Proceedings of the Sixth International Conference on Urban Pests
William H Robinson and Dániel Bajomi (editors), 2008
Printed by OOK-Press Kft., H-8200 Veszprém, Pápai út 37/a, Hungary

CHRONOMIDS (DIPTERA: CHIRONOMIDAE) ATTRACTED TO VENDING MACHINES IN THE MIDDLE REACHES OF THE SHINANO RIVER, JAPAN

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Abstract The species composition and abundance of chironomid midges attracted to the illuminated showcase of a vending machine, set on the riverside in the middle reaches of the Shinano River (Ueda City, Nagano Prefecture, Japan), were investigated. A total of 4,439 midges (1,719 males and 2,720 females) were collected on the showcase of the machine (110 × 85 cm^2) for 20 minutes a day beginning at 20:00, everyday from March 28 to December 1, 2006. Males were identified as belonging to 92 species, of which the three most abundant were *Chironomus kiiensis* (379 males and 125 females: 11.4%), *Polypedilum nubifer* (236 males and 372 females: 13.7%) and *Smittia aterrima* (184 males and 254 females: 9.9%), accounting for 34.9% of the total Chironomidae abundance. The daily total Chironomidae abundance showed the highest peak in late August and showed the maximum attraction of 215.0 ind./20 min./m^2 (201 ind./20 min./110 × 85 cm^2) on August 23. *C. kiiensis* was collected from late June to mid-September, and its daily abundance was highest in late August. *P. nubifer* was collected from late June to late September and its daily abundance showed two distinct peaks, the earlier one in mid-July and the later one in late August. *S. aterrima* was collected from mid-September to early December, the end of the study period, and was abundant in November. Daily abundances of total Chironomidae, *C. kiiensis* and *P. nubifer* showed significant positive correlations with daily mean air temperature, whereas *S. aterrima* showed a significant negative correlation.
Key Words phototactic attraction, midges, seasonal abundance

INTRODUCTION

Vending machines, especially those that sell canned or bottled drinks, are popular in some countries and contribute to social convenience and economy. In Japan, more than 5.5 million vending machines are in place and their total annual turnover exceeds 6.8 trillion Japanese yen (approximately $570 billion USD), the highest sales among countries throughout the world (Japan Vending Machine Manufacturers Association, 2007). Because vending machines are often set outside to sell merchandise all day, their illumination sometimes causes nuisance attraction of insects with positive phototaxis. The attracted insects may reduce both the interest of potential customers and the income of the machines by the revolting appearance of insect swarms, and may increase maintenance cost for cleaning due to accumulation of carcasses.

Flying adults of swarming aquatic insects are often attracted to light and therefore cause commercial losses as nuisance pests (Watanabe et al., 1998). Chironomid midges are one of the major taxa of such insects (Tabaru et al., 1987; Ali, 1995). The family Chironomidae contains more than 10,000 species and has worldwide distribution (Langton and Pinder, 2007). Chironomid larvae are frequently the most abundant group of insects in freshwater environments (Pinder, 1986), although a part of the species is terrestrial (Wiederholm, 1989). In Japan, the species composition, population dynamics and emergence of chironomids have been investigated in various aquatic habitats: lakes (Yamagishi and Fukuhara, 1971; Iwakuma, 1992; Kawai et al., 2002; Hirabayashi et al., 2003), rivers (Kondo and Sasa, 1994; Kawai et al., 1997; Inoue et al., 2005), and rice paddy area (Kikuchi et al., 1985; Takamura, 1996). Most of such studies did not aim to evaluate phototactic attraction of chironomids to vending machines, but the attraction differs greatly both among sites and among seasons (Hirabayashi et al., 2001). In addition to assessing the source of occurrence, continuous monitoring of species composition and abundance is a first step for drafting a plan to prevent nuisance attraction of chironomid midges.

In this study, we investigated the species composition and abundance of chironomid midges attracted to illumination of a common vending machine to clarify the real state of affairs in the study area.

