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Faunal and seasonal surveys on drosophilid flies by net sweeping in Ehime Prefecture, Shikoku, Japan

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A faunal survey on drosophilid flies by net sweeping was carried out in Ehime Prefecture, Shikoku, Japan from October 2009 to October 2010. A total of 11,663 individuals of 54 species belonging to 15 genera were collected by the year-round samplings at two localities, Dogo Park and Mt. Miyukiji, and occasional ones at another site in Matsuyama. The most abundant species was *Liodrosophila aerea* (49%), followed by *Drosophila rufa* (17%), *D. lutescens* (9.6%), *D. sternopleuralis* (4.0%) and *D. bizonata* (3.8%). The six dominant species showed more or less similar patterns in seasonal population fluctuation, being abundant in spring and/or fall with some variation between the localities. The observed seasonal patterns of drosophilid flies are discussed in relation to the extraordinary hot weather in the summer of 2010.

1. Introduction

Although the drosophilid fauna of the Japan Archipelago is better known (in total 307 species; Toda, 2006-2010) in comparison to other regions of the world, intensively explored areas are still limited. In Hokkaido, Momma, Toda and their collaborators have clarified the basic information on its drosophilid fauna and seasonality through the serial papers of "*Drosophila* survey of Hokkaido" and "Bionomics of Drosophilidae (Diptera) in Hokkaido". In addition, continuous ecological studies of drosophilid species in Hokkaido have been carried out on daily activity, migration, food preference, diapause, etc. (Toda, 1973; Kimura, 1988; Kimura and Toda, 1989; Kimura and Beppu, 1993). Toda (1984) compared guild structure between drosophilid communities in Morioka, Iwate Prefecture and Kiyosumi, Chiba Prefecture. In the central part of Japan, faunal and ecological surveys were carried out in Shiga Height, Nagano Prefecture and Imperial Palace grounds, Tokyo (Beppu, 2000, 2001, 2006). Drosophilid faunas of subtropical islands were relatively intensively surveyed on the Ogasawara Islands (Watada et al., 2011), and Iriomote-jima and Kume-jima of the Ryukyu Islands (Hirai et al., 2000; Kondo and Kimura, 2008).

On the other hand, only few fragmentary information has been brought from the western mainland of Japan on its drosophilid fauna. Watada et al. (2000) revealed the predominance of two sibling species, *Drosophila simulans* and *D. albomicans*, in domestic and semi-domestic areas in Ehime Prefecture, using banana-bait traps; *D. albomicans* that was originally a tropical and subtropical species was dominant from the summer to the fall in the urban area in Matsuyama, while *D. simulans* was the most abundant from October to December. By banana trap collections, Hoshina and Watada (2001) studied distribution of drosophilid flies in natural forests and Japanese cedar forests at several localities in Ehime, and showed the predominance of *D. immigrans* in both types of the forests. Along with these results, the two previous studies by banana-bait trapping, in combination, brought faunal records of 28 species belonging to three genera (*Drosophila*, *Scaptodrosophila* and *Styloptera*) from Ehime Prefecture. It is, however, very difficult to reveal the entire fauna of drosophilid flies by banana trap collection, because a number of drosophilid species are not attracted to banana-bait traps. In the present study, we collected drosophilid flies by net sweeping in a semi-natural park and along

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a trail on a small mountain in Matsuyama.

2. Collection localities and methods

Drosophilid flies were collected from October 2009 to October 2010 in Matsuyama (33°N, 132°E), by net sweeping at two localities (Dogo Park and Mt. Miyukiji) in Matsuyama, Ehime Prefecture. The two localities are only 1.5 km apart from each other. Dogo Park is a semi-natural woods with a small hill (71 m in altitude) located in an urban area, and Mt. Miyukiji is a small mountain (165 m in altitude), both being close to a small mountain range. Sweeping was made with an insect net along trails of nearly the same length (700 m) at both localities. In addition, three occasional collections were made at the third locality, Matsuyama General Park, with many planted camellia trees but less weeds. Collections were usually made four times a month at Dogo Park and Mt. Miyukiji, but more frequently, eight to 15 times, in each of several early months of the collection period (Tables 1 and 2). To compare seasonal changes in

