III. Biological Data

14. Zoobenthos

(by Toshio Iwakuma and Ryuhei Ueno)

1. Methods

(1) Sample collection

During the period from April 1990 to March 1998, the zoobenthos was sampled at four stations (St. 3 in Takahamairi Bay, 4 m depth; St. 7 in Tsuchiurairi Bay, 2.8 m depth; St. 9 in the main basin, 6 m depth; and St. 12 off Asou Town, 4 m depth) after the routine surveys such as measurement of environmental factors and samplings of lake water and plankton. Three replicate sediment samples were collected with an Ekman-Birge sampler (15 cm × 15 cm) at each sampling station.

(2) Pretreatment

Each sediment sample was washed in situ with a nylon net (NGG54, 0.315 mesh opening) to remove fine mud. Zoobenthos retained on the net was collected in a polyethylene bag with 10% formalin solution, and the bag was tied firmly.

(3) Microscopic observation

Zoobenthos sample was dispersed in a white plastic pan in the laboratory, and the larger chironomids and oligochaetes were picked up. Smaller organisms were picked up under a dissecting microscope of 5× - 40× magnifications for sediment subsamples. Wet weights were measured for chironomids and oligochaetes up to the nearest 0.1 mg. Torn-off bodies of chironomids were all picked up for the measurement of weights but only the head parts were counted for the number of individuals. Similarly, all torn-off bodies of oligochaetes were picked up, but all the parts were included for measurement of weight and for counting of individuals. Dry weights were estimated from the wet weights using a reported dry weight:wet weight ratio of 0.19 (Iwakuma *et al.*, 1984). The densities and biomasses of each chironomid species will be reported elsewhere.

(4) Accuracy control

4. 1. Sampling efficiency

The maximum sampling depth in sediment was 10 cm. The burrowing depths of zoobenthos in Lake Kasumigaura are variable among developmental stages and seasons. Larvae of an Orthocladiinae species, *Propsilocerus akamusi* (Tokunaga), which was formerly named as *Propsilocerus akamusi* and have recently been revised to the current name by Saether and Wang (1996), burrow about 80 cm in the sediment. Larvae of a Chironominae, *Chironomus plumosus* (L.) burrow to about 40 cm in the sediment (Iwakuma and Yasuno, 1981, 1983). The sampling efficiency

of the Ekman-Birge sampler against an 80-cm tall sediment sampler in early March, when fourth-instar larvae of *P. akamusi* and *C. plumosus* ascend to near the sediment surface, is 55% for *P. akamusi*, 65% for *C. plumosus* and 65% for oligochaetes (Iwakuma *et al*., 1984). No *P. akamusi* larvae were collected with the Ekman-Birge sampler during April-September since they burrowed deeper than 40 cm in the sediment. Major chironomid species collected with the sampler during the period are *C. plumosus* and Tanypodinae species, *Clinotanypus sugiyamai* Tokunaga and *Procladius culiciformis* (Iwakuma, 1987).

4.2. Retention efficiency during pretreatment

The mean head capsule widths of third-instar larvae of chironomids dominant in Lake Kasumigaura are 0.43 mm (*n*=30, range 0.41-0.47 mm) for *P. akamusi*, 0.44 mm (*n*=21, range 0.40-0.48 mm) for *C. plumosus*, 0.50 mm (*n*=58, range 0.39-0.64) for *C. sugiyamai* and 0.41 mm (*n*=59, range 0.31-0.51 mm) for *P. culiciformis* (Iwakuma 1987). The values of head-capsule width are larger than the mesh opening of the nylon net used for washing sediment in situ. Therefore all the third- and fourth-instar larvae of the four dominant chironomids were considered to be collected on the nylon net during sampling and washing. Chironomids pupate after four larval instars. The average larval weight of each instar of chironomids relative to that of the fourth instar (taken to be 100) is 4.0 (second instar) and 12 (third instar) for *C. sugiyamai*, 24 (third instar) for *P. culiciformis*, 0.09 (first instar), 0.7 (second instar) and 5.1 (third instar) for *P. akamusi* and 1.2 (second instar) and 4.8 (third instar) for *C. plumosus* (calculated from Iwakuma 1987). Since the average weights of the second instar are about or less than 10% of the fourth instar for both *P. akamusi* and *C. plumosus*, and since these two species are much larger than the other two Tanypodinae species, *C. sugiyamai* and *P. culiciformis*, both in terms of density and individual weight, the loss of biomass due to washing of sampled sediments in situ is expected to be less than 10% of the actual value.

Meiobenthos, namely zoobenthos less than 0.3 mm in length, such as rotifers, cladocerans, harpacticoids, ostracods, nematodes, tardigrades and small oligochaetes are distributed in the sediment of Lake Kasumigaura at densities of 10^4-10^5 individuals m^{-2} (Iwakuma et al., 1984). Since these meiobenthos would have all passed through the nylon net, they are not included in the present study.

4.3. Other remarks

Since each torn-off body of oligochaete was counted as one individual in the present study, the number of oligochaetes shown in the present report does not indicate the actual density. The number should be treated as an indicator, and we must take biomass value into consideration for understanding the structure of Lake Kasumigaura ecosystem.

References

Iwakuma, T. (1987): Density, biomass, and production of Chironomidae (Diptera) in Lake Kasumigaura during 1982-1986. Jpn. J. Limnol., 48: S59-S75.

Iwakuma, T. (1990): Change in densities and biomasses of chironomid larvae in the pelagic zones of Lake Kasumigaura during 1982-1990. Miscell. Rep. Natl. Inst. Environ. Stud., F25: 53-79 (in Japanese).

Iwakuma, T. and M. Yasuno (1981): Chironomid populations in highly eutrophic Lake Kasumigaura. Verh. Int. Ver. Limnol., 21: 632-642.

Iwakuma, T. and M. Yasuno (1983): Fate of the univoltine chironomid, *Propsilocerus akamusi* (Diptera: Chironomidae), at emergence in Lake Kasumigaura, Japan. Arch. Hydrobiol., 99: 37-59.

Iwakuma, T., M. Yasuno and Y. Sugaya (1984): The distribution and production of zoobenthos, and the role of chironomids in the matter flow, in Lake Kasumigaura. Res. Rep. Natl. Inst. Environ. Stud., 51: 103-140 (in Japanese with English summary).

Saether, O. A. and X. Wang (1996): Revision of the orthoclad genus *Propsilocerus* Kieffer (=*Propsilocerus* Sasa) (Diptera: Chironomidae). Ent. Scand. 27: 441-479.