MATERIALS AND METHODS

Study Site

We selected a drink vending machine (DyDo DRINKO, Inc.), set on the riverside in the middle reaches of the Shinano River (450 m a.s.l.; 36°23′N, 138°15′E; Ueda City, Nagano Prefecture, Japan), to collect chironomid midges attracted to lamplight of the machine. Shinano River (length 367 km) is the longest river in Japan of which the 5th order section runs from east to west through the center of Ueda City. Channel width between the dikes of the river ranges between 250 and 450 m in the city. The river water width is between 40 and 150 m at the usual water level and meanders in the dry riverbed of boulders, pebbles and cobbles. At least one kilometer around the vending machine, an urban residential area mostly covered the river to the north, whereas the rural area to the south was largely composed of rice paddy and woodland. The vending machine stood on the north riverbank and faced the river across a road (width 6 m). The showcase (width 110 cm; height 85 cm; ground clearance 100 cm) of the machine was equipped with three 32 W daylight color fluorescent lamps (FL32SEX-D-HG; NEC Corp.) for illumination. There was no other strong light source which might otherwise attract midges within 100 m from the machine at least along the adjacent river.

Chironomid Collection and Identification

Everyday from March 28 to December 1, 2006, i.e. 249 days, we collected all the chironomid midges attracted to the illuminated showcase of the vending machine during the 20 minutes beginning at 20:00 by an insect aspirator. The collected midges were preserved in 70% ethanol until counting and identification. All the male midges were mounted on slides with gum chloral under a dissecting microscope (max. 56 × magnifications). Then they were identified as to species under a microscope (max. 800× magnifications) following the taxonomical keys of Wiederholm (1989), Sasa and Kikuchi (1995), Saether et al. (2000) and Langton and Pinder (2007). Female midges were identified as to subfamily except for several abundant species because of the difficulty in accurate species identification (Inoue et al., 2004).

Environmental Data

Daily mean air temperature during the study period measured at the nearest public observatory, Ueda Station (Japan Meteorological Agency, 2006) (Figure 1), was used as an environmental variable to relate with the daily abundance and daily number of male Chironomidae species.

Data Analysis

Linear regressions of daily abundances of total Chironomidae and several abundant species on daily mean air temperature were conducted using the software StatView for Windows version 5.0 (SAS Institute, 1998). Significances of the correlation coefficients were tested in the above procedure.

RESULTS

Species Composition and Abundance of Chironomids

A total of 4,439 Chironomidae midges (1,719 males and 2,720 females) was collected during the study period (Table 1). Chironominae was the most abundant subfamily accounting for 65.2% of the total abundance, followed by Orthocladiinae (33.7%). Tanypodinae (0.7%), Diamesinae (0.4%) and Prodiamesinae (< 0.1%) were rarely collected. Males were identified from 92 species belonging to 44 genera in total excepting damaged specimens (Table 1). Species belonging to Chironominae (55 species: 59.8%) and Orthocladiinae (30 species: 32.6%) accounted for 92.4% of the total number of male Chironomidae species, followed by Tanypodinae (4 species: 4.3%), Diamesinae (2 species: 2.2%) and Prodiamesinae (1 species: 1.1%).

The most abundant species in males was *Chironomus kiiensis* Tokunaga, followed by *Polypedilum nubifer* (Skuse), *Smittia aterrima* (Meigen), *Tanytarsus tamaundecimus* Sasa and *Rheocricotopus chalybeatus* (Edwards) (Table 1). On the other hand, males of many species were rare, i.e., 63 species of which total male abundance was less than 10. Fortunately, females of *C. kiiensis*, *P. nubifer* and *S. aterrima* were easily able to associate with males of the same species by their key characters, e.g., body coloration, wing markings and/or venation. Therefore, we identified females of these three species in order to analyse the annual fluctuation of their daily abundances. As a result, we counted a total of 504 midges of *C. kiiensis* (379 males and 125 females: 11.4%), 608 midges of *P. nubifer* (236 males and 372 females: 13.7%) and 438 midges of *S. aterrima* (184 males and 254 females: 9.9%). These three species occupied 34.9% of the total Chironomidae abundance altogether.

