Research Note

Chironomid fauna in the Lake Biwa area

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Abstract: Chironomid fauna in the Lake Biwa Area was investigated by collection of adult males emerging from the bottom samples, attracted to light sources and resting in the vegetation. A total of 64 species was collected. *Cricotopus bimaculatus* and *Chironomus yoshimatsui* and *Chironomus nipponensis* were collected only from the southern and northern basins, respectively. *Cricotopus sylvestris*, *Psectrocladius aquatronus*, *Chironomus plumosus* and *Polypedilum nubeculosum* were collected from almost the entire lake. There were remarkable differences in the occurrence season among the species. *Tanytus punctipennis*, *Prodiamesa nagaii*, etc.; *Procladius sagittalis*, *Cryptochironomus albofasciatus*, etc.; and *Clinotanypus sugiyamai*, *C. bimaculatus*, etc. were collected only in spring, summer and autumn, respectively. *C. sylvestris* and *Einfeldia dissidens* were collected in all seasons.

INTRODUCTION

Lake Biwa is the largest lake in Japan, situated at the elevation of 86 m, having a lake area of 670 km², a catchment area of 3,174 km² and the maximal depth of 104 m. It has 113 tributary rivers and had a total of 33 lagoons, 15 of which had been completely or partially reclaimed (Munemiya, 2000). Lake Sonenuma is one of the remaining small lagoons. Lake Yogo is situated in the north to Lake Biwa and at the elevation of 134 m, having a lake area of 1.63 km² and the maximal depth of 15 m, and is connected to Lake Biwa via the River Yogo. Lake Biwa has an extremely long history of 5 million years, and thus as many as 54 species of planktonic or benthic organisms have been recorded as indigenous species to the lake (Mori and Miura, 1980). There have been a few studies on the chironomid fauna of the lake. Kato (1962) described 30 species at the

larval stages. Sasa and Kawai (1987) conducted a systematic study, covering almost the entire lake, by sweeping of adults and bottom sampling of larvae, and recorded a total of 71 species. Sasa and Nishino (1995) collected adult midges of 4 species, comprising 2 new species, in winter season at Uchidehama, Otsu City. Kitagawa (1997) recorded 75 taxa at the larval stages. However, still more surveys should be conducted for a complete clarification of the chironomid fauna of the lake.

In this study, chironomid fauna in the Lake Biwa Area, comprising Lakes Biwa, Sonenuma and Yogo, was investigated by collection of adult males emerging from the bottom samples, those attracted to artificial light sources and those resting in the vegetation.

MATERIALS AND METHODS

Sampling stations

A total of 13 sampling stations was set around Lake Biwa, covering the entire length of the shoreline, and two associated waters, Lakes Yogo and Sonenuma (Fig. 1).

Sampling methods

A combination of three methods was used; collection of emerging adults from bottom samples (bottom sampling), sweeping of adults resting in the vegetation or elsewhere (sweeping) and collection of male adults attracted to artificial light

sources such as vending machines (light sampling).

For bottom sampling, a concrete plate was used as an artificial substrate for larval attaching (Kawai et al., 1998). A concrete plate (W30 cm × D30 cm × H3 cm) was submerged at the depth of 5–67 cm (34 cm in average) for each station. About two to three months later, materials attaching to the whole surface of the plate were collected as a quantitative sample into a plastic bag which was filled with a small amount of water, and transported to the laboratory with gentle cooling. The plate was washed completely and again submerged at the same point. Another two to four months later, sampling was again perfo-

Fig. 1. Map of Lake Biwa and the associated waters, showing the locations of 13 sampling stations.
★River Mouth.

med. The sample was put into a container ($\phi 15\text{ cm} \times \text{H}9\text{ cm}$), which was filled with dechlorinated water to a level of about 5 cm, covered with a nylon net and aerated rather vigorously at room temperature. Emerging adults were collected every other day. Primary setting of the plates was performed in spring (between April 15 and May 17), and the first and the second samplings were made in summer (between July 5 and July 21) and in autumn (between Oct. 4 and Nov. 21), respectively, in 1994.