Table 1 : Number of drosophilid flies monthly collected at Dogo Park

Year	2009			2010										
Drosophilid species/Month	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	**Total**
Steganinae														
Portica magna	3	–	–	–	–	1	1	–	–	–	–	–	–	**5**
P. okadai	6	–	–	–	–	1	5	–	1	–	–	–	–	**13**
Leucophenga angusta	3	1	–	–	–	–	–	–	1	–	–	4	1	**10**
L. bellula	2	–	–	–	–	–	–	–	–	–	–	–	–	**2**
L. concilia	–	–	1	–	–	–	–	–	–	–	–	–	–	**1**
L. interrupta	10	1	–	–	–	1	–	3	4	1	1	–	1	**22**
L. maculata	3	1	–	–	–	1	–	1	–	–	–	–	–	**6**
L. orientalis	4	1	–	–	–	7	–	–	–	–	–	–	–	**12**
L. ornata	1	–	–	–	–	–	–	1	–	–	–	–	–	**2**
Drosophilinae														
Microdrosophila (*Mi.*) *maculata*	–	1	–	–	–	1	–	–	–	–	–	–	–	**2**
Mi. (*Mi.*) *pseudopleurolineata*	1	11	6	3	2	2	31	2	–	3	1	1	1	**64**
Mi. (*Oxystyloptera*) *urashimae*	–	–	–	1	–	2	33	4	–	–	–	–	–	**40**
Liodrosophila aerea	193	1110	561	153	371	895	641	616	147	37	–	53	276	**5053**
Li. castanea	–	–	–	–	–	–	–	–	–	1	–	–	–	**1**
Dichaetophora acutissima	–	27	18	9	34	67	33	2	2	–	–	1	–	**193**
Mycodrosophila gratiosa	2	3	1	–	1	–	1	1	1	1	–	1	–	**12**
Paramycodrosophila nakamurai	–	–	–	–	–	–	2	3	2	–	–	–	–	**7**
Collessia kirishimana	–	–	–	–	–	–	–	–	–	4	–	–	–	**4**
Scaptomyza (*Parascaptomyza*) *pallida*	2	1	2	–	–	–	15	38	–	–	–	–	–	**58**
Sc. (*Scaptomyza*) *graminum*	3	1	–	1	–	3	2	7	–	–	–	–	–	**17**
Zaprionus (*Aprionus*) *aungsani*	1	–	–	–	–	–	–	–	–	–	–	–	–	**1**
Scaptodrosophila coracina	–	–	–	–	–	25	15	5	–	–	–	–	1	**46**
Sa. subtilis	–	–	–	–	–	10	7	–	–	–	–	–	–	**17**
Sa. sp.	5	11	2	–	–	–	–	–	–	1	1	–	1	**21**
Hirtodrosophila mediohispida	–	–	–	–	–	1	–	–	–	–	–	–	–	**1**
Drosophila (*Sophophora*) *tukubaensis*	–	–	–	–	–	1	3	–	–	–	–	–	–	**4**
D. (*S.*) *oshimai*	–	1	–	–	10	70	3	–	–	–	–	–	–	**84**
D. (*S.*) *subpulchrella*	–	2	1	–	–	2	1	–	–	–	–	–	–	**6**
D. (*S.*) *suzukii*	11	14	8	8	4	36	16	–	1	–	–	–	–	**98**
D. (*S.*) *lutescens*	7	23	29	15	35	156	525	155	55	–	–	–	2	**1002**
D. (*S.*) *simulans*	1	–	–	–	–	–	–	–	–	–	–	–	–	**1**
D. (*S.*) *ficusphila*	16	15	3	–	1	3	–	–	–	–	–	–	1	**39**
D. (*S.*) *auraria*	–	–	–	–	1	9	7	6	47	12	1	–	–	**83**
D. (*S.*) *biauraria*	–	–	–	–	–	1	1	–	–	–	–	–	–	**2**
D. (*S.*) *rufa*	89	273	93	31	103	211	167	273	87	150	–	3	38	**1518**
D. (*Drosophila*) *hydei*	–	–	–	–	–	2	–	1	–	–	–	–	–	**3**
D. (*D.*) *brachynephros*	6	7	–	–	–	1	1	–	–	1	–	–	–	**16**
D. (*D.*) *nigromaculata*	–	–	–	–	–	–	–	1	–	–	–	–	–	**1**
D. (*D.*) *bizonata*	85	59	14	3	6	16	8	7	6	21	1	13	12	**251**
D. (*D.*) *sternopleuralis*	7	26	5	2	6	221	99	27	10	1	–	5	29	**438**
D. (*D.*) *albomicans*	12	38	6	–	–	–	–	–	–	2	–	–	2	**60**
D. (*D.*) *annulipes*	–	2	1	2	–	–	–	–	–	–	–	1	–	**6**
D. (*D.*) *curviceps*	–	1	3	2	2	85	37	8	2	–	–	–	–	**140**
D. (*D.*) *immigrans*	11	16	4	2	–	10	38	103	34	1	–	–	–	**219**
D. (*Dorsilopha*) *busckii*	–	–	–	–	–	1	1	5	1	1	–	–	–	**9**
Total number of individuals	484	1646	758	232	576	1842	1693	1269	401	237	5	82	365	**9590**
Number of species	25	23	16	13	13	30	26	22	16	15	5	9	12	**45**
Number of collections	13	15	8	5	2	8	4	4	4	4	4	4	4	

