



Study on the Spatiotemporal Changes of Zooplankton Community Structure and Water Quality Evaluation in Shijiu Lake of Jiangsu Province

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Abstract. In order to understand the changes in the community structure and water quality evaluation of zooplankton in Shijiu Lake of Jiangsu Province, the project team conducted sampling and analysed of zooplankton in Shijiu from January to December 2022. The research results indicated that there were 42 species of zooplankton in Shijiu Lake, Protozoa had 16 species, which accounted for 38.1% of the overall species. Rotifers had 16 species, which accounted for 38.1% . Cladocera had 6 species, which accounted for 14.3%. Copepods had 4 species, which accounted for 9.5%. The zooplankton in Shijiu Lake were mainly dominated by Protozoa and Rotifers. Cladocera and Copepods contributed significantly to the biomass. The average density of Shijiu Lake 's zooplankton was 2133.0 ind./ L, the average biomass of Shijiu Lake 's zooplankton was 2.4850mg/L. The Shannon -Wiener diversity index of zooplankton indicated that Shijiu Lake was a moderately polluted water body.

Keywords: Shijiu Lake; zooplankton community structure; water quality evaluation; Shannon -Wiener diversity index.

1 Introduction

Shijiu Lake, also known as Beihu Lake, was once a part of the ancient Danyang Lake in history. It is the only lake in Jiangsu Province that connects to the Yangtze River^[1]. It is a structural freshwater lake with a protected area of 222.9 km² (115.3 km² within Jiangsu Province). It mainly serves functions such as flood control and storage, water resource supply, ecological maintenance, fisheries and aquaculture, and tourism.

In recent years, the ecosystem of Shijiu Lake had suffered significant damage, duing to human activities in the watershed and fishing activities in the lake area. At present, scientific research on Shijiu Lake mainly focuses on sediment^[2], with relatively little research on aquatic organisms. As a component of aquatic organisms, zooplankton are the bait for fish and other economic animals, and are important secondary producers in the aquatic ecosystem. They have strong sensitivity to the water environment and can

better characterize changes in the nutritional status of the water body. The author mainly chose Shijiu Lake in Jiangsu Province as the research object, conducted monthly surveys of zooplankton in 2022, and analyzed the spatiotemporal dynamic changes in their density and biomass, in order to provide scientific support for the protection and management of the aquatic ecological environment of Shijiu Lake.

2 Materials and Methods

2.1 Sample Distribution

Based on the hydrological conditions and basin shape of Shijiu Lake, as well as the retention time of the lake's water, and taking into account various factors such as inflow and outflow rivers, aquaculture, and water bodies affected by external sources (point and non-point sources), 12 sampling points were set up (Figure 1).

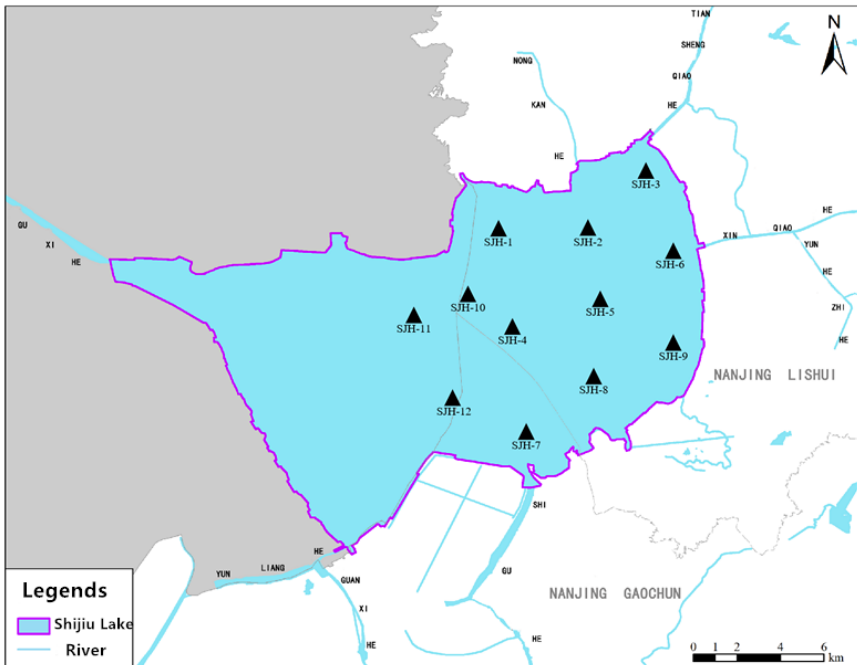


Fig. 1. The sampling points of Shijiu Lake

2.2 Processing and Analysing

2.2.1 Collection and Identification of Zooplankton in Shijiu Lake.

The collection, processing, and identification of zooplankton samples in Shijiu Lake were carried out by standard DB32/T 3202-2017.

