Dynamics of planktonic communities in Lake Shumarinai

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(1)Bacterioplankton and picophytoplankton

Fig.1 shows horizontal distribution of bacterioplankton (comparison with surface layer at sta.1-6) and vertical distribution (sta. 1 and 2). Bacterioplankton density in surface layer varied from 8.71 x 10^6 cell/ml (Sta5) to 1.32×10^8 cell/ml (Sta.6), and its mean value was 6.83×10^7 cell/ml. The density increased in summer with water temperature. The vertical distribution showed higher level in metalimnion and hypolimnion than in surface layer.. In general, the cell density is high in eutrophic level. Although Lake Shumarinai is not in eutrophic level, bacterioplankton cell size was smaller and was higher than that in other eutrophic lake (10^6-10^7 cells/ml).

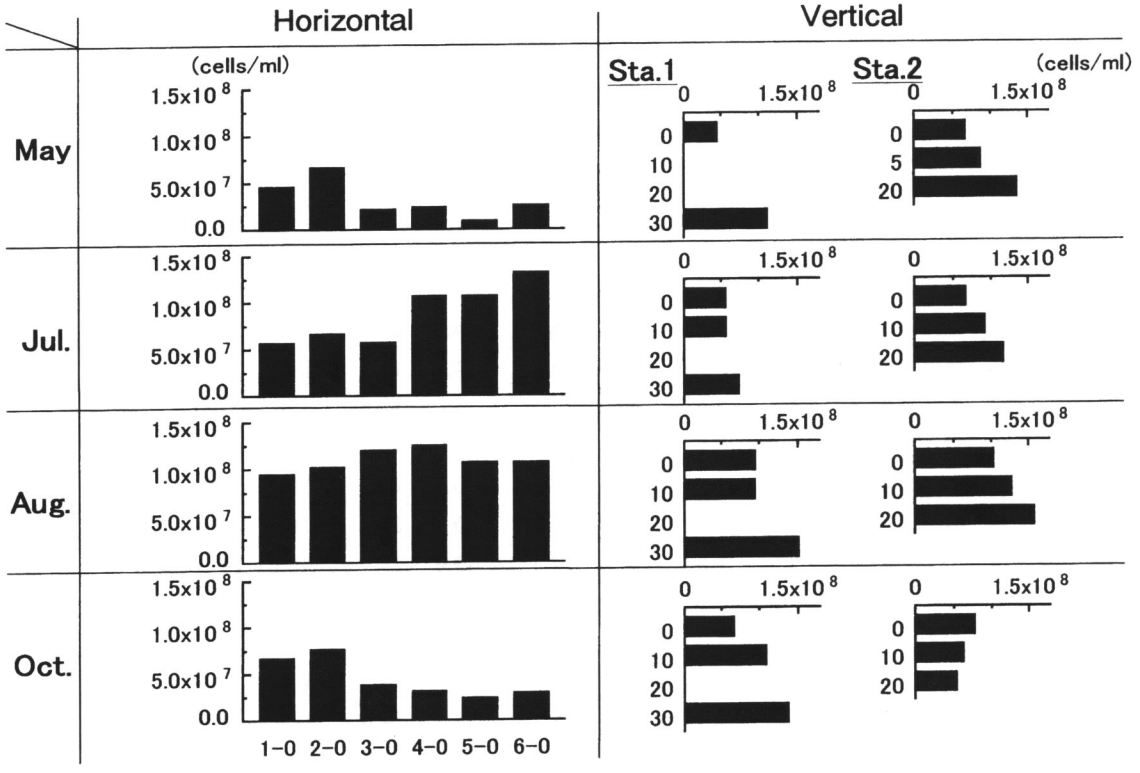

Fig.1 Bacterial density of horizontal and vertical distribution in Lake Shumarinai (2002)

Picophytoplanton was separated red type from orange type when those were measured by fluorescent microscope. In surface layer, the total cell density varied from 5.22×10^3 cell/ml (Sta.2) to 1.11×10^5 cell/ml (Sta.5), and mean value was 3.76×10^4 cell/ml. The cell density increased in summer similar to bacterioplankton. In vertical distribution, red type and orange type plankton mainly distributed in surface layer and in deep layer, respectively.