population density among six dominant species, the numbers of their collected individuals were standardized by four times of collection per month (Figs 1 and 2). Most of collected flies were transferred into 70% alcohol and classified under a dissection microscope. Females of *D. lutescens* and *D. takahashii* that were morphologically indistinguishable were individually cultured, and males of their F1 progenies were used for species identification. It was impossible to identify females of *Amiota* species that could be neither distinguished morphologically nor bred in laboratory. Then, females of *Amiota* species were pooled as *Amiota* spp. in Table 2.

3. Results and discussion

3.1 Drosophilid fauna in Ehime

A total of 11,590 individuals of 53 species belonging to 15 genera in 2 subfamilies (9,590 individuals, 45 species, 13 genera at Dogo Park, and 2,000 individuals, 43 species, 14 genera on Mt. Miyukiji) were collected in the present study (Tables 1–3). As for the genus *Amiota*, all individuals of this genus were collected at the same point of Mt. Miyukiji and included males of

Table 2 : Number of drosophilid flies monthly collected on Mt. Miyukiji

Year	2009			2010										
Drosophilid species/Month	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	**Total**
Steganinae														
Stegana (*Steganina*) *nigrifrons*	–	–	1	–	–	–	–	–	–	–	–	–	–	**1**
Amiota furcata	–	–	–	–	–	–	–	–	1	1	–	–	–	**2**
A. spp. ♀	–	–	–	–	–	–	–	1	1	1	–	–	–	**3**
Phortica magna	1	–	–	–	1	6	2	1	2	1	–	–	–	**14**
P. okadai	8	1	–	–	–	1	–	–	2	15	3	1	–	**31**
P. sp. aff. *glabra*	–	–	–	–	–	–	–	–	–	–	–	–	1	**1**
Leucophenga angusta	3	2	–	–	–	–	–	2	1	–	–	15	1	**24**
L. bellula	2	–	1	–	–	–	–	–	–	–	–	–	–	**3**
L. interrupta	23	2	–	–	–	–	–	–	–	4	–	–	–	**29**
L. maculata	–	2	–	–	–	–	–	1	1	–	1	–	–	**5**
L. orientalis	4	–	–	–	–	–	1	–	–	–	–	–	1	**6**
L. ornata	–	–	–	–	–	–	–	–	1	1	–	–	–	**2**
Drosophilinae														
Microdrosophila (*Mi.*) *pseudopleurolineata*	2	2	–	–	–	–	–	–	–	–	–	2	1	**7**
Liodrosophila aerea	34	124	163	33	56	10	3	68	10	25	–	21	74	**621**
Dichaetophora acutissima	–	2	9	1	1	–	1	–	–	–	–	–	–	**14**
Di. delicata	1	–	–	–	–	–	–	–	–	–	–	–	–	**1**
Mycodrosophila gratiosa	–	–	1	–	–	–	–	–	3	76	–	–	1	**81**
My. planipalpis	–	–	–	–	–	–	–	1	1	–	–	–	–	**2**
My. poecilogastra	–	–	–	–	–	–	–	1	–	23	–	–	–	**24**
Paramycodrosophila nakamurai	–	–	–	–	–	–	–	2	1	2	–	–	–	**5**
Collessia kirishimana	–	–	–	–	–	–	–	–	–	2	–	–	–	**2**
Scaptomyza (*Parascaptomyza*) *pallida*	1	–	4	8	–	–	5	2	–	–	–	–	–	**20**
Sc. (*Scaptomyza*) *graminum*	1	–	1	–	–	–	–	–	–	–	–	–	–	**2**
Scaptodrosophila coracina	–	1	–	–	–	–	–	–	1	–	–	–	–	**2**
Sa. subtilis	–	2	–	–	–	–	–	–	–	–	1	–	–	**3**
Sa. sp.	9	1	3	–	–	–	–	–	–	7	–	–	–	**20**
Hirtodrosophila mediohispida	–	–	1	–	–	–	–	–	–	–	–	–	–	**1**
Drosophila (*Sophophora*) *oshimai*	–	–	–	–	–	–	–	1	–	–	–	–	–	**1**
D. (*S.*) *subpulchrella*	–	–	2	–	–	1	–	–	–	–	–	–	–	**3**
D. (*S.*) *suzukii*	19	17	34	3	7	–	1	–	–	–	–	–	–	**81**
D. (*S.*) *lutescens*	7	21	29	–	1	–	1	31	13	3	–	–	2	**108**
D. (*S.*) *takahashii*	–	–	–	–	–	–	–	–	–	3	1	–	–	**4**
D. (*S.*) *melanogaster*	1	–	–	–	–	–	–	–	–	–	–	–	–	**1**
D. (*S.*) *ficusphila*	9	3	8	1	–	–	–	–	–	–	–	–	–	**21**
D. (*S.*) *auraria*	–	–	–	–	–	–	–	1	–	21	–	–	–	**22**
D. (*S.*) *rufa*	18	26	45	1	5	1	–	55	25	301	3	–	9	**489**
D. (*Drosophila*) *brachynephros*	8	–	–	–	–	–	–	–	–	11	–	–	–	**19**
D. (*D.*) *bizonata*	61	13	10	–	6	2	1	6	3	66	4	6	8	**186**
D. (*D.*) *sternopleuralis*	–	3	7	2	3	1	1	1	6	–	–	1	5	**30**
D. (*D.*) *albomicans*	1	2	2	–	–	–	–	–	–	–	–	–	1	**6**
D. (*D.*) *annulipes*	2	–	2	2	1	–	–	–	1	–	–	–	–	**8**
D. (*D.*) *curviceps*	–	–	–	–	–	–	2	27	–	–	–	–	–	**29**
D. (*D.*) *immigrans*	–	2	11	–	–	–	1	39	7	2	–	–	–	**62**
D. (*Dorsilopha*) *busckii*	–	–	–	–	–	–	–	4	–	–	–	–	–	**4**
Total number of individuals	215	226	334	51	81	22	19	244	80	565	13	46	104	**2000**
Number of species	21	18	19	8	9	7	11	18	17	18	6	6	11	**43**
Number of collections	8	3	8	4	4	3	4	4	4	4	4	4	4	