Light sampling was performed on the shoreline near the station, taking advantage of the light emitted by vending machines for drinks, etc., set on or near the shoreline. Adult males attracted to one vending machine were collected for 15 minutes at night (7:00 p.m.–0:00 a.m.) per station. Samplings were performed during the same periods in the three seasons in 1994 as the bottom sampling.

Sweeping was performed over various types of vegetation near the shore, using a nylon insect net, 42 cm in diameter, for 5 minutes during the same periods in 1994 as the bottom sampling.

Sweeping was performed at all the sites. Bottom sampling was performed at all the sites except for Katata. Light sampling could be performed only at Otsu, Kitakomatsu, Hannoura, Sugoshi, Miyagahama and Mizugahama, due to the lack of vending machines near the shoreline at other stations.

Identification

Only male adults were identified because of the difficulty of correct identification of the female specimens to species. Male adults were mounted onto slides according to the methods described by Sasa et al. (1980). Mounted specimens were identified using the keys provided by Brundin (1947), Pinder (1978) and Sasa and Kikuchi (1995).

Table 1. List and number of individuals for collected species.

Species	No. indiv.
Tanypodinae	
<i>Ablabesmyia monilis</i>	10
<i>Clinotanypus sugiyamai</i>	12
* <i>Conchapelopia japonica</i>	1
* <i>Procladius sagittalis</i>	1
<i>Tanypus punctipennis</i>	1
Diamesinae	
* <i>Prodiamesa nagaii</i>	2
Orthocladiinae	
* <i>Corynoneura longipennis</i>	1
<i>Cricotopus bicinctus</i>	27
<i>C. bimaculatus</i>	5
<i>C. biwannulatus</i>	1
<i>C. sylvestris</i>	1897
<i>C. triannulatus</i>	1
<i>C. trifasciatus</i>	9
* <i>Eukiefferiella coelurescens</i>	7
* <i>Limnophyes minimus</i>	2
* <i>Nanocladius seoulensis</i>	4
<i>Orthocladius glabripennis</i>	2
* <i>O. tamarutilus</i>	1
<i>Paratrachocladius rufiventris</i>	1
* <i>P. tamaater</i>	2
<i>Propiloscerus akamusi</i>	27
* <i>Psectrocladius aquatronus</i>	58
<i>Rheocricotopus chalybeatus</i>	5
<i>Smittia aterrima</i>	5
* <i>S. itachipennis</i>	158
<i>Thienemanniella vittata</i>	55
Chironominae	
Chironomini	
<i>Chironomus biwaprimus</i>	3
<i>C. circumdatus</i>	2
<i>C. flaviplumus</i>	8
<i>C. nippodorsalis</i>	2
<i>C. nipponensis</i>	9
<i>C. plumosus</i>	73
<i>C. yoshimatsui</i>	2
<i>Cryptochironomus albofasciatus</i>	1
<i>Dicrotendipes pelochloris</i>	4
<i>D. nervosus</i>	8
<i>Einfeldia dissidens</i>	28
<i>Endochironomus pekanus</i>	2
<i>Glyptotendipes tokunagai</i>	13
<i>Harnischia curtilamellata</i>	7
* <i>Harnischia</i> sp.	3
<i>Microchironomus tener</i>	1
<i>Parachironomus arcuatus</i>	33
* <i>Paracladopelma camptolabis</i>	1
<i>Paratendipes tamayubai</i>	5
<i>Polypedilum cultellatum</i>	24
<i>P. japonicum</i>	4
<i>P. nubeculosum</i>	25

Table 1. continued

Species	No. indiv.
<i>P. nubifer</i>	73
* <i>P. tamahinoense</i>	1
* <i>P. tigrinum</i>	1
<i>Stictochironomus akizukii</i>	369
* <i>Xenochironomus xenolabis</i>	1
Tanytarsini	
* <i>Paratanytarsus stagnarius</i>	9
<i>P. miikesecondus</i>	1
<i>Rheotanytarsus aestuarius</i>	49
* <i>Stempellina subglabripennis</i>	1
<i>Tanytarsus biwatrifurcatus</i>	1
* <i>T. mendax</i>	1
* <i>T. nipogregarius</i>	1
<i>T. oyamai</i>	7
<i>T. takahashii</i>	8
<i>T. tamagotoi</i>	9
<i>T. unagiseptimus</i>	10
No. species	64

* Species newly recorded from the Lake Biwa Area.