Seasonal Change in attracted chironomids

Abundance of daily total Chironomidae, collected in 20 minutes starting daily at 20:00, fluctuated greatly during the study period (Figure 2). However, the highest peak was recognised in late August with the maximum value of 215.0 ind./20 min./m^2 (201 ind./20 min./110×85 cm^2) on August 23. Monthly total Chironomidae abundance increased from April to August and decreased in September, then increased again in November (Table 1). Chironominae accounted for 89.1% of the monthly total Chironomidae in August and they were abundant when the daily mean air temperature exceeded 20.0°C (Figure 1; Table 1). On the other hand, Orthocladiinae accounted for 92.5% of the monthly total Chironomidae in November and they were abundant when the daily mean air temperature was below 15.0°C (Figure 1; Table 1).

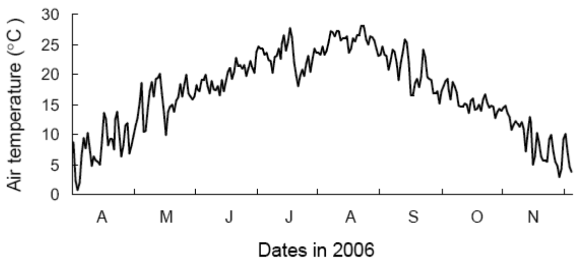


Figure 1. Daily mean air temperature measured at the public observatory, Ueda Station, in 2006 (Japan Meteorological Agency, 2006).

The monthly total number of male Chironomidae species was high in June (51 species) and August (55 species), then gradually decreased from September to November (Table 1). The daily number of male Chironomidae species evidenced repeated short-term fluctuation, as with the daily total Chironomidae, and was highest on August 20 (23 species) (Figure 3). The monthly mean daily number of male Chironomidae species was highest in August (7.8 species), followed by June (4.1 species) and September (3.1 species) (Table 1). The cumulative number of male Chironomidae species increased rapidly from May to June (Figure 3). In addition, 65 (70.7%) out of the total 92 male species were collected before July. Since July, the cumulative number of male species increased gradually, and 86 species (93.5%) were collected before September.

Among the three abundant species described earlier, *C. kiiensis* was collected from late June to mid-September. Its daily abundance showed a distinct peak in late August, with the maximum value of 81.3 ind./20 min./m^2 (76 ind./20 min./110 × 85 cm^2) on August 23 (Figure 2). *P. nubifer* was collected from late June to late September, and its daily abundance showed two distinct peaks; the first peak in mid July that recorded the maximum value of 65.2 ind./20 min./m^2 (61 ind./20 min./110×85 cm^2) on July 11, and the second peak in late August that recorded the maximum value of 68.4 ind./20 min./m^2 (64 ind./20 min./110 × 85 cm^2) on August 23. On the other hand, *S. aterrima* was collected from mid-September to early December, the end of the study period. The monthly total abundance of this species was highest in November, although its daily abundance fluctuated greatly.

In relation to the rest of the species, males of a Chironominae species, *T. tamaundecimus*, were abundant in May (Table 1). Monthly total male abundances of two Orthocladiinae species, *R. chalybeatus* and *Thienemanniella nipponica* (Tokunaga), were highest in August. Males of an Orthocladiinae genus, *Cricotopus*, especially *Cricotopus bimaculatus* Tokunaga and *Cricotopus triannulatus* (Macquart), were collected from May to November.

Relationship Between Attracted Chironomids and Air Temperature

The daily mean air temperature during the study period ranged from 0.6 to 27.9°C, recorded on March 30 and August 18, 2006, respectively (Figure 1). The monthly mean air temperature was highest in August (25.6 ± 1.5°C) and exceeded 20.0°C from June to September. In May and October, air temperature averaged 16.2 ± 2.7 and 15.0 ± 1.4°C, respectively. During the rest of the study period, the monthly mean air temperature was lower than 10.0°C.