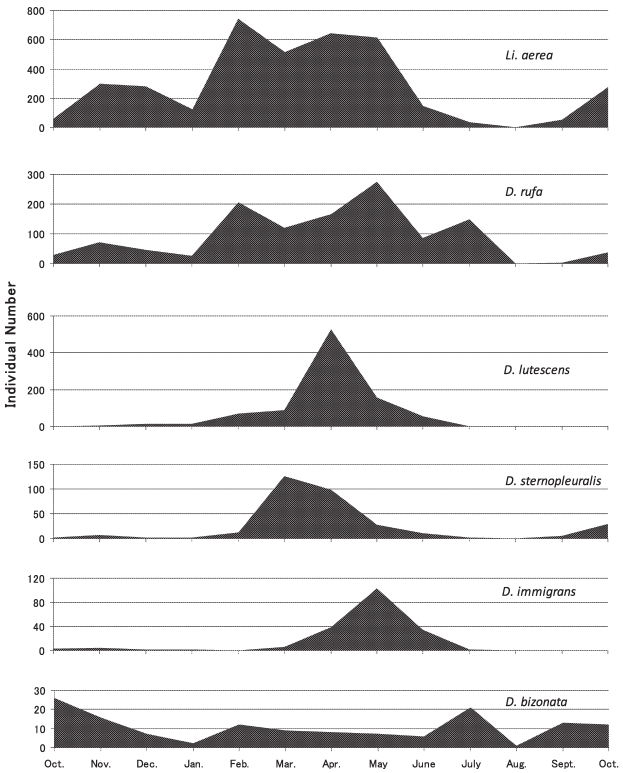


Figure 1 : Seasonal fluctuation patterns of six dominant drosophilid species collected from October, 2009 to October, 2010 at Dogo Park.

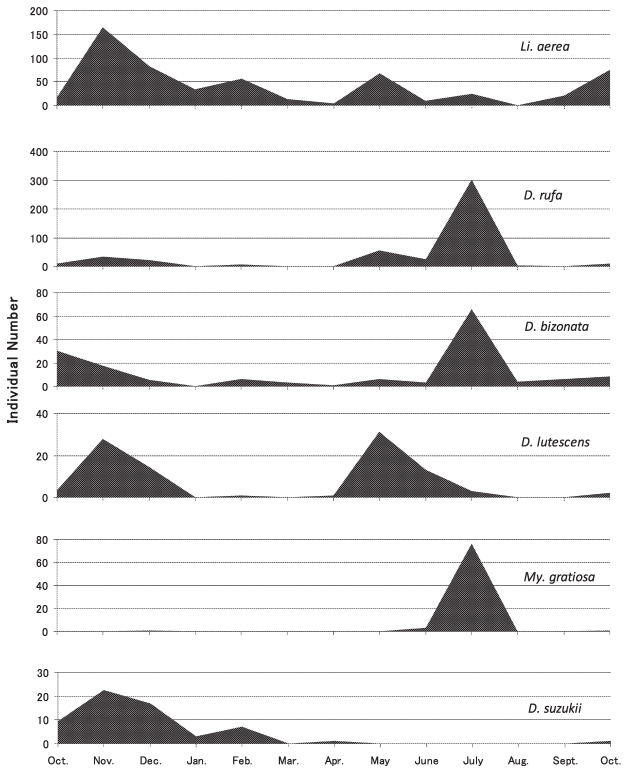


Figure 2 : Seasonal fluctuation patterns of six dominant drosophilid species collected from October, 2009 to October, 2010 on Mt. Miyukiji.

Table 3 : Number of drosophilid flies collected in Matsuyama General Park

Year	2009	2010		
Drosophilid species/Month	Oct.	Apr.	May	**Total**
Steganinae				
Leucophenga angusta	1	–	1	**2**
L. maculata	1	–	–	**1**
L. orientalis	3	–	–	**3**
Drosophilinae				
Liodrosophila aerea	13	–	1	**14**
Paramycodrosophila nakamurai	–	–	1	**1**
Scaptomyza (*Parascaptomyza*) *pallida*	–	9	–	**9**
Drosophila (*Sophophora*) *suzukii*	–	2	–	**2**
D. (*S.*) *lutescens*	–	1	12	**13**
D. (*S.*) *ficusphila*	1	–	–	**1**
D. (*S.*) *rufa*	6	–	–	**6**
Drosophila (*Drosophila*) *guangdongensis*	1	–	–	**1**
D. (*D.*) *bizonata*	13	–	1	**14**
D. (*D.*) *sternopleuralis*	–	–	2	**2**
D. (*D.*) *annulipes*	1	–	–	**1**
D. (*D.*) *curviceps*	–	1	1	**2**
D. (*D.*) *immigrans*	–	–	1	**1**
Total number of individuals	40	13	20	**73**
Number of species	9	4	8	**16**