(2)Changes in species compositions and abundance of phytoplankton

The species compositions and abundance of phytoplankton were investigated in Lake Shumarinai. Fig.2 shows fluctuation in cell density of phytoplankton as mean value of surface layer in all stations on May, June , August and October in 2002 and 2003. Diatoms dominated in May. The dominant phytoplankton species was *Diatoma* sp., and the cell density 4500 cells/ml as mean value of surface layer in all stations. This dominant species was replaced by *Stephanodiscus astraea* and by *Aulacoseira ambigua* in June, and by several flagellates in August.

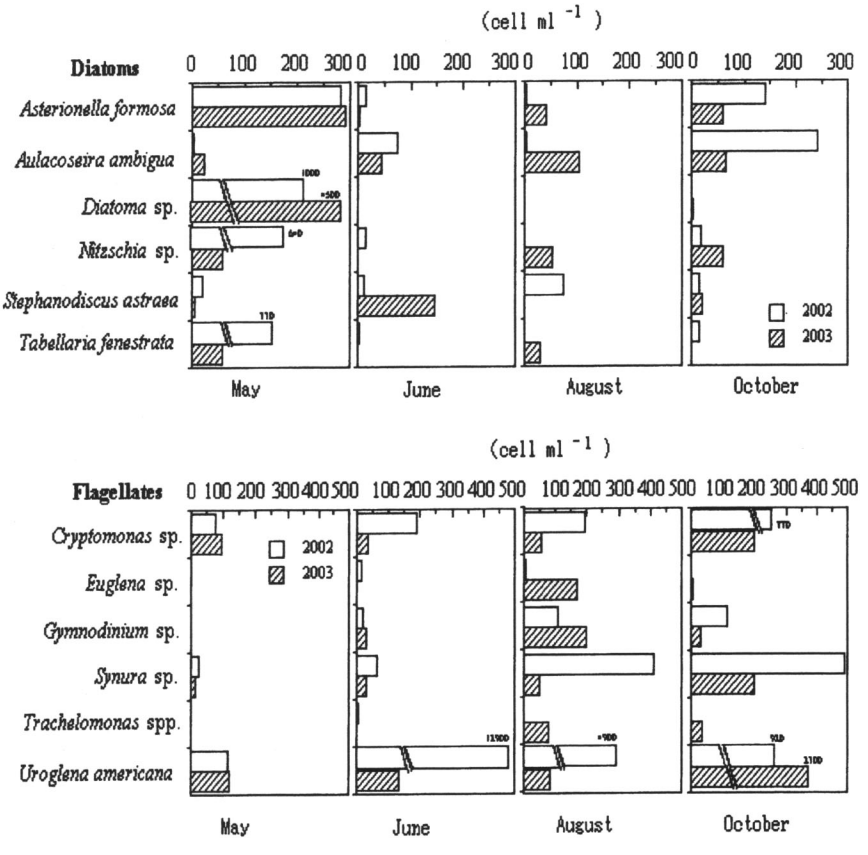

Fig.2 Cell density of phytoplankton in Lake Shumarinai (2002-2003)
(Mean value of surface layer in Sta. 1-6)

Anabaena planktonica did not appear abundantly in June and August in 2002, 2003 and

2005. In contrast, it increased in summer on 2002 and 2004 and formed the dense water bloom. In autumn, diatoms slightly appeared and mixotrophic phytoplankton appeared instead of diatoms. *Uroglena americana, Gymnodinium* sp., and *Synura* sp. showed a high cell density from June to October. *Uroglena Americana* was most dominant species and its maximum cell density was 12900 cells/ml in 2002, and 2300 cells/ml in 2003 although its density varied markedly (Fig.3). Although water bloom of *Anabaena planktonica* did not appear, dense *Gymnodinium* sp. appeared in 5 m layer(5±0.3 m) at Sta.2 in 2005.

