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Note on the Seasonal Activity of *Drosophila* observed in the Rakuzan Park, Matsue City

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Recently population genetics of insects have been studied by many investigators (Patterson 1943, Dobzhansky and Pavan 1950, Williams and Miller 1952, Ishihara 1954, Basden 1955, Suzuki 1955, Mather 1956, Nozawa 1956, and Wakahama 1956 and 1957). During the past three years the author has made the observation of the seasonal activity of *Drosophila* in Matsue City, Southeastern Japan. The author wished to publish his data in comparing with his previous works carried on in Sapporo and with obthers.

Before going further, the author expresses his cordial thanks to Professor Ichiro Hayasaka, the President of the Shimane University for reading through the manuscript. And he is greatly indebted to Dr. Toyohi Okada, Tokyo Metropolitan University for his valuable advices concerning the identification of species.

Method of Collection: Collections were done every month except the snowy seasons during three years from 1957 to 1959 at the Rakuzan Park in Matsue City. Ten traps were equipped with the fermented banana, and flies were collected two times a day both in the morning and in the evening during three successive days from April to November. Further the occasional net-sweeping and direct collections by the use of a glass pipe were adopted.

Rsults

During three successive years, 6830 flies were collected; they were represented by 22 species, as shown in Figure 1 and Tables 1, 2, and 3.

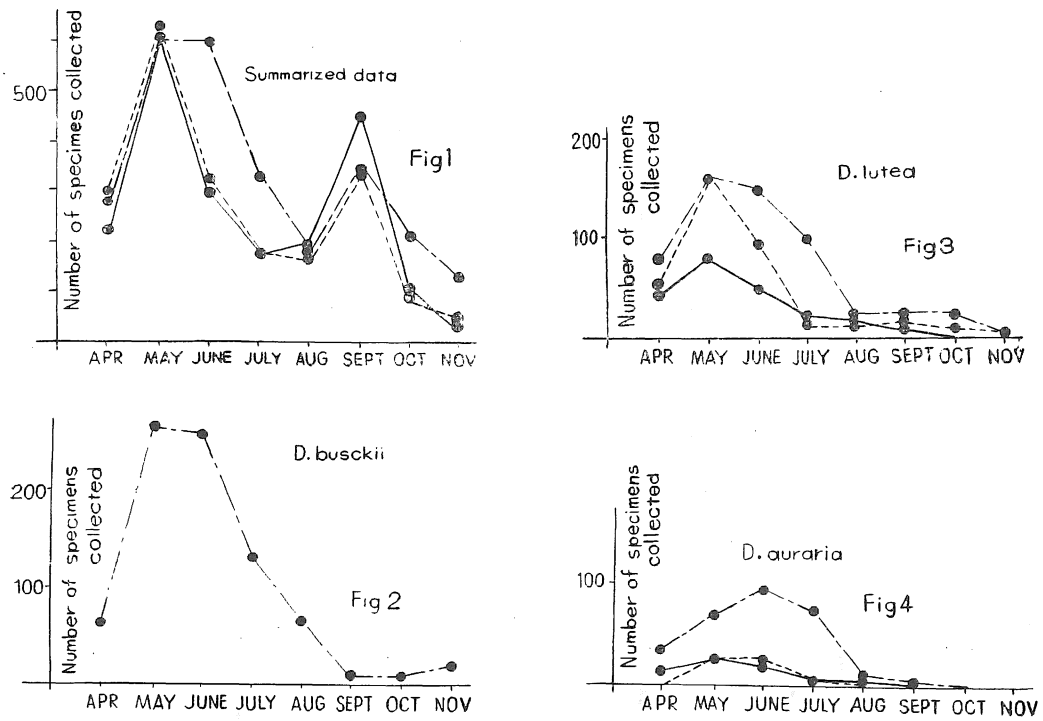
Fluctuation of population size: The population showed the bimodal curves of the seasonal activity each year. The first peak occurred in May (605 individuals, 28.89 per cent of total in 1957, 630 individuals, 30.49 per cent in 1958 and 604 individuals 22.62 per cent in 1959). The second peak appeared in September (469 individuals, 22.39 per cent of total in 1957, 325 individuals, 15.73 per cent in 1958 and 347 individuals, 12.99 per cent in 1959) (Fig. 1).