only *A. furcata*. Therefore, the remaining female specimens would be of *A. furcata* as well. Combining these results with the previous records by Okada (1988), Watada et al. (2000) and Hoshina and Watada (2001), a list of 79 drosophilid species belonging to 16 genera so far recorded from Ehime Prefecture is presented in Table 4. Of them, two are undescribed new species. *Phortica* sp. aff. *glabra* belongs to the *P. foliiseta* species complex that is distributed in subtropical and tropical regions from Taiwan to New Guinea (Toda, 2006–2010); only one species, *P. speculum* (Máca & Lin, 1993), has been recorded from Japan (Iriomote-jima). *Scaptodrosphila* sp. is widely distributed in western Japan (Watada, unpublished data). A new record from Japan is *D. guangdongensis* collected in Matsuyama General Park. In addition, the following seven species were newly recorded from Shikoku: *Stegana nigrifrons*, *Microdrosophila pseudopleurolineata*, *Liodrosophila castanea*, *Dichaetophora delicata*, *Mycodrosophila planipalpis*, *Zaprionus aungsani* and *Hirtodrosophila mediohispida*. *Drosophila takahashii*, which had been recorded in southern Ehime (Watada et al., 2000) and Kochi (Okada, 1988), was collected from Matsuyama for the first time in the summer of 2010, suggesting that its distribution range is expanding to north in Shikoku.

Liodrosophila aerea was the most dominant species, occupying 53% of the total sample collected at Dogo Park and 31% on Mt. Miyukiji. Such extraordinary abundance of this species is a remarkable characteristic of the samples obtained by net

Table 4 : Drosophilid species recorded in Ehime Prefecture, Shikoku

	Species	References†		Species	References†
1	*Stegana nigrifrons* de Meijere, 1911*		41	*H. histrioides* (Okada & Kurokawa, 1957)	1)
2	*Amiota furcata* Okada, 1971		42	*H. mediohispida* (Okada, 1967)*	
3	*Phortica magna* (Okada, 1960)		43	*H. omogoensis* (Okada, 1956)	1)
4	*P. okadai* (Máca, 1977)		44	*H. quadrivittata* (Okada, 1956)	1)
5	*P.* sp. aff. *glabra****		45	*Drosophila* (*Sophophora*) *bifaciata* Pomini, 1940	3)
6	*Leucophenga actipollinosa* Okada, 1987	1)	46	*D.* (*S.*) *tukubaensis* Takamori & Okada, 1983	
7	*L. angusta* Okada, 1956		47	*D.* (*S.*) *oshimai* Choo & Nakamura, 1973	
8	*L. bellula* (Bergroth, 1894)		48	*D.* (*S.*) *subpulchrella* Takamori & Watabe, 2006,	
9	*L. concilia* Okada, 1956		49	*D.* (*S.*) *suzukii* (Matsumura, 1934)	
10	*L. interrupta* Duda, 1924		50	*D.* (*S.*) *lutescens* Okada, 1975	
11	*L. maculata* (Dufour, 1839)		51	*D.* (*S.*) *takahashii* Sturtevant, 1927	