Characteristic of this lake for phytoplankton is that much mixotrophic phytoplankton appeared from summer to autumn. As phosphorus is lacking in this lake at the same time, mixotrophic phytoplankton might increase to obtain phosphorus *etc* from bacteria and picoplankton by predation. However, water bloom of *Anabaena planktonica* appeared in July and August in 2002 and 2003. In this time, this phytoplankton must uptake phosphorus by method except for predation. It is unclear for the reason that *Anabaena* and mixotrophic phytoplankton coexist in the same time in 2002. The low temperature or shortage of water may be also one of the reasons for the difference of dominant species and abundance of phytoplankton and zooplankton between 2002 and 2003.

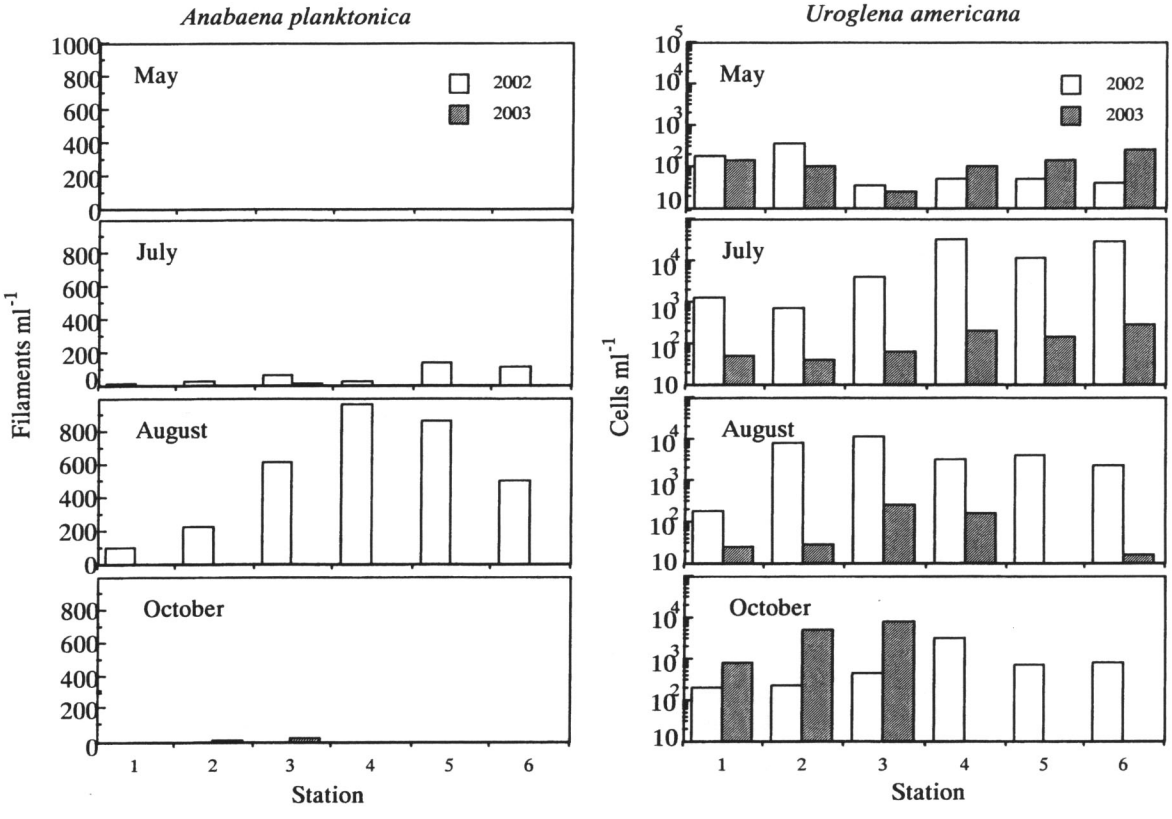

Fig.3 Seasonal variation of filamentus and cell density *Anabaena planktonica* and *Uroglena americana* in Lake Shumarinai

