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The limnological survey of a coastal lagoon in Korea: Lake Hwajinpo

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ABSTRACT: Physicochemical parameters, plankton biomass, and sediment were surveyed from 1998 to 2000 on two months interval in a eutrophic coastal lagoon (Lake Hwajinpo, Korea) segregated from the sea by a sand dune. Littoral zone is well developed and floating-leaved aquatic plants also thrive. A shallow sill divides the lake into two basins. It has permeation of seawater and chemoclines formed by salinity were observed at 1m depth all the year round. DO was often very low (< 1 mgO_2/L) at hypolimnion. Temperature inversions were observed in November. Transparency was 0.2～1.7 m. Nitrate and ammonium concentrations were very low (< 0.1mgN/L), even though TN was usually 2.0～3.5 mgN/L. TN/TP was generally lower than the Redfield ratio. TSI was 63～74. COD, TP, and TN of sediment were 3.1～40.3 mgO_2/g, 0.91～1.39 mgP/g, and 0.34～3.07 mgN/g, respectively. Phytoplankton chlorophyll-a was mostly over 40 mg/m^3. Two basins showed different phytoplankton communities with *Oscillatoria* sp., *Trachelomonas* sp., *Schizochlamys gelatinosa*, and *Anabaena spiroides* dominant in South basin, and with *Trachelomonas* sp., *Schroederia* sp., *Schizochlamys gelatinosa*, and *Trachelomonas* sp. dominant in the North basin. The seasonal succession of phytoplankton was very fast, possibly due to sudden changes in physical characteristics such as wind, turbidity, salinity and light, etc.

Introduction

Lake Hwajinpo, a lagoon in the eastern coastal of Korea, has brackish water. It is a total surface area of 2.3 km^2 and is divided into two halves being narrow at the center. Each half has different water quality: biotic effected freshwater in the south and seawater in the north. The maximum depth was about 5m. The drainage area is 19.9 km^2 with a field area of 4.19 km^2 and forest area of 10.97 km^2 in drainage basin. The livestock population was also significantly high (2,000 in number, which included of pigs, cattle and poultry) and the human population was about 1,740 persons. Therefore most nutrient loading comes from non-point sources in the watershed. Most of sewage is not treated properly causing eutrophication of lake, which increased the density of phytoplankton, turbid water and bad smells from the anaerobic sediment. The general N loading was 270 kg/day and general P loading was 48 kg/day (Heo *et al.*, 1999).

In this study limnological parameters were surveyed in Lake Hwajinpo located the eastern coast of Korea. Salinity, DO, SS, TP, TN, chlorophyll *a* concentration, secchi disc transparency (SD) and dominant phytoplankton were measured from May 1998 to November 2000.

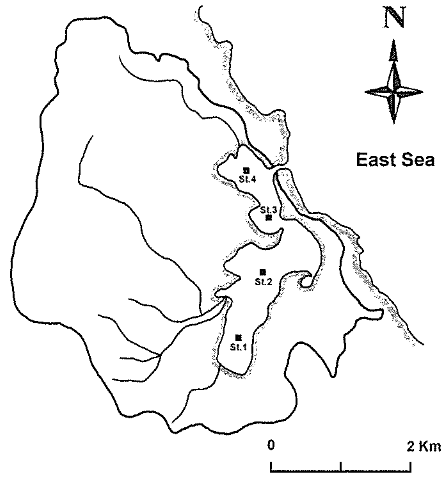

Fig. 1. Map showing the watershed and sampling sites of Lake Hwajinpo.

Materials and Methods

The water samples were collected on 4 sites (Fig. 1), on two months interval, from May 1998 to November 2000, using PVC Van Dorn. Salinity, DO, SS, TP, TN, chlorophyll *a* concentration, secchi disc transparency (SD) and dominant phytoplankton were measured. The water samples were taken at different levels as well as from the sediment. The samples collected were later filtered using the GF/C filter paper in the lab. The filtered paper was preserved in the freezing state and was homogenized to extract chlorophyll *a*. Lorenzen (1967) method was used to calculate chlorophyll *a*. Filtered water was then used to calculate dissolved nitrogen and phosphorus. While not filtered water samples were used to calculate TP and TN. The TP was calculated using Standard Methods (1992) of per-sulfate digestion and ascorbic acid. The TN was calculated using cadmium reduction method using the equipment (BRAN+LUEBBE, Auto Analyzer3). Temperature, DO, salinity and turbidity were calculated using Multiprobe (YSI 6000).

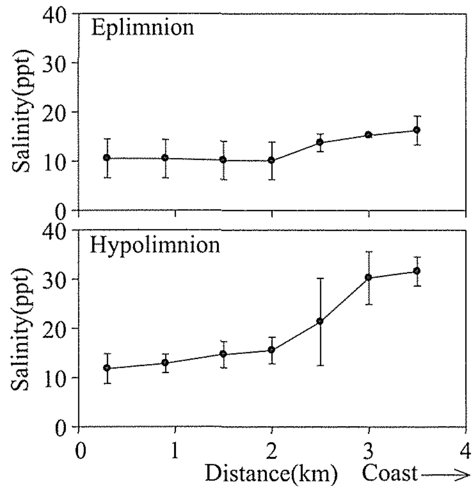

Fig. 2. Horizontal variations of salinity(‰) in epilimnion and hypolimnion.