12	*L. orientalis* Lin & Wheeler, 1972		52	*D.* (*S.*) *melanogaster* Meigen, 1830	
13	*L. ornata* Wheeler, 1959		53	*D.* (*S.*) *simulans* Sturtvant, 1919	
14	*Microdrosophila* (*Microdrosophila*) *maculata* Okada, 1960		54	*D.* (*S.*) *ficusphila* Kikkawa & Peng, 1938	
15	*Mi.* (*Mi.*) *pseudopleurolineata* Okada, 1968*		55	*D.* (*S.*) *auraria* Peng, 1937	
16	*Mi.* (*Oxystyloptera*) *urashimae* Okada, 1960		56	*D.* (*S.*) *biauraria* Bock & Wheeler, 1972	
17	*Liodrosophila aerea* Okada, 1956		57	*D.* (*S.*) *kikkawai* Burla, 1954	1)
18	*Li. castanea* Okada & Chung, 1960*		58	*D.* (*S.*) *rufa* Kikkawa & Peng, 1938	
19	*Dichaetophora acutissima* (Okada, 1956)		59	*D.* (*S.*) *triauraria* Bock & Wheeler, 1972	1)
20	*Di. delicata* (Nishiharu, 1981)*		60	*D.* (*Drosophila*) *guangdongensis* Toda & Peng, 1989**	
21	*Di. tenuicauda* (Okada, 1956)	1)	61	*D.* (*D.*) *virilis* Sturtevant, 1916	2)
22	*Mycodrosophila gratiosa* (de Meijere, 1911)		62	*D.* (*D.*) *tsigana* Burla & Gloor, 1952	1)
23	*My. palmata* Okada, 1956	1)	63	*D.* (*D.*) *lacertosa* Okada, 1956	2)
24	*My. planipalpis* Kang, Lee & Bahng, 1966*		64	*D.* (*D.*) *neokadai* Kaneko & Takada, 1966	3)
25	*My. poecilogastra* (Loew, 1874)		65	*D.* (*D.*) *hydei* Sturtvant, 1921	
26	*My. shikokuana* Okada, 1956	1)	66	*D.* (*D.*) *daruma* Okada, 1956	2)
27	*Styloptera nishiharui* Okada, 1982	3)	67	*D.* (*D.*) *angularis* Okada, 1956	1)
28	*Paramycodrosophila nakamurai* Okada, 1973		68	*D.* (*D.*) *brachynephros* Okada, 1956	
29	*Collessia kirishimana* (Okada, 1967)		69	*D.* (*D.*) *nigromaculata* Kikkawa & Peng, 1938	
30	*Scaptomyza* (*Parascaptomyza*) *elmoi* Takada, 1970	1)	70	*D.* (*D.*) *unispina* Okada, 1956	3)
31	*Sc.* (*Para.*) *pallida* (Zetterstedt, 1847)		71	*D.* (*D.*) *testacea* von Roser, 1840	1)
32	*Sc.* (*Scaptomyza*) *consimilis* Hackman, 1955	1)	72	*D.* (*D.*) *bizonata* Kikkawa & Peng, 1938	
33	*Sc.* (*Sc.*) *graminum* (Fallén, 1823)		73	*D.* (*D.*) *histrio* Meigen, 1830	1)
34	*Zaprionus* (*Anaprionus*) *aungsani* Soe Wynn & Toda, 1988*		74	*D.* (*D.*) *sternopleuralis* Okada & Kurokawa, 1957	
35	*Z.* (*A.*) *grandis* (Kikkawa & Peng, 1938)	1)	75	*D.* (*D.*) *albomicans* Duda, 1924	
36	*Scaptodrosophila coracina* (Kikkawa & Peng, 1938)		76	*D.* (*D.*) *annulipes* Duda, 1924	
37	*Sa. subtilis* (Kikkawa & Peng, 1938)		77	*D.* (*D.*) *curviceps* Okada & Kurokawa, 1957	
38	*Sa. throckmortoni* (Okada, 1973)	1)	78	*D.* (*D.*) *immigrans* Sturtvant, 1921	
39	*Sa.* sp.***		79	*D.* (*Dorsilopha*) *busckii* Conquillett, 1901	
40	*Hirtodrosophila alboralis* (Momma & Takada, 1954)	1)			

