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Seasonal Changes, Life Cycle, and Production of a Psychrophilic Chironomid (*Propsilocerus akamusi*) in a Chinese Lake

ABSTRACT

Seasonal changes, life cycle, and production of a psychrophilic Chironomidae species, *Propsilocerus akamusi* (Tokunage), were studied in eutrophic Lake Donghu. The *P. akamusi* population was characterized by a single annual reproduction period during late November to December, and the larval growth mainly occurred in winter. Most of *P. akamusi* were univoltine, while some of them came to emergence in two years or more. The average density and biomass were 318.9 ind./m^2 and 0.57 g dry weight /m^2 during January 1998 to June 2000, respectively, but these values did not include any summer measurements since the larvae aestivated in the deep sediment layer and could not be sampled routinely in summer. The annual production of *P. akamusi* was 2.73g dry weight/m^2, and the corresponding production/biomass ratio was 4.60.

Propsilocerus akamusi (Tokunage) (formerly *Tokunagayusurika akamusi*) is one of the dominant chironomid species in many lakes of eastern Asia. Compared with many univoline species, the pattern of emergence of *P. akamusi* appears unique in that it emerges in late autumn to early winter within a range of decreasing water temperature of 18°C to 10°C (Iwakuma 1987). There have been few studies on the ecology and biology of *P. akamusi* in China. Thus, we examined the population dynamics and production of *P. akamusi* in Lake Donghu, a shallow, eutrophic lake located near the Yangtze River.

P. akamusi was sampled monthly at a central site of Lake Donghu (30°33' N, 114° 23' E) from January 1998 to June 2000 with a modified Petersen grab sampler and a 0.25 mm mesh net. Specimens were picked alive in the laboratory, preserved with 10% formalin, and weighed with an electronic balance. For those samples collected June 1999 to May 2000, the larval length and head capsule width were measured with an ocular micrometer. The secondary production was calculated with the size-frequency method

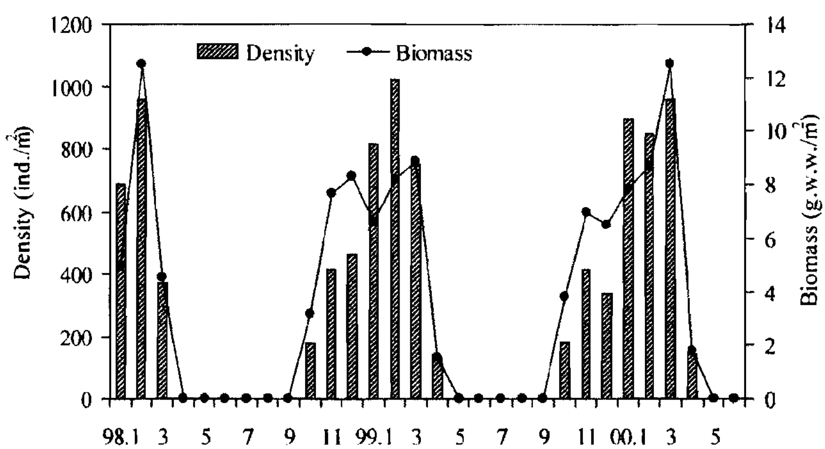

Figure 1. Seasonal dynamics of density and biomass of *P. akamusi* during 1998-2000 in Lake Donghu.

(Hynes and Coleman 1968, Hamilton 1969, Benke 1993). Monthly densities of *P. akamusi* in Lake Donghu were estimated for the all collections (January 1998 to June 2000).

P. akamusi is a psychrophilic species. As the larvae aestivates in the sediment layer of 30-80 cm in depth in summer, they were not sampled with the grab sampler during May to September. During January 1998 to June 2000, population density of *P. akamusi* peaked in February-March at near 1000 ind./m^2 and then sharply decreased as a result of aestivation (Fig. 1). There were two biomass peaks of *P. akamusi*, with the winter peak being slightly lower than the spring one. The former was the result of the recovery of *P. akamusi* from deeper layers to surface sediment, and the latter was mainly due to the production of the new cohort. The mean density and biomass of *P. akamusi* were 318.9 ind./ m^2 0.57 g dry weight/ m^2, respectively, not including unrecovered summer stocks.

Only one reproduction period of *P. akamusi* was observed during 1999-2000 (Fig. 2). The pupae of this species began to largely appear in mid-November. Emergence happened when the lake water temperature decreased to about 15°C in late November. However, the instars I and II (body length less than 3 mm) did not appear in the lake until January 2000. This long development time was likely due to the low average water temperature (about 5 °C) during this period (Gong et al. 2001). On the contrary, the larvae of *P. akamusi* grew very quickly, and their body length increased from several millimeters to about 15 mm in two months under low water temperature (about 5-8°C). After mid-April, with increasing water temperature, the larval number decreased in the surface sediment and disappeared completely after May.