RESULTS

A total of 3,095 males, belonging to 64 species of 4 subfamilies, was collected (Table 1). Twenty species were first recorded by this study at the adult stage. *Cricotopus sylvestris* was collected in extremely large number. *Psectrocladius aquatrons*, *Smittia itachipennis*, *Thienemanniella vitata*, *Chironomus plumosus*, *Polypedilum nubifer*, *Stictochironomus akizukii* and *Rheotanytarsus aestuarius* were collected in large numbers. Other species were collected in small numbers.

Differences in collected species among the stations

More than 20 species were collected at the stations, Otsu, Tenjin and Kitafunaki. *C. sylvestris*, *P. aquatrons*, *C. plumosus* and *Polypedilum nubeculosum* were collected largely from the entire lake. On the other hand, *Cricotopus bimaculatus* and *Chironomus yoshimatsui* were collected only from the southern basin whereas *Chironomus nipponensis* was collected only

from the northern basin and Lake Yogo. *Cricotopus triannulatus* and *Paratanytarsus miikesecondus* were collected only from Lake Yogo. *Procladius sagittalis*, *Tanypus punctipennis* and *Tanytarsus mendax* were collected only from Lake Sonenuma (Table 2).

Differences in collected species among the seasons

Nineteen species involving *T. punctipennis* and *Prodiamesa nagaii* were collected only in spring whereas 14 species involving *Clinotanypus sugiyamai* and *C. bimaculatus* were collected only in autumn. *P. sagittalis*, *Cryptochironomus albofasciatus*, *Microchironomus tener*, *Stempellina subglabripennis* and *Tanytarsus biwatrifurcatus* were collected only in summer. *Ablabesmyia monilis*, *Paratrachocladius tamaater* and *Dicrotendipes pelochloris* were collected in spring and summer whereas *Dicrotendipes nervosus*, *Tanytarsus takahashii* and *T. unagiseptimus* were collected in summer and autumn. Twelve species involving *Cricotopus bicinctus* and *C. trifasciatus* were collected in spring and autumn. Eight species involving *C. sylvestris* and *Einfeldia dissidens* were collected in the three seasons studied (Table 3).

DISCUSSION

As many as 20 chironomid species were first recorded at the adult stage by this study from the Lake Biwa Area. This is partly because the associated waters, Lakes Yogo and Sonenuma, were also involved in this study. Indeed, 5 species, *P. sagittalis*, *T. punctipennis*, *C. triannulatus*, *P. miikesecondus* and *T. mendax* were recorded only from Lakes Yogo and Sonenuma. Besides, the new records of many species are also partly attributable to the changes with respect to various environmental factors, such as water quality and physical conditions in the littoral zone in Lake Biwa itself.

On the other hand, a part of the species collected in this study is considered to be

Table 2. Differences in collected species among 13 sampling stations.