Daily total Chironomidae abundance showed a significant positive correlation with daily mean air temperature ($R = 0.312$; $p < 0.001$). Similarly, daily abundances of both *C. kiiensis* ($R = 0.322$; $p < 0.001$) and *P. nubifer* ($R = 0.350$; $p < 0.001$) showed significant positive correlations with daily mean air temperature. On the other hand, daily abundance of *S. aterrima* showed a significant negative correlation with daily mean air temperature ($R = -0.237$; $p < 0.001$).

The daily number of total male Chironomidae species showed a significant positive correlation with daily mean air temperature ($R = 0.411$; $p < 0.001$). The daily number of male Chironominae species also showed a significant positive correlation with daily mean temperature ($R = 0.507$; $p < 0.001$), whereas the relationship was not significant in Orthocladiinae ($p = 0.644$).

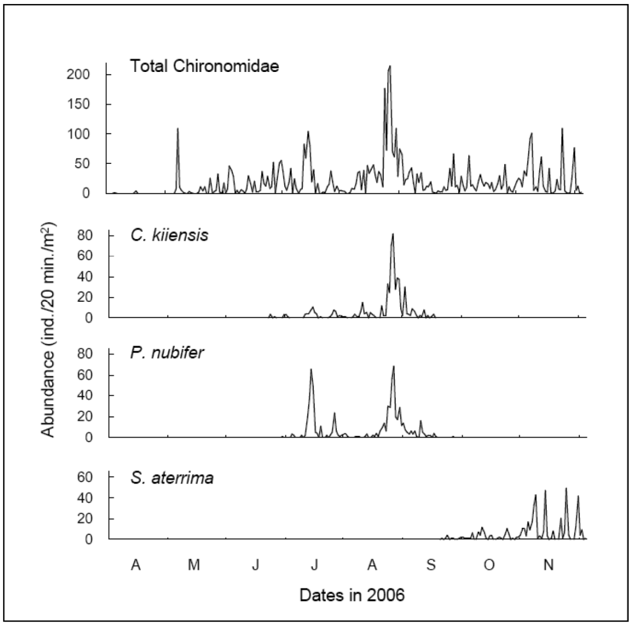
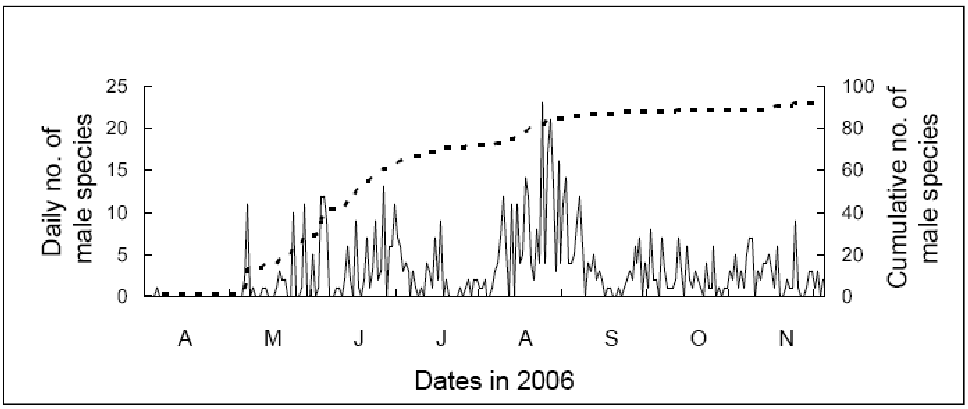


Figure 2. Daily abundances (ind./20 min./m^2) of total Chironomidae, *C. kiiensis*, *P. nubifer* and *S. aterrima* attracted to the illuminated showcase (110 × 85 cm^2) of the vending machine, set along the Shinano River, in 2006. The abundances shown are the sum of males and females.

