Toda, and Hide-aki Watabe for their kind advice, and to Mr. Nobuaki Ichijô who helped me with my collections at Soranuma.

Area Studied and Method

a) In order to survey a faunal change of the *robusta* group species due to differences of stream or streamside environments, three different streams were selected: two were at Ban-nosawa and at Jozankei, in the suburbs of Sapporo City

(cf. Beppu 1976), and one was at Kami-Otoineppu in the northern part of Hokkaido (cf. Toda 1973, Kimura and Toda 1976). The environments around the trap spots at each locality are shown schematically in Fig. 1.

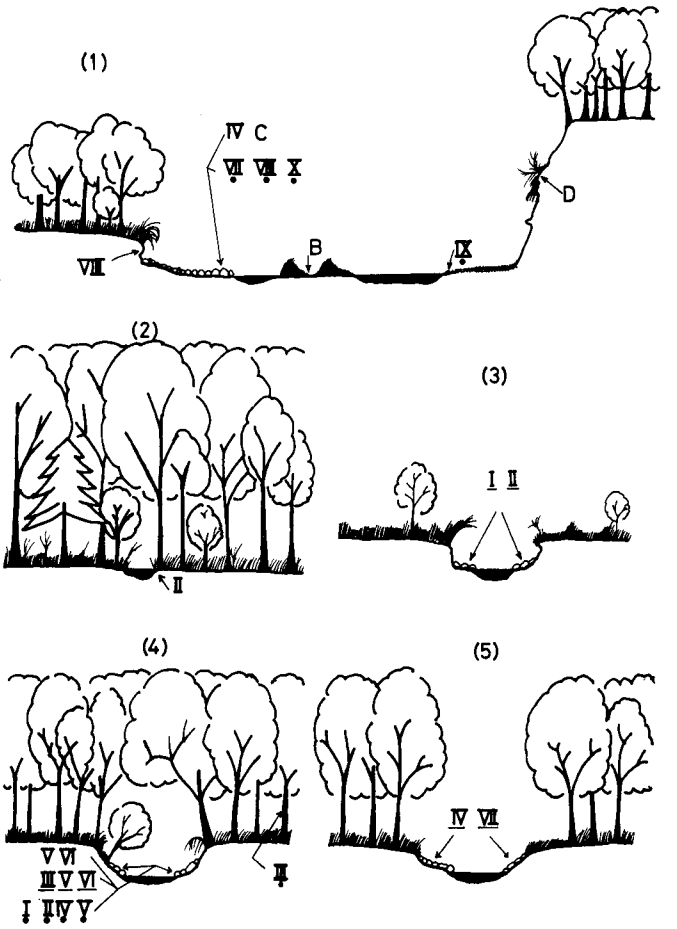

Fig. 1. Schemata of the environments around the trap spots.
(Dot: Kami-Otoineppu, Underline: Ban-nosawa, Nothing: Jozankei)

Jozankei

Eight milk can traps were used. The trap spots were named as follows, II, IV, V, VI, VIII, B, C, and D. Among these traps, IV and C were set along the streamside of the Toyohira River. Traps, V and VI, were set along the streamside of a branch of the Toyohira River, and II was set along the streamside of another

branch (cf. Fig. 1). Trap B was set on the dry river bed of the Toyohira River where grass and bushes such as *Artemisia montana etc.* were to be seen in places. This trap was about 10 m from the river. Traps VIII and D were set in the shelter of a cliff in the side of the valley. Collections were carried out in 1976, once a month for two successive days at one hour intervals from 5:00 to 10:00 from May to September, and from 7:00 to 12:00 in October.

Ban-nosawa

Seven retainer traps (named I-VII) were used. These traps were set along the streamside of a branch of the Toyohira River about 2 m in width. Four traps (I, II, IV, and VII) were set at the streamside where trees didn't canopy the stream surface, but the other three traps (III, V, and VI) were set at the streamside where trees did canopy the stream surface. Grassland extended around the spots I and II, while the streamside forest approached the streamside at IV and VII. Baited retainer traps were exposed for a week, and the bait was renewed every other week. Samples were collected three times in 1975 from the middle of July to the end of August.