2.2.2 Data Statistics and Analysis.

Mainly using EXCEL and SPSS22.0 software for corresponding processing and analysis of zooplankton data [3].

2.2.3 Calculation Method for Dominance of Zooplankton.

The formula for calculating the dominance of zooplankton could be found in reference 4 [4], Selected $Y(\text{dominance degree}) \geq 0.02$ as the dominant species.

2.2.4 Calculation Method of Shannon -Wiener Diversity Index of Zooplankton.

The diversity of planktonic animal species in Shijiu Lake was calculated using the Shannon -Wiener index formula, as shown in reference 4.

3 Results and Analysis

3.1 Temporal Changes in the Community Structure of Zooplankton in Shijiu Lake

3.1.1 Composition and Dominant Species.

A total of 42 species of planktonic animals were observed in the microscopic examination of water samples throughout 2022. There were a total of 42 species of zooplankton in Shijiu Lake. Protozoa had 16 species, which accounted for 38.1% of the overall species. Rotifers had 16 species, which accounted for 38.1%. Cladocera had 6 species, which accounted for 14.3%. Copepods had 4 species, which accounted for 9.5%.

The dominance of Protozoa were *Strobilidium* sp., *Tintinnopsis kiangsuensis* and *Diffflugia globulosa*. The dominance of Rotifers were *Keratella cochlearis*, *Polyarthra dolichoptera* and *Brachionus calyciflorus*. The dominance of Cladocera were *Bosmina coregoni* and *Moina micrura*. The dominance of Copepods were *Sinocalanus dorrii*, *Copepodid* and *Nauplii*.

3.1.2 Temporal Changes in the Community Structure.

The survey showed that the annual average total density of zooplankton was 2133 ind./ L. Among them, the annual average density of Protozoa was 1075 ind./ L. The annual average density of Rotifers was 1030 ind./ L. The average annual density of Cladocera was 11 ind./ L. The average annual density of Copepods was 17 ind./ L. The data reflected that the determined density of zooplankton in Shijiu Lake were Protozoa and Rotifers, the density of Cladocera and Copepods was relatively low.

Protozoa had the highest annual density (1525 ind./ L) in spring, the lowest annual density was 316.7 ind./ L in winter. The highest annual density of Rotifers was in autumn, with a density of 2383.3 ind./ L, the lowest was 208.3 ind./ L in winter. The highest annual density of Cladocera was 15.8 ind./ L in autumn, the minimum was in winter, which was 5 ind./ L. Copepods had the highest annual density (27.9 ind./ L) in autumn, the minimum annual density (8.3 ind./ L) was in winter.

The biomass of value was 2.48mg/L in Shijiu Lake. The biomass of Protozoa was 0.095mg/L, accounting for 3.8%.The biomass of Rotifers was 1.97mg/L, accounting for 79.2%. The biomass of Cladocera was 0.26mg/L, accounting for 10.6%. The biomass of Copepods was 0.16mg/L, accounting for 6.4%. Although the combined annual density of Cladocera and Copepods accounted for only about 1.5% of the total density of zooplankton, their biomass accounted for over 15%.

3.2 Spatial Change of Zooplankton Density and Biomass

The spatial distribution of zooplankton density and biomass in Shijiu Lake was basically consistent, with high values of density and biomass occurring in the southern water body of Shijiu Lake, while the central and northern water body of the lake area were relatively lower. The data showed that the variation range of planktonic animal density in Shijiu Lake was 886.3~3355 ind./L,the top five sampling points were SJH-7, SJH-8, SJH-6, SJH-9, and SJH-12, with the lowest value occurring at SJH-3 sampling point.The range of annual average biomass variation was 1.47-4.96mg/L. The top five biomass sites were SJH-7, SJH-6, SJH-8, SJH-10, and SJH-9, with the lowest annual average biomass occurring at SJH-4 site(Figure 2).