Figure 3. Daily number (solid line) and cumulative number (dashed line) of male Chironomidaes attracted to the illuminated vending machine, set along the Shinano River, in 2006.



DISCUSSION

In our study, a total of 92 species were recorded in male Chironomidae during 249 days at a single vending machine in Ueda City. On the other hand, Hirabayashi et al. (2001) collected chironomid midges at 108 vending machines in summer (from August 25 to September 4, 1997) and 103 machines in fall (from September 30 to October 14, 1997) covering an area of 177 km^2 in Ueda City. They recorded a total of 97 species, but the number of species per site in their study averaged 7.7 in summer and 4.9 in fall. In the present study, the mean daily number of male Chironomidae species was 7.8 in August and 2.2 in October. In addition, the cumulative number of male Chironomidae species exceeded 90% of the total before September. These facts indicate that massive monitoring, at least daily from May to August in the present case, is needed for accurate evaluation of species composition at a site.

Despite differences in the methods of collection, Hirabayashi et al. (2001) also reported that *P. nubifer* and *C. kiiensis* were the two most abundant species in summer, whereas *S. aterrima* was the most abundant species in fall based on the number of sites collected. The correspondence with our study in the majority of these three species demonstrates that *C. kiiensis*, *P. nubifer* and *S. aterrima* are the most important potential nuisance species in Ueda City. *C. kiiensis* and *P. nubifer* distribute widely in Japan (Sasa and Kikuchi, 1995) and were recorded from rivers (Kawai et al., 1997), lakes (Iwakuma, 1992; Kawai et al., 2002; Hirabayashi et al., 2003) and massively from rice paddies (Kikuchi et al., 1985; Takamura, 1996). We collected chironomid midges on the riverside of the Shinano River, where the opposite side of the river was largely covered by rice paddies. Therefore, these two species of midges attracted can be considered to come from either the adjacent river and/or the rice paddy area across the river. *S. aterrima* is also recorded widely in Japan (Sasa and Kikuchi, 1995), and its larvae are terrestrial (Wiederholm, 1989). In the present study, attracted midges of this species might come from the woods inland area on the opposite side of the river and/or the dry riverbed of the Shinano River. However, the water in rice paddies is usually drained away as of September in Ueda City, suggesting a possibility that *S. aterrima* also flew in from the rice paddy area.

In this study, the many chironomid midges attracted to the vending machine increased with rising air temperature. In addition, the total daily number of male Chironomidae and Chironominae species also increased with air temperature. The short-term fluctuation in daily abundance may be caused by weather, wind speed and its direction in the surrounding area. Contrariwise, thermal conditions are fundamental factors which determine the flying activity, larval development, emergence period and number of generations per year that govern the seasonality of insects (Gullan and Cranston, 1994; Inoue et al., 2007). We confirmed that the monthly total abundance of Chironominae, especially *C. kiiensis* and *P. nubifer*, were highest in August, whereas Orthocladiinae, especially *S. aterrima*, were the most abundant subfamily in November. These temperature-related occurrence patterns of the subfamilies are usually observed worldwide (e.g. Pinder, 1995), but it was not always true at species or genus level judging by the male abundances in our study.

The above three major species, *C. kiiensis*, *P. nubifer* and *S. aterrima*, were rarely collected from late March to July. In addition, the rest of the species attracted to vending machine illumination accounted for 65.1% of total Chironomidae. Therefore, the attraction of chironomid midges other than the three major species can not be ruled out, especially before late August. In order to specify the source of all species, the species composition of chironomid larvae in the surrounding area, especially the Shinano River and rice paddy area, should be investigated directly, e.g., by rearing larvae collected in the field.