Kami-Otoineppu

Ten milk can traps (named I-X) were used. Four of them, I, II, IV, and V, were set along the streamside of a branch of the Otoineppu River, and the other four traps, VII, VIII, IX, and X, were set along the streamside of the Otoineppu River itself, which is about 5 m in width. Trap III was set in the streamside forest about 10 m from the stream, and VI at the confluence of the main river and its branch stream. The branch stream is canopied by trees such as *Quercus crispula*, *Fraxinus mandshurica*, and *Picea jezoensis*, *etc.* forming the streamside forest. The undergrowth layers consist mainly of *Sasa senanensis*, which hangs over the sides of the branch. The Otoineppu River has a wide dry river bed. Trap IX was set on this dry bed where there was sandy soil and the other three traps (VII, VIII, and X) were set on the dry bed among stones or small rocks, some of which were partly covered with mosses. Collections were carried out in 1976 on 5/30, 7/31, and 9/27, at one hour intervals from 5:00 to 10:00.

b) In order to survey the phenology of *D. okadai* and *D. neokadai*, a stream at Soranuma was selected. This stream, named Yunosawa, was about 5 m in width and has a dry river bed where stones, small rocks, or fallen trees, *etc.* are to be seen everywhere. Four milk can traps were used and these were set along the streamside of the Yunosawa. Collections were carried out in 1976 at about one hour intervals from 5:00 to 9:00 or 10:00 at the end of April and in May.

Results

Jozankei (Table 1 and Fig. 2)

A total of 1,415 specimens was collected. The *robusta* group species consisted about 40% of them. Other abundant species were *D. ezoana*, *D. bifasciata*, *D.*

confusa, *D. histrio*, and *D. coracina* (Table 1). As shown in Fig. 2, the fauna at spot II was characterized by the following three species, *D. confusa*, *D. moriwakii*,