D. busckii: This species is domestic. Only 2 specimens were collected in the first two years. However, the species appeared as the most dominant species in 1959, culminating 831 in number of specimens (31.12 per cent of the total), and showed a monomodal curve marking the seasonal maxima in May (268 individuals) and in June (256 individuals) (Fig. 2).

D. lutea: This is one of the dominant spceies in Matsue and its adjacent localities (Wakahama 1960 a). Two hundred and thirty-five flies of this species were collected in 1957, 384 in 1958 and

593 in 1959. This species corresponds to 11.22 per cent of the total specimens in 1957, 18.58 per cent in 1958 and 22.20 per cent in 1959. This species was a typical spring-type species marking a monomodal peak in May (Fig. 3).

D. auraria: This species was not so abundant in the first two years, but showed a considerable increase in number in 1959. The total number of specimens of this species collected in 1957 was 78 representing 3.72 per cent of that of the total, 62, 3.00 per cent in 1958 and 289, 10.82 per cent in 1958 and 289, 10.82 per cent in 1959. The seasonal curve of this species was shown in monomodal like that of *D. lutea*. The seasonal peak appeared in May of 1957, and June of 1958, and in June of 1959 (Fig. 4).



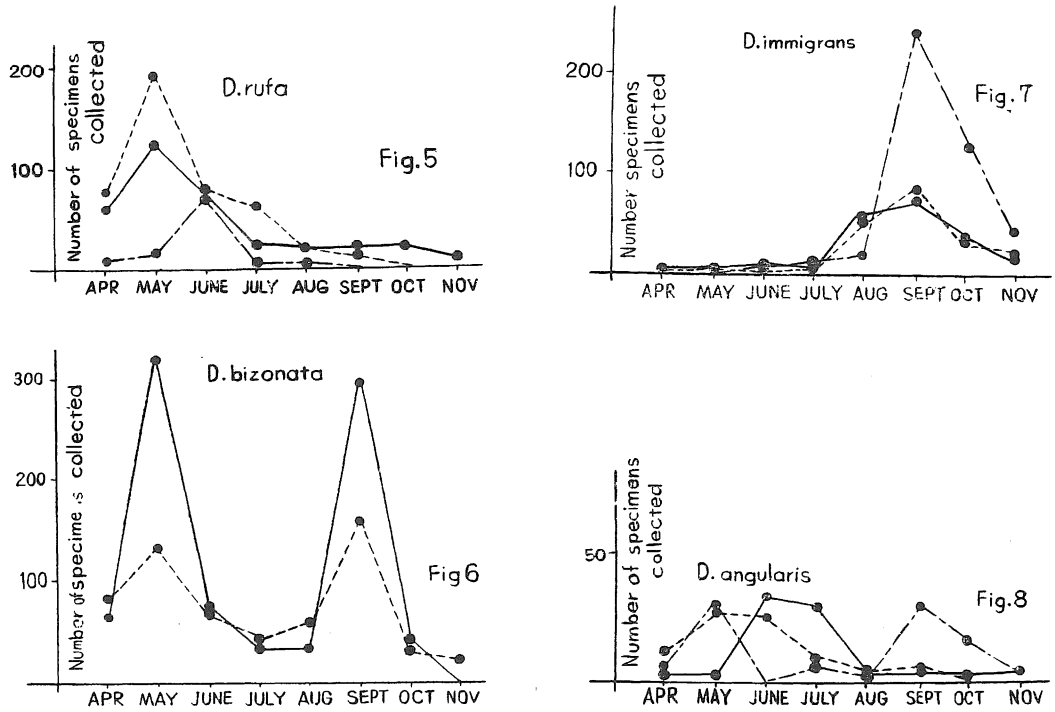
Figs 1-4. Graphs showing the seasonal activity of *Drosophila* observed in the Rakuzan Park, Matsue, in three successive years from 1957 to 1958; solid lines indicate the result of 1957, dotted lines those of 1958 and chain lines those of 1959. 1, summarized data from all species under observation. 2, *D. busckii*. 3, *D. lutea*. 4, *D. auraria*.