In our study, the daily abundance of *C. kiiensis* showed a peak in late August and *P. nubifer* showed two peaks in mid-June and late August. Thus, the maximum daily total number of Chironomidae observed in late August, was mainly due to both the peak daily abundance of *C. kiiensis* and the second peak of *P. nubifer* that occurred at the same time. Because *C. kiiensis* and *P. nubifer* are common nuisance species in Japan, control methods for these two species were studied and mainly focused on larval susceptibility to insecticides (Tabaru et al., 1987; Ali, 1995). In relation to control for other species, the efficiency of acoustic traps, which emit nearly the same sound frequency as the wingbeat of female midges, to catch males of several nuisance species was examined (e.g., Ogawa and Sato, 1993; Hirabayashi and Ogawa, 2000). From the viewpoint of vending machine operation, however, it is impractical to use insecticides for all potential larval habitats around the vending machine. Running acoustic traps near vending machines at night is also not possible because neighboring residents will be annoyed by the noise of the traps. In this study, the daily total Chironomidae abundance became high mostly when the daily mean air temperature was higher than 20.0°C. Therefore, dimming or turning off the illumination at night if daily mean air temperature is expected to exceed 20.0°C would be the most simple and best tentative way to reduce the phototactic attraction of chironomid midges, especially in late August in our case, unless the vending machine sales at night could not offset the costs of operation. Besides ecological nuisance controls, the development of mechanical devices, e.g., blowers and aspirators, for vending machines to prevent insect attraction is needed to reduce the nuisance complaints.

ACKNOWLEDGMENTS

Chironomid midges were collected with permission from the owner of the vending machine, Tezuka Manufacturing Inc. We thank Daisuke Toyoda, Keisuke Masada and Kenichi Nishikawa for their assistance in chironomid collection. This work was supported by Grant-in-Aid for Global COE Program by the Ministry of Education, Culture, Sports, Science and Technology, Government of Japan.

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Table 1. Species list of chironomid males and monthly total numbers (ind./20 min./110×85 cm^2) attracted to vending machine illumination set along middle reaches of Shinano River (2006).