Some researchers think that *P. akamusi* is a univoltine species (Yamagishi and Fukuhara 1971, Iwakuma 1987, Yan 1998). However and very conspicuously, two generations of this species coexisted during October 1999 to April 2000 [i.e., the 1998-year class (old generation) and the 1999-year class (new generation)] (Fig. 2).

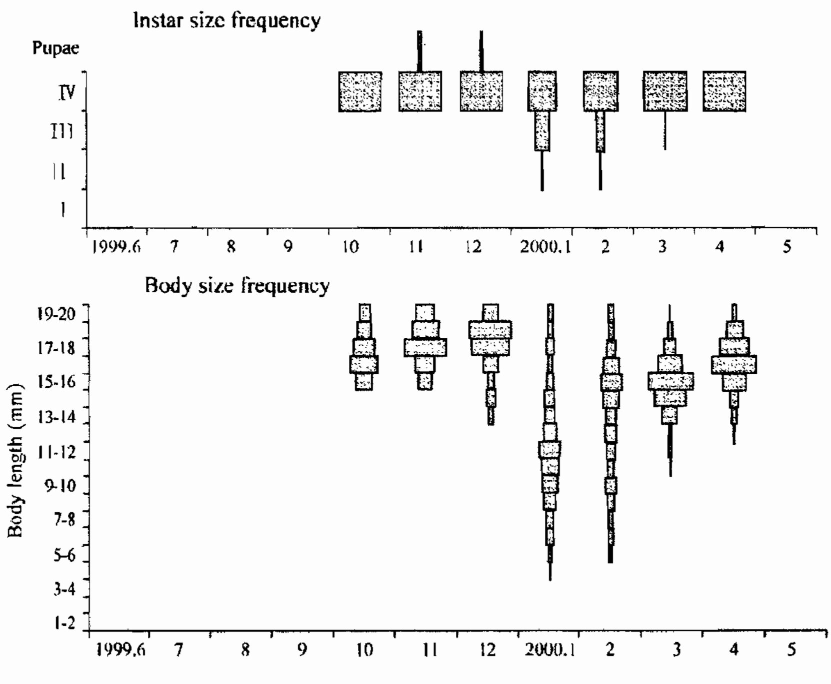

Figure 2. Monthly instar and body size-frequency histograms of *P. akamusi* during 1999-2000 in Lake Donghu.

During October to November, the larvae of the 1998 generation appeared abundantly in the surface sediment, and a majority of them pupated and emerged. After December 1999, the remainder of the 1998 generation did not pupate, which could be discerned from larvae of the 1999 generation by the body size and weight until March 2000. These larvae may have come to emergence in 2000 or even 2001. This emergence pattern is different from that of most of other Chironomidae (Waters 1977).

As suggested by Benke (1993), negative production values for the smallest size class were included in the estimate of production. The annual production was 18.45 g wet weight/m^2 (2.73 g dry weight/m^2), and production/biomass turnover ratio was 4.60. According to Waters (1977), the annual production of Chironomidae is frequently in the range of 0.024-24 g dry weight/m^2, and turnover ratios are frequently 0.18-12.7. Only four estimates of *P. akamusi* production and turnover ratios were available for comparison; they are Lake Kasumigaura, Lake Suwa, Lake Biandantang, and Lake Houhu (Yamagishi and Fukuhara 1971, Iwakuma 1987, Yan 1998). The turnover ratio of *P. akamusi* in our study was similar to those in these lakes, but the production was different from the four lakes and the P/B value varied from 0.30 to 3.69. It seems that the production of *P. akamusi* increases with the nutrient state of a lake, which suggested that *P. akamusi* may be a good eutrophic indicator species.

ACKNOWLEDGMENTS

This study was funded by a key project of the Chinese Academy of Sciences (Grant No. KZCX2-YW-419) and National Natural Sciences Foundation of China (Grant No. 50730529 and 30770404).

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Zhijun Gong[a,b], Yanling Li[a,b,c], and Ping Xie[b]

[a] State Key Laboratory of Lake Science and Environment, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing 210008 P.R. China.

[b] Donghu Experimental Station of Lake Ecosystems, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan 430072 P.R. China.

[c] Corresponding author; E-mail: ylli@niglas.ac.cn

Received: 21 February 2008 Accepted: 25 April 2008