D. rufa: This also is one of the dominant species in the Rakuzan Park. In the total of 936 specimens, 376 were obtained in 1957, 454 in 1958, and 106 in 1959. They showed high frequencies, being 17.95 per cent in 1957, 21.97 per cent in 1958, marking remarkable decrease (0.39 per cent) in 1959. Seasonal curves of this species were monomodal. The peaks were observed in May in the first two years and in June of the third year (Fig. 5).

D. bizonata: This species was the most frequent in this park, but showed a quite low frequency in 1959. A total number of the collected flies of this species was 1440, including, respectively, 852, (40.68 per cent) in 1957, 586, (28.36 per cent), in 1958, and only 2, (0.07 per cent) in 1959. This species showed a bimodal curve in each of the first two years. The first peak was observed in May: the second peak appeared in September (Fig. 6).

D. immigrans: In the Rakuzan Park this species showed a moderate frequency in each of the first two years (206 specimens, 9.83 per cent in 1957 and 203 individuals, 9.82 per cent in 1958). But this species showed a considerable increase (501 individuals, 18.76 per cent) in 1959. This species is an Autumn-type, showing very low frequency during the spring, and marked the unimodal seasonal peak in September (Fig. 7).

D. angularis: This species occurs in a moderate number, too, in the Rakuzan Park. Eighty-five specimens (4.05 per cent) were collected in 1957, 89 (4.30 per cent) in 1958 and 105 3.93 per cent) in 1959. But this species showed a confusing type in the seasonal curves: that is, a monomodal type was observed in each of the first two years, the seasonal peak having been observed in June in 1957 and in May in 1958, while in 1959 this species showed a bimodal curve. The first peak occured in May, and the second peak in September (Fig. 8).



Figs. 5-8. Graphs showing the seasonal activity of *Drosophila*. 5, *D. rufa*. 6, *D. bizonata*. 7, *D. immigrans*. 8, *D. angularis*.

Discussion

Fluctuation of the population size of the *Drosophila* has been reported by many authors (Patterson 1943, Dobzhansky and Pavan 1950, Williams and Miller 1952, Basden 1955, Ohba 1956, Mather 1956, Nozawa 1956, and Wakahama 1956 and 1957). Most of the auhtors have observed the bimodal ones. The present author, however, descrived the monomodal curve in Sapporo, Hokkaido, Japan. No fly has been found in the field in Matsue from late November or early December to late March. In spite of a considerably long period of hibernation, the population showed the bimodal curve in a year. Nozawa (1956) observed four phases concerning the seasonal activity in Anjyo, in the central part of Japan; the first active phase, the summer resting phase, the second active phase, and the hibernating period. The variation of the population size observed

by the present author in Matsue exactly agreed with Nozawa's results.