† References: 1) Okada (1988), 2) Watada et al. (2000), 3) Hoshina and Watada (2001); unless noted, the species was recorded in this study. New records: *new to Shikoku, **new to Japan, ***new species.

sweeping in the surveyed area, compared with samples from other areas such as the Imperial Palace of Tokyo (Beppu, 2006) and Iriomote-jima of the Ryukyu Islands (Hirai et al., 2000), where *Li. aerea* occupied only 1.6% and 1.8%, respectively. The second abundant species was *D. rufa* (17%), followed by *D. lutescens* (9.6%), *D. sternopleuralis* (4.0%) and *D. bizonata* (3.8%). The relative frequencies of these species are similar to those observed in the Imperial Palace (Beppu, 2006), where *D. rufa* occupied 14%, *D. lutescens* 8.5%, *D. sternopleuralis* 6.8% and *D. bizonata* 4.3%.

In spite of the five times difference in the total number of collected individuals between Dogo Park (9,590) and Mt. Miyukiji (2,000), the total numbers of species were nearly the same, 45 species in Dogo Park and 43 species on Mt. Miyukiji. However, the species composition was somewhat different between the two localities, with ten species (*Leucophenga concilia, Microdrosophila maculata*, *Mi. urashimae*, *Li. castanea*, *Z. aungsani*, *D. tsukubaensis*, *D. simulans*, *D. biauraria*, *D. hydei* and *D. nigromaculata*) collected only in Dogo Park and six species (*St. nigrifrons*, *A. furcata*, *P.* sp. aff. *glabra*, *Di. delicata*, *My. planipalpis* and *My. poecilogastra*) collected only on Mt. Miyukiji. A part of these faunal characteristics reflected differences in richness of the subfamily Steganinae and the genus *Mycodrosophila* between the two localities: 73 individuals representing nine species of two steganine genera and 12 individuals of one species of *Mycodrosophila* were collected in Dogo Park, whereas 121 individuals of 11 species of four steganine genera and 107 individuals of three species of *Mycodrosophila* on Mt. Miyukiji. The richness of these species on Mt. Miyukiji

should be due to abundance of their food substances such as leaves, tree sap and fungi there.