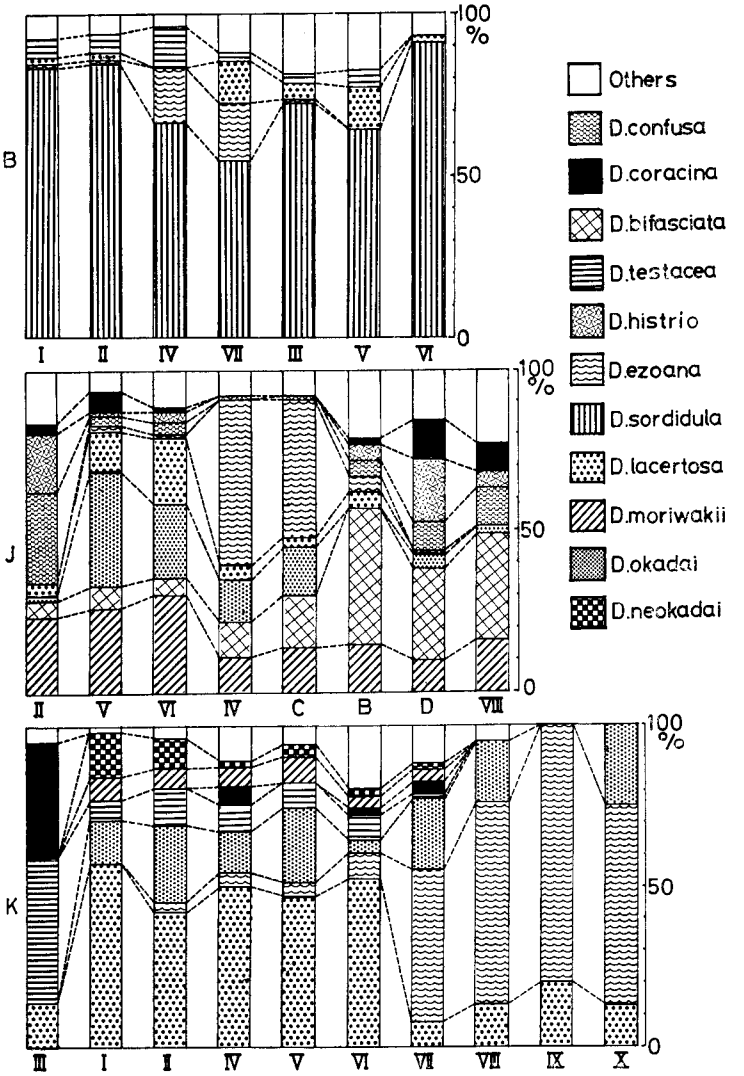

Fig. 2. Fauna at every trap spot in three localities.
(B: Ban-nosawa, J: Jozankei, K: Kami-Otoineppu)

and *D. histrio*. The faunas at IV and C were very similar to each other (Fig. 2), and *D. ezoana* and *robusta* group species were also the main species at these spots. The faunas at V and VI were also very similar to each other, and at these spots

also *robusta* group species were the main species (Fig. 2). The fauna at spot B on the dry river bed was to some extent different from the other streamside spots, and characterized by the forest species like *D. bifasciata* and *D. confusa*. In addition to such forest species, *D. ezoana*, which was known as a streamside species, and grassland species such as *D. auraria* were also collected at this spot (Table 1). The faunas at spots VIII and D were also very similar (Fig. 2), and *D. confusa*, *D. coracina*, and *D. bifasciata* were abundant (Table 1). Among the *robusta* group members only *D. moriwakii* was abundant in all trap spots (Table 1).

Ban-nosawa (Table 1 and Fig. 2)

A total of 1,352 specimens was collected, and about 70% of them were *D. sordidula* (Table 1). This species was collected fairly abundantly at all trap spots. Other abundant species at this locality were *D. ezoana* and *D. lacertosa*, and the former was abundant at I, IV, and VII, while the latter was abundant at I, III, and VII. At spot I, *D. auraria* was collected in abundance in particular as seen in Table 1.

Kami-Otoineppu (Table 1 and Fig. 2)

A total of 310 specimens was collected. Four species of the *robusta* group species (*D. lacertosa*, *D. moriwakii*, *D. okadai*, and *D. neokadai*) consisted about 60% of them. In addition to these species, *D. ezoana*, *D. testacea*, and *D. coracina* were also abundant species. *Drosophila lacertosa* was more abundant at the streamside of the branch stream (I, II, IV, V, and VI) than of the main stream (VII, VIII, and X), and *D. ezoana vice versa* (Table 1). In comparison with these two species, *D. okadai* and *D. neokadai* were collected in almost equal numbers at all trap spots. So the faunas at the streamsides of the branch stream and the main stream were characteristic as shown in Fig. 2. The fauna at III was different from other spots and characterized by *D. testacea* and *D. coracina* (Table 1). The fauna at spot IX was not so different from other spots set at the streamside of the main stream, though the flies collected were very few in number.

Soranuma (Table 2)

As shown in Table 2, *D. okadai* appeared from the beginning of May and *D. neokadai* from about the middle of May. The phenology of these species differed from each other in spring.

Remarks

As shown in Fig. 2, the fauna differed with the environment of the trap spot. The characteristic fauna in the vicinity of streams was seen both at main streamsides and at branch streamsides. The collected number of the main species at the streamsides of main and branch streams is shown in Fig. 3. This graph shows that an abundance of *D. ezoana* is characteristic of the main streamside. In addition to these spots, this species was collected in abundance at I, IV, and VII in Ban-nosawa. The microenvironments around all these trap spots were very