The activity of each species showed considerable differences from locality to locality. From the other point the author divided four activity-types in Sapporo. Type-1 is unimodal activity-type represented by *D. auraria* and *D. immigrans*. Type-2 is bimodal type shown by *D. nigromaculata* and *D. transversa* (*D. angularis*+*D. brachynephros*). Type-3 is non-seasonal type observed in *D. lutea* and *D. melanogaster*. Type-4 is variant type found in *D. testacea* and *D. bifasciata*. In Matsue, *D. lutea*, *D. auraria*, *D. rufa* and *D. immigrans* were found to belong to type-1, *D. bizonata* to type-2, *D. busckii* to type-3, and *D. angularis* to type-4. Nozawa (1956) reported that *D. luter*, *D. auraria*, *D. rufa*, *D. transversa* and *D. immigrans* are the Spring-autumn type. *Drosophila coracina* belongs to the Summer-type, the Autumn-type is represented by *D. suzukii* (*D. pulchrella*), *D. melanogaster* and *D. bizonata*, and certain species of *immigrans* group is contained in the Winter-type. Further, in Sapporo, Spring-autumn-type is represented by *D. histrioides*, and *bifasciata*. *Drosophila nigromaculata*, *D. transversa*, *D. immigrans*, and *D. lutea* belong to the Autumn-type. *Drosophila lacertosa*, *D. sordidula*, *D. testacea* and *D. auraria* are referred to the Summer-type.

Table 1. Collection records from the Rakuzan Park, Matsue, from April to November 1957.

	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Amiota variegata	—	—	2	—	1	—	—	—	3
Mycodrosophila splendida	1	—	2	3	4	18	5	—	33
Parascaptomyza disticha	—	1	3	3	5	8	1	—	21
Drosophila histrioides	—	5	—	—	—	—	—	—	5
D. coracina	1	1	5	21	15	3	1	—	47
D. busckii	—	—	2	—	—	—	—	—	2
D. nipponica	—	3	—	4	2	2	—	—	11
D. suzukii	—	—	—	—	—	9	2	2	13
D. lutea	47	85	52	20	18	12	1	—	235
D. melanogaster	—	—	—	8	12	5	—	—	25
D. auraria	16	29	19	6	6	—	1	1	78
D. rufa	59	126	75	30	26	25	25	10	376
D. angularis	2	3	35	32	3	5	2	3	85
D. nigromaculata	8	9	3	—	2	2	1	—	25
D. bizonata	59	326	72	30	32	298	35	—	852
D. lmmigrans	2	3	7	7	56	78	35	18	206
D. virilis	8	3	5	2	5	—	—	—	23
D. lacertosa	11	5	7	6	5	2	—	3	39
D. sternopleuralis	1	4	2	1	—	—	—	—	8
D. sexvittata	2	—	—	—	—	—	—	—	2
D. virgata	—	—	—	—	—	2	—	—	2
undistinguished	—	2	1	—	—	—	—	—	3
TOTAL	217	605	292	173	192	469	109	37	2094

Comparing the results of the observations in the three localities noted above, *D. rufa*, *D. auraria* and *D. lutea* in both Matsue and Anjyo proved to be of the same type, but *D. lutea* in Sapporo was a quite contrast type (Autum-type). *Drosophila* immigrans was of the same type in both Matsue and Sapporo (Autumn-type), but was of the Spring-type in Anjyo. And *D. bizonata* also,

Table 2. Collection records from the Rakuzan Park, Matsue, from April to November 1958.

	Apr.	May	June	July	Aug.	Sept.	Oct	Nov.	Total
Leucophenga ornatipennis	—	—	—	1	—	—	—	—	1
Mycodrosophila splendida	—	—	—	—	—	15	2	—	17
Parascaptomyza disticha	3	5	2	4	5	3	1	—	23
Drosophila histrioides	—	1	—	—	—	—	—	—	1
D. sexvittata	—	—	8	—	—	—	—	—	8
D. coracina	5	22	13	—	3	2	—	—	45
D. suzukii	—	—	—	—	5	8	—	—	13
D. nipponica	—	10	4	15	—	—	—	—	29
D. lutea	62	169	98	10	13	15	12	5	384
D. melanogaster	—	—	1	13	8	—	—	—	22
D. auraria	—	29	30	3	—	—	—	—	62
D. rufa	75	198	86	65	20	10	—	—	454
D. angularis	12	28	25	10	5	9	—	—	89
D. nigromaculata	12	2	3	4	—	—	11	—	32
D. bizonata	79	135	65	39	59	165	26	18	586
D. immigrans	—	4	—	3	48	95	32	21	203
D. virilis	10	5	—	2	1	1	2	—	21
D. lacertosa	35	18	5	5	3	2	—	—	68
D. sternopleuralis	—	3	—	—	—	—	—	—	3
undistinguishhed	2	1	2	—	—	—	—	—	5
TOTAL	295	630	342	174	170	325	86	44	2066

Table 3. Collection records from the Rakuzan Park, Matsue, from April to November 1959.