Male species	Months in 2006										Total	(%)
	Mar.[1] (4)	Apr. (30)	May (31)	Jun. (30)	Jul. (31)	Aug. (31)	Sep. (30)	Oct. (31)	Nov. (30)	Dec.[2] (1)	(249 days)	
Subfamily Chironominae												
Tribe Chironomini												
Chironomus flaviplumus Tokunaga				3	2	10					15	0.9
Chironomus kiiensis Tokunaga				5	24	333	17				379	22.0
Chironomus nipponensis Tokunaga				6	1	2					9	0.5
Chironomus yoshimatsui Martin et Sublette				3	1	5					9	0.5
Cladopelma edwardsi (Kruseman)					2	7	1				10	0.6
Cryptochironomus albofasciatus (Staeger)				1		3	1				5	0.3
Demicryptochironomus vulneratus (Zetterstedt)				1							1	< 0.1
Einfeldia dissidens (Walker)					1						1	< 0.1
Glyptotendipes biwasecundus Sasa et Kawai							2				2	0.1
Glyptotendipes tokunagai Sasa						1					1	< 0.1
Harnischia japonica Hashimoto				2		17	3	1			23	1.3
Microtendipes shoukomaki Sasa			1	4		7	2	2			16	0.9
Microtendipes truncatus Kawai et Sasa						1					1	< 0.1
Polypedilum (*Cerobregma*) *kamotertium* Sasa			1	4		20	9	1			35	2.0
Polypedilum (*Pentapedilum*) *tritum* (Walker)					1						1	< 0.1
Polypedilum (*Polypedilum*) *akisplendens* Kawai, Inoue et Imabayashi						1					1	< 0.1
Polypedilum (*Polypedilum*) *asakawaense* Sasa				1	1	2	1	1			6	0.3
Polypedilum (*Polypedilum*) *kyotoense* (Tokunaga)				3	4	8					15	0.9
Polypedilum (*Polypedilum*) *nubeculosum* (Meigen)			1	8	4	3	2				18	1.0
Polypedilum (*Polypedilum*) *nubifer* (Skuse)					8	216	12				236	13.7
Polypedilum (*Polypedilum*) *parviacumen* Kawai et Sasa			11	6		3		1			21	1.2
Polypedilum (*Polypedilum*) *pedestre* (Meigen)			1								1	< 0.1
Polypedilum (*Polypedilum*) *tamaharaki* Sasa				1							1	< 0.1
Polypedilum (*Polypedilum*) *tamahosohige* Sasa					1	3					4	0.2
Polypedilum (*Polypedilum*) *tamanigrum* Sasa			2			1	1	1	7		12	0.7
Polypedilum (*Polypedilum*) *tochibicolor* Niitsuma						2					2	0.1
Polypedilum (*Polypedilum*) *toganudum* Sasa et Okazawa				1			3	2			6	0.3
Polypedilum (*Polypedilum*) *tsukubaense* Sasa						1		1			2	0.1
Polypedilum (*Tripodura*) *japonicum* (Tokunaga)			3	7	1	15		1			27	1.6
Polypedilum (*Tripodura*) *tamahinoense* Sasa et Ichimori			5	6	2	10	4	1			28	1.6
Polypedilum (*Tripodura*) *unifascium* (Tokunaga)			1	2		10		1			14	0.8
Polypedilum (*Uresipedilum*) *aviceps* Townes			1	1			1				3	0.2
Polypedilum (*Uresipedilum*) *convictum* (Walker)						2					2	0.1
Polypedilum (*Uresipedilum*) *cultellatum* Goetghebuer			1	1	1	29	4	2			38	2.2
Polypedilum (*Uresipedilum*) *paraviceps* Niitsuma			13	10	1	4					28	1.6
Polypedilum (*Uresipedilum*) *pedatum* Townes						2					2	0.1
Polypedilum (*Uresipedilum*) *surugense* Niitsuma			1			3					4	0.2
Polypedilum spp. damaged specimens			1		1						2	0.1
Tribe Tanytarsini												
Cladotanytarsus vanderwulpi (Edwards)			2	1		22	1				26	1.5
Cladotanytarsus sp.			4	1			1				6	0.3
Micropsectra chuzelonga Sasa				1	1						2	0.1
Neozavrelia bicoliocula (Tokunaga)			5	11		1			1		18	1.0
Neozavrelia tamanona (Sasa)			1					1			2	0.1
Paratanytarsus inawaprimus Sasa				1							1	< 0.1
Paratanytarsus kuramacircus Sasa				6	1		2				9	0.5
Paratanytasus stagnarius (Tokunaga)						1	1	1			3	0.2
Rheotanytarsus kyotoensis (Tokunaga)			2	2	1	2					7	0.4
Rheotanytarsus tamasecundus Sasa						1					1	< 0.1
Rheotanytarsus tamatertius Sasa			5	4		1			1		11	0.6
Tanytarsus angulatus Kawai				1	1	2					4	0.2
Tanytarsus oyamai Sasa				3							3	0.2
Tanytarsus takahashii Kawai et Sasa				3	4	13	2				22	1.3
Tanytarsus tamagotoi Sasa				1	2	3		1			7	0.4
Tanytarsus tamaundecimus Sasa			41	4	2	13	3	6	1		70	4.1
Tanytarsus unagiseptimus Sasa					2	10	3				15	0.9
Virgatanytarsus arduennensis (Goetghebuer)								1			1	< 0.1
Tanytarsini spp. damaged specimens				1		1	1				3	0.2

Table 1. Continued.