Table 1. Number of flies

Locality	Jozankei									Ban-nosawa			
Spot	II	IV	V	VI	VIII	B	C	D	Total	I	II	III	IV
Species													
Amiota													
conifera takadai	–	1	–	–	5	7	–	2	15	4	5	2	–
Chymomyza													
caudatula	–	–	–	–	–	–	–	–	–	–	–	–	–
Drosophila													
confusa	28	2	7	6	21	9	1	7	81	–	–	–	–
coracina	3	2	15	3	15	5	–	14	57	1	–	–	–
bifasciata	5	43	17	7	56	69	16	23	236	1	–	2	–
imaii	–	–	1	–	6	3	2	–	12	–	–	–	–
suzukii	–	–	–	–	–	–	–	–	–	1	–	–	–
auraria	–	1	4	2	1	4	–	–	12	27	7	7	8
biauraria	3	–	1	–	–	5	–	–	9	–	–	–	–
testacea	4	–	2	5	5	1	–	2	19	3	–	10	1
nigromaculata	5	–	1	–	1	4	1	–	12	1	2	8	2
brachynephros	1	–	1	–	1	1	–	–	4	5	–	6	–
unispina	1	–	–	–	1	–	–	–	2	–	–	–	–
histrio	18	4	4	5	9	8	–	16	64	1	–	6	–
immigrans	1	–	–	–	2	–	–	–	3	11	1	2	–
ezoana	–	204	6	2	–	8	43	–	263	6	1	2	11
sordidula	2	7	1	–	7	6	–	1	24	387	101	168	42
pseudosordidula	–	–	–	–	–	1	–	–	1	–	–	–	–
lacertosa	4	15	33	28	1	8	3	1	93	10	2	12	–
moriwakii	23	44	67	39	28	25	14	8	248	–	–	1	–
okadai	2	57	90	31	4	–	15	4	203	–	–	–	–
neokadai	1	18	7	6	–	–	4	–	36	–	–	–	–
multispina	–	–	–	–	–	–	–	–	–	–	–	–	–
pengi	–	2	1	–	8	1	3	3	18	2	–	6	–
makinoi	–	–	1	–	–	–	–	–	1	–	–	–	–
sp.	–	2	–	–	–	–	–	–	2	–	–	–	–
Total	101	402	259	134	171	165	102	81	1,415	460	119	232	64

similar; there are stones, small rocks and/or fallen trees, but no sandy soil or pebbles. A similar trend shown by *D. ezoana* was reported by Herting (1955) for *D. littoralis*, which also belongs to the *virilis* species group. From these facts, this trend may be an ecological characteristic of some wild *virilis* group species. On the other hand, *D. okadai* and *D. neokadai* were not so restricted as *D. ezoana* in their habitat preferences (Fig. 3). They were collected in some abundance both at main streamsides and at branch streamsides, but less so at the streamside of very narrow streams like spot II in Jozankei. As shown in Fig. 3, *D. lacertosa* was more abundant at the branch streamsides than at the main streamsides in Jozankei and Kami-Otoineppu, and at the very narrow streamsides in Moiwa and Nopporo where the streamside was partly covered with grasses of mosses (cf. Beppu 1976). This species seemed to have more extensive habitat preference than the other three

collected at three localities

				Kami-Otoineppu										
V	VI	VII	Total	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
–	–	5	16	–	–	–	–	–	1	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	1	–	–	–	1
–	–	–	–	–	–	–	2	–	–	–	–	–	–	2
1	–	1	3	–	–	8	3	–	1	2	–	–	–	14
–	–	2	5	–	–	–	2	–	1	–	–	–	–	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.	–	–	1	–	–	–	–	–	–	–	–	–	–	–
3	–	9	61	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	1	–	–	1
2	2	8	26	1	4	10	4	4	4	1	–	–	–	28
3	–	2	18	–	1	1	1	1	5	–	–	–	–	9
3	–	6	20	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	2	–	10	–	–	–	–	1	–	–	–	–	–	1
1	1	6	22	–	–	–	–	–	1	–	–	–	–	1
–	–	61	81	–	1	–	2	2	4	32	10	4	15	70
39	63	189	989	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8	1	45	78	8	14	3	24	22	24	4	2	1	3	105
–	–	4	5	1	2	–	3	4	2	2	–	–	–	14
–	–	1	1	2	8	–	6	11	2	12	3	–	6	50
–	–	1	1	2	3	–	1	2	1	1	–	–	–	10
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	7	15	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
61	69	347	1,352	14	33	22	48	47	46	55	16	5	24	310