	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Mycodrosophila splendida	—	—	—	—	1	10	5	5	21
Parascaptomyza disticha	3	5	3	2	—	1	5	4	23
Drosophila historiaides	—	2	—	—	—	—	—	—	2
D. sexvittata	—	—	—	—	—	—	1	—	1
D. coracina	5	10	5	—	—	—	—	—	20
D. busckii	65	268	256	127	69	11	10	25	831
D. snzukii	—	—	—	—	1	5	3	—	9
D. nipponica	—	3	—	—	2	—	—	3	8
D. lutea	79	167	152	104	26	26	28	11	593
D. melanogaster	—	1	10	15	8	2	—	—	36
D. auraria	38	72	86	73	16	4	—	—	289
D. rufa	8	19	72	3	4	—	—	—	106
D. angularis	5	34	—	7	2	34	18	5	105
D. nigromaculata	19	5	4	—	—	3	7	—	38
D. bizonata	—	—	—	—	—	—	2	—	2
D. immigrans	—	—	5	10	31	251	129	75	501
D. virilis	5	5	2	3	10	—	—	—	25
D. lacertosa	18	11	5	8	7	—	—	—	49
D. sternopleuralis	4	2	1	—	—	—	—	—	7
undistinguished	—	—	—	1	3	—	—	—	4
TOTAL	249	604	601	353	180	347	208	128	2670

presented the different types in Matsue and in Anjyo. *Drosophila angularis* was represented by theree different types in each of the localities. That is, no species showed the type common in three localities.

Based on the present results, it may be stated that the seasonal activity of *Drosophila* in Matsue is divided into the following three types: type-1 showing the seasonal maximum in Spring, type-2 marking the seasonal maximum in Autumn and type-3 with two yearly maxima. Type-1 is represented by *D. lutea*, *D. auraria*, *D. rufa*, *D. busckii* (1959) and *D. angularis* (1957 & 1958), type-2 by *D. immigrans*, and type-3 by *D. angularis* (1959) and *D. bizonata* (1957 & 1958).

Summary

The seasonal activity of *Drosophila* flies was observed in the Rakuzan Park, Matsue in three successive years (1957-1959). The results of the observations showed three types: type-1 of Spring-type, type-2 of Autumn-type and type-3 of bimodal type. Comparing the present data with the previous observations in Sapporo done by the author and those in Anjyo by Nozawa, there are no species that presented a type common throughout the three localities referred to in the present study.

References

Basden, E. B. 1955. Trans. Roy. Soc. Edin., 57: 603-654.

Dobzhabnsky, T. and C. Pavan 1950. J. Anim. Ecol., 19: 1-14.

Mather, W. B. 1956. Austr. J. Zool., 4: 65-75.

Moriwaki, D. et al. 1956. Studies on population genetics in *Drosophila* (in Japanese with Engulish rèsumè). Baifukan (Tokyo).

Nozawa, K. 1956. Jap. J. Ecol., 6: 1-6.

Okada, T. 1956. Systematic study of Drosophilidae and allied families of Japan. Gihodo (Tokyo).

Patterson, J. T. 1943. Univ. Texas Publ., No. 4313: 7-216.

Wakahama, K. 1956. Annot. Zool. Japon., 29: 161-164.

_____. 1957. Annot. Zool. Japon., 30: 217-224.

_____. 1960. Coll. Ess. Comm. Shimane Univ. (Natural Sci.)

Williams, D. D. and D. D. Millers 1951. Bull. Univ. Nebrasaka State Mus., 3: 1-19.