3.2 Seasonal changes

Seasonal changes in the number of individuals collected per month at Dogo Park and on Mt. Miyukiji are shown, separately for each of the six dominant species at each locality, in Figs 1 and 2, respectively. *Liodrosophila aerea*, the most dominant species, was abundant in the spring and the fall, though two times more in the spring than in the fall, at Dogo Park, but was abundunt only in the fall on Mt. Miyukiji. *Drosophila rufa* was similar to *Li. aerea* in the seasonal fluctuation pattern at Dogo Park, but was quite different from it on Mt. Miyukiji showing only one peak in July. The patterns of *D. lutescens* and *D. bizonata* were also different between the two localities. *Drosophila lutescens* was abundant in November and May on Mt. Miyukiji, but had a large peak in April at Dogo Park. On Mt. Miyukiji, the numbers of collected individuals of *D. bizonata* and *My. gratiosa* were the most abundant in July of 2010. Most individuals of these species were collected from white fungi that grew on fallen trees. *Drosophila sternopleuralis* and *D. immigrans* showed a peak in March and in May, respectively, at Dogo Park. *Drosophila suzukii* occured from the fall to the winter, being relatively abundant in the fall, on Mt. Miyukiji.

The number of collected flies in August and September of 2010 was the least among the 13 months of survey period. According to the records of Matsuyama Local Meteorological Observatory, the monthly mean air temperature of August, 2010 in Matsuyama was 29.7 ℃ and the monthly precipitation was 4.5 mm, being the highest and the third least, respectively, since the first observation in 1890 there. The drastic decrease of collected flies in August and September of 2010 seems to have reflected this extraordinarily severe condition. Even in usual summers, the population densities of many drosophilid species decrease at lowlands of central mainland of Japan, and some species such as *D. oshimai* and *D. suzukii* are considered to migrate from lowlands to highlands in summer (Beppu, 2006). Likely, some species would have escaped from the severe summer conditions by migrating from the collection localities to the backyard mountain range.

Usually, banana-bait trapping is not so effective to collect drosophilid flies in mid winter even in relatively warm areas of central to southern Japan (e.g., Toda, 1979; Watada et al., 2000): Toda (1979) collected drosophilid flies in January at Kariya, Aichi Prefecture by banana-bait trapping and net sweeping, and obtained 219 individuals by net sweeping and 20 individuals by trapping. This suggests that net sweeping is more effective than banana-bait trapping in winter in the mainland of Japan. In the present study as well, drosophilid flies collected from January to February at Dogo Park were more than those in August and September of 2010 there; many *Camellia japonica* trees bloomed from the late January to March at Dogo Park, and a lot of drosophilid flies were collected from March to May on its fallen flowers. Most individuals of *D. lutescens* and *D. sternopleuralis* were collected from the fallen flowers in winter at Dogo Park. On the other hand, only few drosophilid flies were collected in March and April was on Mt. Miyukiji, probably due to lack of *C. japonica* trees there.

We collected many drosophilid flies at the two localities of Matsuyama by year-round net sweeping, with discovery of the following new records: two species new to science, one to Japan and seven to Shikoku. In the present study, however, seasonal population fluctuation patterns were preliminarily described only for eight dominant species, based on samples collected by net sweeping conducted in the not strictly quantitative way. It is necessary to conduct sampling in more quantitive ways, for example by standardizing the number of sweeps per sampling, and to analyze the reproductive age structure of populations in order to understand the phenological properties of drosophilids in a warm-temperate region of southern Japan. In addition, more extensive surveys in different environments will bring more new findings of drosophilid faunal components in Ehime Prefecture.

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