Results and Discussion

Strong vertical chemocline is observed in lake with large difference of DO between surface and sediment. Turbulence and the vertical transfer of oxygen and nutrients are strongly suppressed by the chemocline of high stability caused by saline bottom water. The DO was often very low (<1 mgO_2/L) at the hypolimnion. The DO concentration at the epilimnion was also extraordinary high (about 15 mgO_2/L) due to the photosynthesis of phytoplankton and macrophytes. But in November, the temperature showed inverse vertical flux. With increase of depth, the temperature showed slight increase because of the higher salinity in the hypolimnion in both lakes. The north lake is a path to ocean but the south retains fresh water stream inflow for a longer period (1.3 years). The salinity concentration at the both hypolimnion and epilimnion was low in the South lake, but the North lake, had higher salinity concentration in both hypolimnion and epilimnion. (Fig. 2).

The algal growth and turbulence by wind mixing in the south lake resulted to less transparency of 0.2

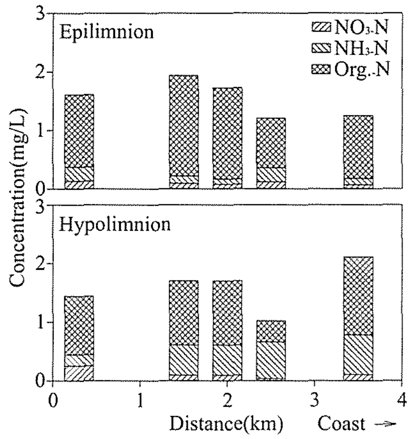

Fig. 3. Distributions of nitrogen concentration(NO_3-N, NH_3-N, Org-N) in the epilimnion and hypolimnion from the distance(Data is monthly averages of nitrogen).

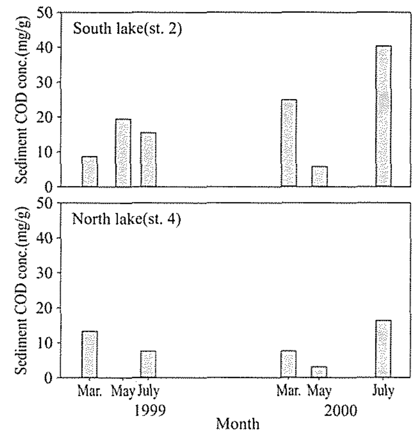

Fig. 4. Monthly variations of COD concentration on the surface sediment in the site 2 and 4.

~1.5m. The transparency in the north lake was 0.4~1.7m. Nitrate and ammonium concentrations were very low (< 0.1mgN/L), even though TN was usually 2.0~3.5 mgN/L (Fig. 3). Nitrogen seems to be the limiting nutrient for phytoplankton. The TP and DIP were in the range of 0.045~0.22 mg/L and 0.002 ~0.033 mg/L respectively. Though the TN/TP weight ratio is not lower than the average algal composition. Light deficiency also seems to be an important limiting factor for phytoplankton. TSI was in the range of eutrophy to hyper-eutrophy, from 63 to 74. COD of sediment was 3.1~40.3 mgO_2/g, (Fig. 4). While the TP and TN on the sediment was 0.91~1.39 mgP/g, and 0.34~3.07 mgN/g respectively (Fig. 5).

Phytoplankton chlorophyll-a was mostly over 40 mg/m^3. Two basins showed different phytoplankton communities with *Oscillatoria* sp., *Trachelomonas* sp., *Schizochlamys gelatinosa*, and *Anabaena spiroides* dominant in South basin, and with *Trachelomonas* sp., *Schroederia* sp.,

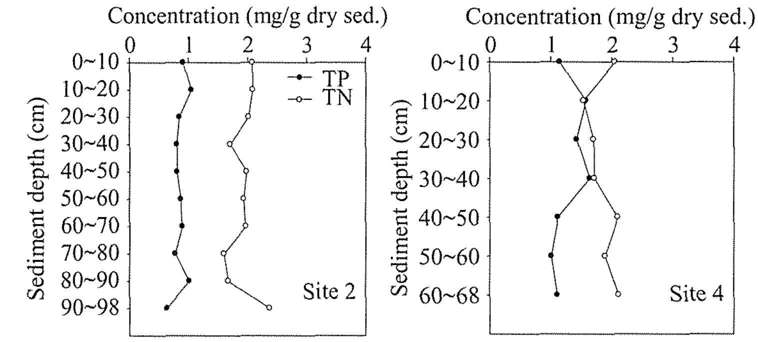

Fig. 5. Vertical distributions of TP and TN concentration in lake sediment.

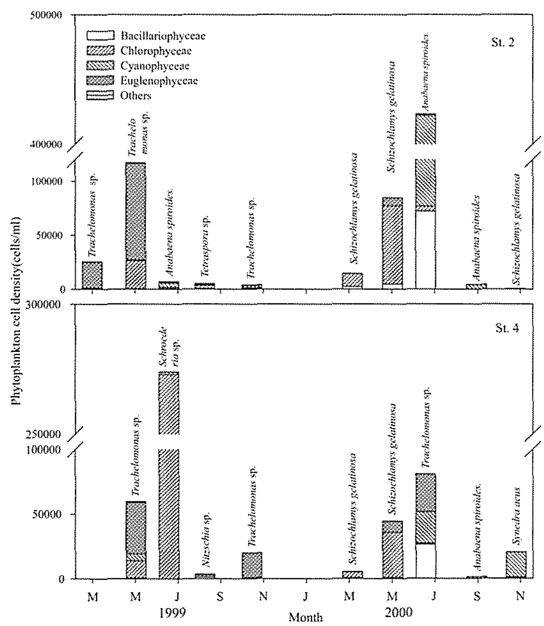

Fig. 6. Seasonal variations of phytoplankton cell density (cells/ml) and dominant species.

Schizochlamys gelatinosa, and *Trachelomonas* sp. dominant in the North basin (Fig. 6). The seasonal succession of phytoplankton was very fast, possibly due to sudden changes in physical characteristics such as wind, turbidity, salinity and light, etc.

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