(3) Changes in species compositions and abundance of zooplankton

Fig.4 shows fluctuation in individual density of zooplankton as mean value of surface layer in all stations. Maximum individual density in each station was 178 inds./l (Aug. 2003; Sta. 6), and minimum was 0.0 inds./l (Oct. 2003; Sta. 1, 4, and 5). In Lake Shumarinai, Copepoda slightly appeared in all stations, and Eurotatorea was relatively dominant. The dominant zooplankton species are *Asplanchna priodonta*, *Polyarthra vulgaris*, and *Keratella cochrearis* throughout a year. *Filinia longiseta* and *Holopedium gibberum* are also abundant in 2002 and 2003, respectively. In Lake Shumarinai, zooplankton was not abundant in May 2002 and October 2003. This phenomenon might be due to low water temperature because of late spring or early winter. Low water temperature introduced decreasing of phytoplankton activity and biomass, and lacking of food for zooplanktons.

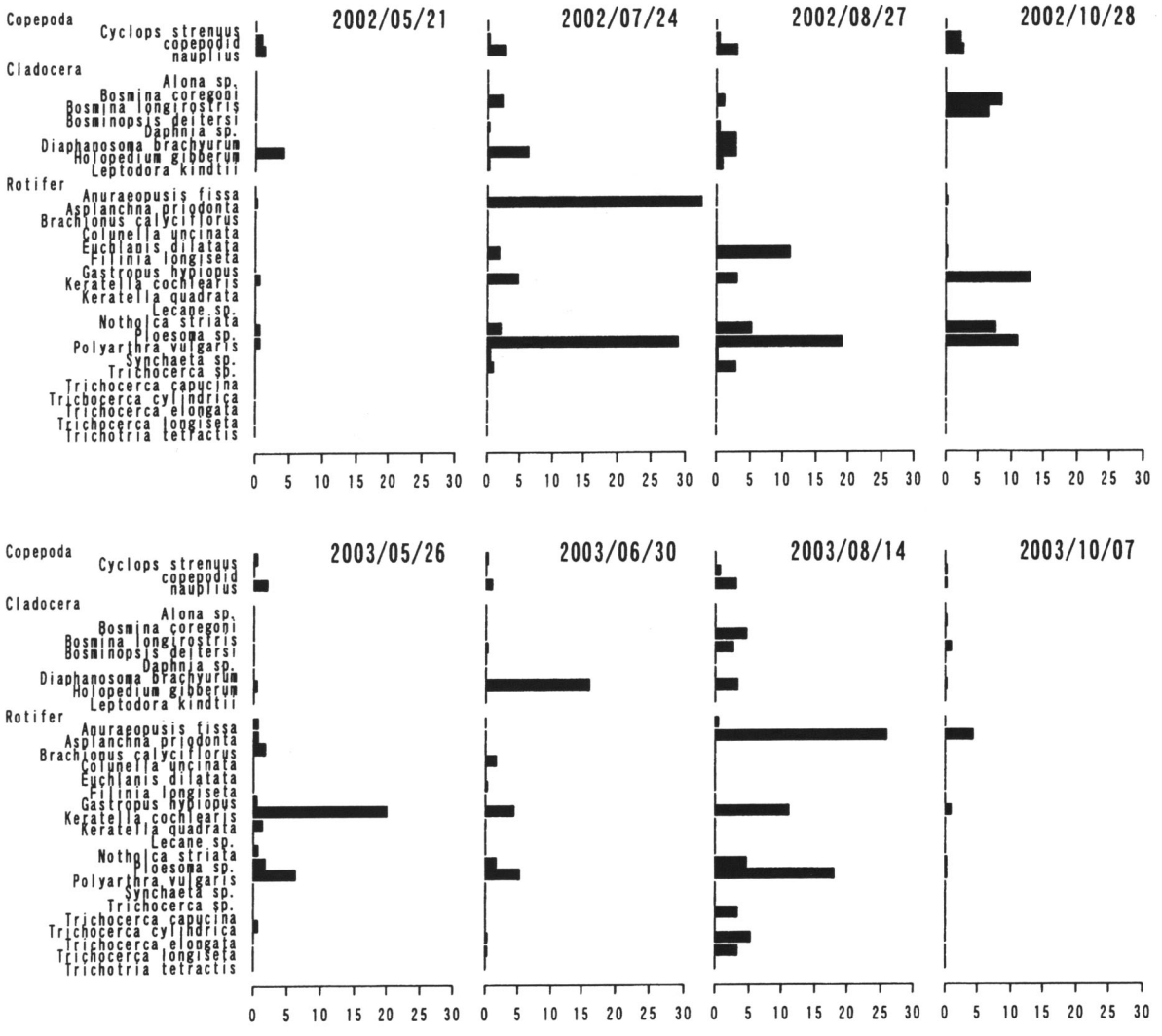

Fig.4. List of zooplankton in Lake Shumarinai (2002-2003).

(4) Interaction of microbial community

Fig. 5 shows interaction of microbial community in Lake Shumarinai. Fluctuation in cell density or individual density of bacterioplankton, picophytoplankton, phytoplankton, and zooplankton was due to feeding together besides water temperature and light intensity etc. Rotifer (Eurotatorea) highly related to Crysophyta and red type picophytoplankton. Although diatoms highly related to Chlorophyta (positive correlation) and bacterioplankton (negative correlation), it did not related to other zooplankton community.

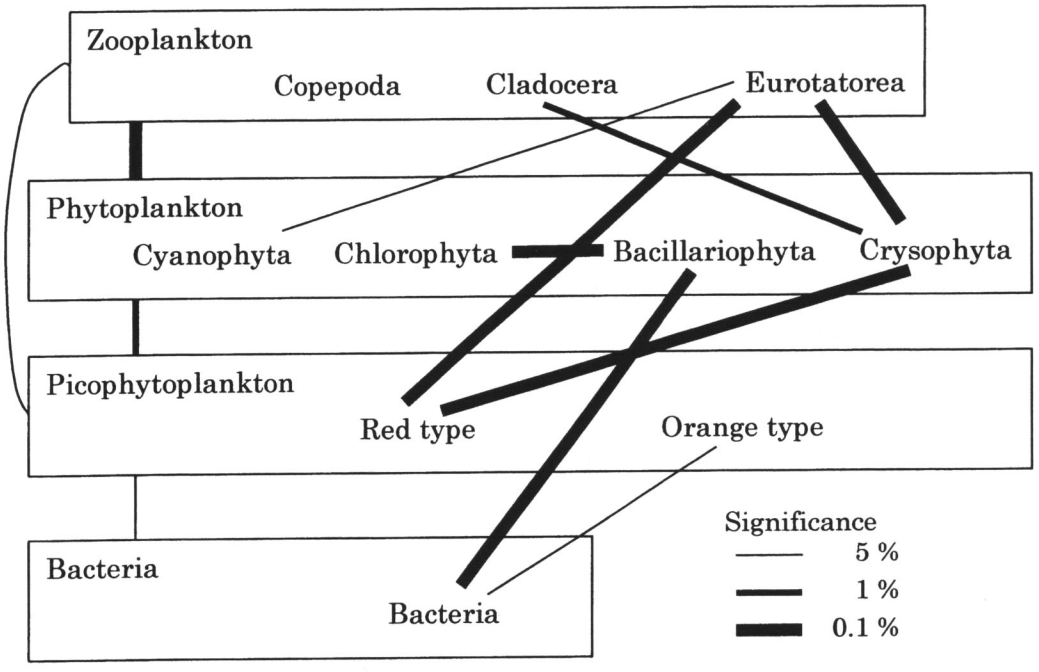

Fig.5 Interaction of microbial community in Lake Shumarinai.