Table 2. Phenology of *D. okadai* and *D. neokadai* at Soranuma

Date	4/27	5/1	5/2	5/3	5/9	5/18	5/26	5/23
D. okadai	–	–	40	5	45	25	23	18
D. neokadai	–	–	–	–	1	3	25	16

species belonging to the first type. From these facts, it may be suggested that *D. ezoana* prefers more open streamsides such as a main streamside or an uncanopied branch streamside. On the other hand, *D. lacertosa* prefers more canopied streamsides. *Drosophila okadai* and *D. neokadai* were abundant both at open and canopied streamsides, but they were not collected at the streamside of very narrow streams regardless of the abundance of *D. lacertosa*. In my behavioral observation in the

field, several flies of these two species were found at cracks among damp stones at the streamside or on the dry river bed (Beppu unpubl.). Therefore, it is suggested that the existence of cracks among such stones or small rocks seemed to be necessary as resting sites for their life in native environments. On the other hand,

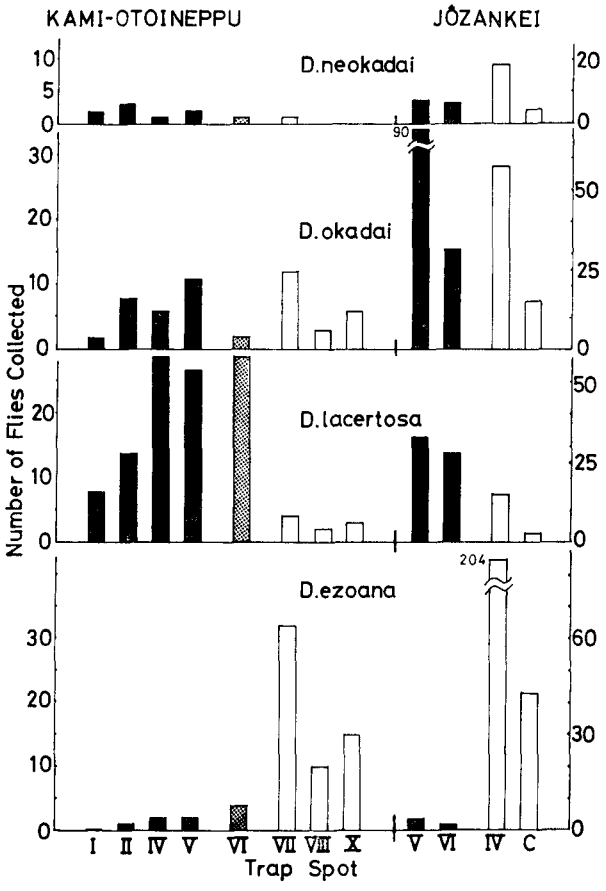

Fig. 3. Number of main collected species at the streamside of the main stream and branch stream (Black: Branch stream, Dots: Confluence of the main stream and branch stream, White: Main stream).

flies of *D. lacertosa* also showed such behavior, but they flew in under the leaves of streamside grasses or fern which hung over the stream. Therefore, they seemed to be able to live at the streamside of such narrow streams. *Drosophila okadai* and *D. neokadai* were very similar in their habitat preferences, though their phenologies were different as shown in Table 2. This difference may reflect the difference of their breeding periods.