Species	Otsu	Ten jin RM	Ka tata	Kita koma tsu	Kita funa ki	Kai zu	Han no ura	Naga hama	Su go shi	Miya gaha ma	Mizu gaha ma	Yo go ko	Sone numa
Tanypidinae													
<i>Ablabesmyia monilis</i>		◇				◇						◇	◇
<i>Clinotanytus sugiyamai</i>	◇												
<i>Conchapelopia japonica</i>							◇						
<i>Procladius sagittalis</i>													◇
<i>Tanytus punctipennis</i>													◇
Diamesinae													
<i>Prodiamesa nagaii</i>					◇								
Orthocladiinae													
<i>Corynoneura longipennis</i>					◇								
<i>Cricotopus bicinctus</i>	◇			◇	◇		◇				◇	◇	
<i>C. bimaculatus</i>	◇	◇											
<i>C. biwannulatus</i>				◇									
<i>C. sylvestris</i>	◇	◇			◇	◇		◇			◇	◇	◇
<i>C. triannulatus</i>												◇	
<i>C. trifasciatus</i>	◇	◇		◇	◇			◇					
<i>Eukiefferiella coelurescens</i>								◇					
<i>Limnophyes minimus</i>					◇								
<i>Nanocladius seoulensis</i>					◇			◇					
<i>Orthocladius glabripennis</i>					◇								
<i>O. tamarutilus</i>							◇						
<i>Paratrichocladius rufiventris</i>					◇								
<i>P. tamaater</i>	◇						◇						
<i>Prosilocerus akamusi</i>	◇												
<i>Psectrocladius aquatrons</i>	◇	◇		◇	◇		◇	◇		◇		◇	◇
<i>Rheocricotopus chalybeatus</i>	◇	◇					◇		◇				
<i>Smittia aterrima</i>	◇			◇	◇					◇			
<i>S. itachipennis</i>						◇							◇
<i>Thienemanniella vittata</i>					◇			◇					
Chironominae													
Chironomini													
<i>Chironomus biwaprimus</i>			◇										
<i>C. circumdatus</i>	◇					◇							
<i>C. flaviplumus</i>		◇					◇						◇
<i>C. nippodorsalis</i>							◇						◇
<i>C. nipponensis</i>					◇		◇	◇	◇			◇	
<i>C. plumosus</i>	◇	◇		◇				◇	◇		◇		◇
<i>C. yoshimatsui</i>	◇	◇											
<i>Cryptochironomus albofasciatus</i>	◇												
<i>Dicrotendipes pelochloris</i>		◇											
<i>D. nervosus</i>		◇			◇							◇	
<i>Einfeldia dissidens</i>	◇	◇										◇	◇
<i>Endochironomus pekanus</i>		◇											
<i>Glyptotendipes tokunagai</i>	◇	◇			◇							◇	◇
<i>Harnischia curtilamellata</i>	◇			◇									
<i>Harnischia</i> sp.	◇			◇	◇								
<i>Microchironomus tener</i>		◇											
<i>Parachironomus arcuatus</i>	◇	◇								◇			◇
<i>Paracladopelma camptolabis</i>							◇						
<i>Paratendipes tamayubai</i>				◇		◇	◇						

Table 2. continued

Species	Otsu	Ten jin RM	Ka tata	Kita koma tsu	Kita funa ki	Kai zu	Han no ura	Naga hama	Su go shi	Miya gaha ma	Mizu gaha ma	Yo go ko	Sone numa
<i>Polypedilum cultellatum</i>	◇	◇										◇	
<i>P. japonicum</i>	◇				◇		◇						
<i>P. nubeculosum</i>		◇			◇	◇			◇	◇		◇	◇
<i>P. nubifer</i>	◇												◇
<i>P. tamahinoense</i>							◇						
<i>P. tigrinum</i>	◇												
<i>Stictochironomus akizukii</i>		◇		◇	◇		◇				◇	◇	
<i>Xenochironomus xenolabis</i>										◇			
Tanytarsini													
<i>Paratanytarsus stagnarius</i>				◇									
<i>P. miikesecundus</i>												◇	
<i>Rheotanytarsus aestuarius</i>		◇		◇						◇			
<i>Stempellina subglabripennis</i>		◇											
<i>Tanytarsus biwatrifurcatus</i>						◇							
<i>T. mendax</i>													◇
<i>T. nipogregarius</i>		◇											
<i>T. oyamai</i>		◇			◇							◇	
<i>T. takahashii</i>	◇	◇			◇	◇		◇				◇	
<i>T. tamagotoi</i>				◇			◇	◇					
<i>T. unagiseptimus</i>		◇		◇	◇	◇							◇
No. species	24	25	1	14	22	9	15	10	4	6	4	15	16

Table 3. Differences in collected species among the seasons.