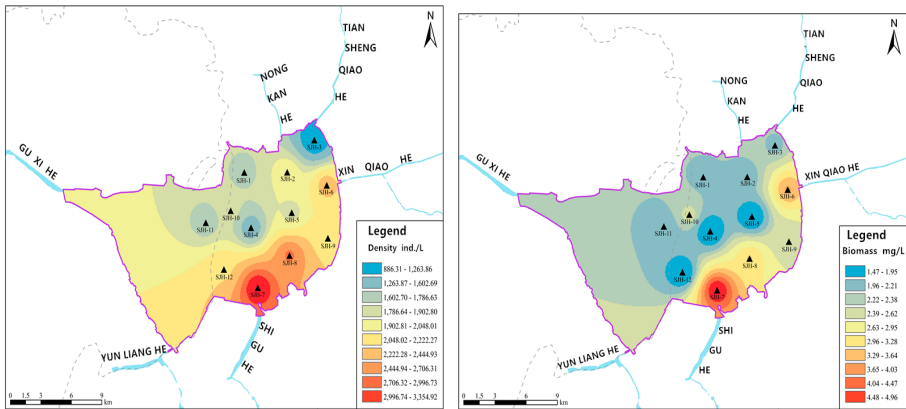


Fig. 2. Spatial variation map of density and biomass

3.3 Water Evaluation of Zooplankton in Shijiu Lake

The Shannon-Wiener index in Shijiu Lake was from 1.6 to 2.4, the average annual value was 1.95. Based on the diversity index, it could be concluded that Shijiu Lake was a moderately polluted water body.

The diversity of zooplankton showed significant spatiotemporal changes^[5], with low values appearing in the southern waters of Shijiu Lake and higher diversity in the open water areas in northern part of the lake as shown in Figure 3.

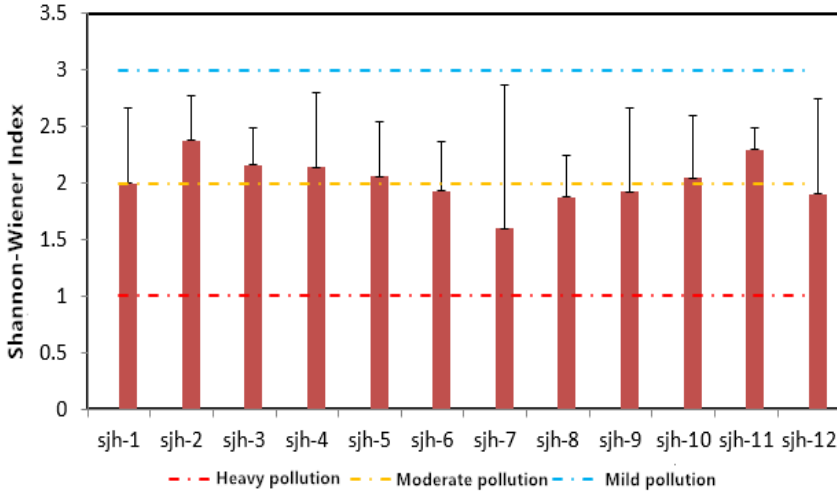


Fig. 3. Spatial variation of zooplankton diversity in Shijiu Lake

4 Conclusion

(1) There were a total of 42 species of zooplankton in Shijiu Lake. Protozoa had 16 species, Rotifers had 16 species, Cladocera had 6 species, Copepods had 4 species.

(2) The average density of Shijiu Lake 's zooplankton was 2133.0 ind./ L, the biomass was 2.4850mg/L.

(3) The Shannon -Wiener diversity index of zooplankton in Shijiu Lake had an annual average of 1.95, indicated that Shijiu Lake was a moderately polluted water body.

5 Discussion

(1) The zooplankton in Shijiu Lake were dominated by Rotifers and Protozoa in terms of biological density and species. Although large crustaceans (such as Cladocera and Copepods) were relatively small in number, they contributed significantly to the biomass. This was similar to the conclusions drawn from the study of the community structure characteristics of zooplankton in other lakes^{[6]-[8]}.

(2) Shijiu Lake had many dominant species such as *Diffflugia globulosa*, *Sinocalanus dorrii* and other pollution resistant species, indicated that the water in Shijiu Lake had been polluted to a certain extent^{[9]-[11]}.

The Shannon -Wiener diversity index of zooplankton in Shijiu Lake indicated that Shijiu Lake was a moderately polluted water body. This was consistent with the appearance of dominant species of zooplankton in the middle pollution zone of Shijiu Lake.

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