Male species	Months in 2006 Mar.[1] (4)	Apr. (30)	May (31)	Jun. (30)	Jul. (31)	Aug. (31)	Sep. (30)	Oct. (31)	Nov. (30)	Dec.[2] (1)	Total (249 days)	(%)
Subfamily Diamesinae												
Diamesa sp.		1									1	< 0.1
Potthastia gaedii (Meigen)			1					1	4		6	0.3
Subfamily Prodiamesinae												
Prodiamesa levanidovae Makarchenko (= *nagaii* Sasa et Kawai)			1								1	< 0.1
Subfamily Orthocladiinae												
Brillia japonica Tokunaga			1								1	< 0.1
Cardiocladius fuscus Kieffer						4	7	4	2		17	1.0
Corynoneura celtica Edwards						1	1				2	0.1
Cricotopus (*Cricotopus*) *bicinctus* (Meigen)				1		1	4	3	1		10	0.6
Cricotopus (*Cricotopus*) *bimaculatus* Tokunaga			4		1	3		1			9	0.5
Cricotopus (*Cricotopus*) *triannulatus* (Macquart)			1	1		6	3	3	9		23	1.3
Cricotopus (*Isocladius*) *tricinctus* (Meigen)				1							1	< 0.1
Cricotopus (*Isocladius*) *trifasciatus* (Meigen in Panzer)				7		2					9	0.5
Diplocladius cultriger Kieffer			1						18	1	20	1.2
Eukiefferiella sp. cf. *jintuquinta*			2	1	1				1		5	0.3
Eukiefferiella sp. cf. *yasunoi*									1		1	< 0.1
Eurycnemus nozakii Kobayashi						1					1	< 0.1
Limnophyes minimus (Meigen)				1			5	2			8	0.5
Nanocladius tamabicolor Sasa			1		1	3			1		6	0.3
Orthocladius glabripennis (Goetghebuer)			16					1	26		43	2.5
Orthocladius makabensis Sasa				2							2	0.1
Orthocladius tamarutilus Sasa									1		1	< 0.1
Parametriocnemus stylatus (Kieffer)			1	3			1		2		7	0.4
Paratrichocladius rufiventris (Meigen)			6	3							9	0.5
Paratrichocladius tamaater Sasa				1					1		2	0.1
Psectrocladius aquatronus Sasa				1							1	< 0.1
Pseudorthocladius matusecundus Sasa et Kawai				1							1	< 0.1
Pseudosmittia triappendiculata (Goetghebuer)						1					1	< 0.1
Rheocricotopus chalybeatus (Edwards)				1		38	17	11			67	3.9
Smittia aterrima (Meigen)							9	43	131	1	184	10.7
Synorthocladius semivirens (Kieffer)									1		1	< 0.1
Thienemanniella nipponica (Tokunaga)			3	4		17	3	2			29	1.7
Thienemanniella vittata (Edwards)			1				1		1		3	0.2
Tokunagaia kibunensis (Tokunaga)				1							1	< 0.1
Tvetenia tamaflava (Sasa)			1	2	1	5	3	4	31		47	2.7
Subfamily Tanypodinae												
Ablabesmyia longistyla Fittkau					1	1					2	0.1
Hayesomyia tripunctata (Goetghebuer)			1								1	< 0.1
Nilotanypus dubius (Meigen)						1					1	< 0.1
Rheopelopia ornata (Meigen)				1		1		1			3	0.2
Total males	0	1	144	148	75	876	131	101	241	2	1,719	100.0
Total females	0	4	139	332	512	580	316	356	481	0	2,720	-
Subfamily (males and females)												
Chironominae			179	359	505	1,298	309	201	43		2,894	65.2
Diamesinae		1	2	1	1	2		1	9		17	0.4
Prodiamesinae			1								1	< 0.1
Orthocladiinae		4	97	115	74	149	134	252	668	2	1,495	33.7
Tanypodinae			4	5	7	7	4	3	2		32	0.7
Total Chironomidae	0	5	283	480	587	1,456	447	457	722	2	4,439	100.0
Monthly mean daily no. of male species	0.0	< 0.1	2.1	4.1	1.7	7.8	3.1	2.2	2.6	2.0	2.9	
Monthly total no. of male species	0	1	35	51	29	55	33	29	20	2	92	

[1]From March 28 to 31; [2]only December 1.