Species	Spring	Summer	Autumn
<i>Tanyrus punctipennis</i>	◇		
<i>Prodiamesa nagaii</i>	◇		
<i>Corynoneura longipennis</i>	◇		
<i>Conchapelopia japonica</i>	◇		
<i>Cricotopus triannulatus</i>	◇		
<i>Eukiefferiella coelurescens</i>	◇		
<i>Limnophyes minimus</i>	◇		
<i>Nanocladius seoulensis</i>	◇		
<i>Orthocladius tamarutilus</i>	◇		
<i>Paratrichocladius rufiventris</i>	◇		
<i>Smittia itachipennis</i>	◇		
<i>Chironomus biwaprimus</i>	◇		
<i>C. flaviplumus</i>	◇		
<i>C. nipodorsalis</i>	◇		
<i>C. yoshimatsui</i>	◇		
<i>Paracladopelma camptolabis</i>	◇		
<i>Polyoedilum tamahinoense</i>	◇		
<i>Paratanytarsus miikesecundus</i>	◇		
<i>Tanytarsus mendax</i>	◇		
<i>Procladius sagittalis</i>		◇	
<i>Cryptochironomus albofasciatus</i>		◇	
<i>Microchironomus tener</i>		◇	
<i>Stempellina subglabripennis</i>		◇	
<i>Tanytarsus biwatrifurcatus</i>		◇	
<i>Clinotanypus sugiyamai</i>			◇
<i>Cricotopus bimaculatus</i>			◇

Table 3. continued

Species	Spring	Summer	Autum
<i>C. biwannulatus</i>			◇
<i>Orthocladius glabripennis</i>			◇
<i>Prosilocerus akamusi</i>			◇
<i>Smittia aterrima</i>			◇
<i>Chironomus circumdatus</i>			◇
<i>C. plumosus</i>			◇
<i>Endochironomus pekanus</i>			◇
<i>Harnischia curtilamellata</i>			◇
<i>Polypedilum tigrinum</i>			◇
<i>Xenochironomus xenolabis</i>			◇
<i>Paratanytarsus stagnarius</i>			◇
<i>Tanytarsus nippogregarius</i>			◇
<i>Ablabesmyia monilis</i>	◇	◇	
<i>Paratrichocladius tamaater</i>	◇	◇	
<i>Dicrotendipes pelochloris</i>	◇	◇	
<i>D. nervosus</i>		◇	◇
<i>Tanytarsus takahashii</i>		◇	◇
<i>T. unagiseptimus</i>		◇	◇
<i>Cricotopus bicinctus</i>	◇		◇
<i>C. trifasciatus</i>	◇		◇
<i>Psectrocladius aquatronus</i>	◇		◇
<i>Rheocricotopus chalybeatus</i>	◇		◇
<i>Thienemanniella vittata</i>	◇		◇
<i>Chironomus nipponensis</i>	◇		◇
<i>Harnischia</i> sp.	◇		◇
<i>Polypedilum cultellatum</i>	◇		◇
<i>P. japonicum</i>	◇		◇
<i>Stictochironomus akizukii</i>	◇		◇
<i>Rheotanytarsus aestuarius</i>	◇		◇
<i>Tanytarsus tamagotoi</i>	◇		◇
<i>Cricotopus sylvestris</i>	◇	◇	◇
<i>Einfeldia dissidens</i>	◇	◇	◇
<i>Glyptotendipes tokunagai</i>	◇	◇	◇
<i>Parachironomus arcuatus</i>	◇	◇	◇
<i>Paratendipes tamayubai</i>	◇	◇	◇
<i>Polypedilum nubeculosum</i>	◇	◇	◇
<i>P. nubifer</i>	◇	◇	◇
<i>Tanytarsus oyamai</i>	◇	◇	◇

allochthonous ones. For example, *C. triannulatus* has been reported to be rheophilic (Kawai and Takahashi, 1986), and thus it is possible to originate from the tributaries flowing into the lake. *S. aterrima* is well known to be a common terrestrial species (Kobayashi, 1987).

Chironomus plumosus was collected largely in the entire lake whereas *C. nipponensis* was collected only in the northern basin. This may reflect the difference in trophic status, determining the profundal

sediment conditions between the northern and southern basins, since the former has been reported to be dominant in more eutrophicated waters than the latter (Yasuno et al., 1983).

As many as 19 and 14 species were collected only in spring and only in autumn, respectively, whereas only 5 species were collected only in summer. Besides, as many as 12 species were collected in spring and autumn whereas only 3 species were each collected in spring and summer

and in summer and autumn. These results suggest that annual occurrences of many chironomid species collected in this study are unimodal in spring or autumn, or bimodal in spring and autumn.

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