The two species belonging to the second type, *D. sordidula* and *D. moriwakii*, did not show a difference of habitat preferences owing to differences of streamside environment, and one more species belonging to this type, *D. pseudosordidula*, was not collected in abundance in this survey. So another survey is continuing on these species (Beppu unpubl.). However, previous series reports made clear that *D. sordidula* had not been collected in abundance in the northern and eastern parts of Hokkaido (Takada 1958, Wakahama *et al.* 1963, Kaneko *et al.* 1967, 1968, Kaneko 1968). The distribution pattern of this species in Hokkaido seems to reflect the characteristic of this species' life history. *Drosophila moriwakii* were often found in daytime in the shelter of the cliff of the streamside, and were collected by net sweeping in such places (Beppu unpubl.). Similar trend was also reported by Toda (1973) for *D. moriwakii* in cut-over areas. Therefore, the abundance of this species in the vicinity of a stream may be due to the existence of this resting site.

Summary

Characteristics of the habitat preferences of the main species in the vicinity of streams were surveyed. *Drosophila ezoana* was abundant at the streamside of main streams and uncanopied branch streams, and preferring more open streamsides. *Drosophila okadai* and *D. neokadai* were abundant at the streamsides of both main and branch streams, but few of them were collected at the streamsides of very narrow streams where no stones or rocks were seen to serve as resting sites for them in daytime. Though the habitat preferences of both species were very similar, *D. okadai* appeared about 2 weeks earlier than *D. neokadai* in spring at Soranuma. *Drosophila lacertosa* was more abundant at canopied and very narrow streamsides. Therefore, this species seemed to prefer more canopied streamsides, and has a wider habitat preference than the other three species belonging to the first type.

Drosophila sordidula was not collected in abundance in the northern part of Hokkaido. The abundance of *D. moriwakii* in the vicinity of a stream may be due to the existence of cliff shelter which serve as a resting site for this species in daytime.

References

Beppu, K. 1976. Drosophila Survey of Hokkaido, XXXI. Microdistribution of drosophilid flies in the vicinity of the stream. Jour. Fac. Sci. Hokkaido Univ. VI. Zool. **20**: 203–210.

——— and E. Momma 1977. Microdistribution of drosophilid flies in the vicinity of the stream. Dro. Infor. Serv. **52**: 18.

Herting, B. 1955. Untersuchungen über die Ökologie der wildlebenden *Drosophila*-Arten Westfalens. Z. Morph. u. Ökol. Tiere **44**: 1–42.

Kaneko, A. 1968. Drosophila Survey of Hokkaido, XXV. Some observations on summer diurnal activity of drosophilid flies in two localities of southwestern Hokkaido. Jour. Fac. Sci. Hokkaido Univ. VI. Zool. **16**: 537–541.

————, Momma E. and T. Shima 1967. Frequencies of abundance of *robusta* species group in Hokkaido. Dro. Infor. Serv. **42**: 104.

————, Tokumitsu T. and T. Shima 1968. Drosophila Survey of Hokkaido, XXIV. On Drosophila collections of six localities in the southwestern part of Hokkaido. Jour. Fac. Sci. Hokkaido Univ. VI. Zool. **16**: 531–536.

Kimura, M. T. and M. J. Toda 1976. Drosophilid fauna in Nakagawa experiment forest, Hokkaido University. Res. Bull. Coll. Exper. Forests, Coll. Agr., Hokkaido Univ. **33**: 449–456. (In Japanese with English summary).

Takada, H. 1958. Drosophila Survey of Hokkaido, X. Drosophilidae from several localities of Hokkaido. Jour. Fac. Sci. Hokkaido Univ. VI. Zool. **14**: 120–127.

Toda, M. J. 1973. Influence of forest felling upon drosophilid fauna at several localities in Hokkaido. Res. Bull. Coll. Exper. Forests, Coll. Agr., Hokkaido Univ. **30**: 389–410.

Wakahama, K., Kaneko, A. and T. Tokumitsu 1963. Drosophila Survey of Hokkaido XIX. Collection records in three localities of Hokkaido, with a note on the diurnal behavior of certain species. Annot. Zool. Japon. **36**: 92–96.