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Aquatic Biocommunity and Ecological Effects of Environmental Pollution in Poyang Lake

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Abstract: In recent years, with the rapid development of urban economy and water conservancy construction, the water environment in the Poyang Lake Basin has gradually deteriorated. Freshwater ecosystems are destroyed, soil erosion is intensified, lakes tend to be more tropical, and the risk of environmental pollution increases. The purpose of this paper is to study the structure of aquatic organism community and the ecological effect of environmental pollution in Poyang Lake. The ecological effects of aquatic biodiversity and environmental pollution are introduced. This paper summarizes the overall environmental status of the Poyang Lake Basin and puts forward the protection strategies of Poyang Lake aquatic organisms. Focus on analyzing the temporal and spatial dynamics of the zooplankton community structure in Poyang Lake, study the differences in community structure in different seasons and divide different types of communities, explore the factors that lead to differences in community structure, and analyze the main community structures. Environmental factors affecting zooplankton community structure. The water quality of Poyang Lake was evaluated by water physicochemical factors and biological indicators. The Shannon-Wiener diversity index and BI index evaluation results showed that the water body of sampling point 2 was seriously polluted, and most of the other water bodies were moderately or polluted.

1. Introduction

The lake ecosystem is the ecosystem of the lake water body and is one of the still water ecosystems. Compared with river ecosystems, lake ecosystems have the characteristics of poor mobility, low oxygen content, and easy pollution [1]. Wet emergent floating-leaf plants are distributed in the amphibious complex belt. Among them, in the open shallow water area of the lake, a large number of submerged plants are distributed at four o'clock. In addition, small plankton, benthic animals and fish, etc., under the material cycle and energy flow, form an intricate ecosystem network that is interconnected and restricted [2].

As an important part of the ecosystem, the aquatic ecosystem provides essential water resources for people, and its main functions include protecting species diversity and improving the quality of the water environment [3]. Since EPA and DHA are mainly produced in aquatic ecosystems, Gladyshev MI calculated the aquaplanar fluxes of these PUFAs versus the biomass of emerging aquatic insects in several biomes. Calculate the water/land area ratio for each biome by dividing each biome's water area by its land area. Data on insects emerging from water bodies were summarized and averaged for each biome. PUFA fluxes occurred between biomes and ranged from 0.04 to 4.39 mg m(-2) year(-1)[4]. Castro M detected nitrifying communities in the water column of the Columbia Pacific Basin with oxygen levels between 6 and 56 M. It was analyzed by terminal restriction fragment length polymorphism (TRFLP) and by pyrosequencing the gene nosZ. These genes are responsible for the production and consumption of the greenhouse gas N2O [5]. By investigating the annual plankton community structure of plankton community, plankton diversity and its relationship with environmental factors, it is very important to discover problems, discover laws, and formulate targeted restoration plans [6].

This paper established 9 sampling points in Poyang Lake, collected zooplankton samples in different seasons, and analyzed the spatiotemporal structure of zooplankton species, dominant species, different species and functional groups. By collecting water samples at different times, various physical and chemical parameters of water bodies can be measured on-site or in the laboratory. A variety of statistical analysis methods were used to analyze the relationship between zooplankton community and the physical and chemical properties of water bodies, to find out the main factors affecting the structure of zooplankton, and to evaluate the water quality of zooplankton.

2. A Study on the Structure of Aquatic Biocommunity and Ecological Effects of Environmental Pollution in Poyang Lake

2.1 Ecological Effects of Aquatic Biodiversity and Environmental Pollution

Biodiversity is the sum of the genotypes and phenotypes of plants, animals, fungi and microorganisms on the earth and is a part of the ecosystem [7]. Simply put, it is the totality of life on earth. Biodiversity is multi-dimensional, and no single measure can fully reflect biodiversity. Biodiversity is considered to be the most important determinant of ecosystem function and stability, and biodiversity helps to improve primary productivity [8].

Functional diversity is measured by integrating biological groups with similar ecological functions on the background data of species diversity. The main concern is not the abundance of species, but the diversification of functional groups in the community. Lineage diversity not only includes species diversity information, but also emphasizes the affinities of species distributed in the community. If the community consists of more closely related species, the lineage diversity is low, and vice versa. The three dimensions of biodiversity are both interrelated and complementary to each other. Selecting suitable biodiversity dimensions for analysis on different ecological issues will provide a reasonable explanation for the status and dynamics of community structure [9-10].

2.2 The Overall Environment of the Poyang Lake Basin

With the rapid increase of GDP, a series of problems such as environmental pollution and ecological damage have begun to plague governments at all levels and the public [11]. Jiangxi belongs to a large agricultural province, and the pace of industrialization is relatively slow. Thanks to this, the ecological environment of the Poyang Lake Basin is relatively lightly eroded by industrialization. Industrial waste only causes local environmental pollution, which is concentrated in cities and counties and towns along the railway., non-ferrous metal industrial and mining areas in southern and northeastern Jiangxi, as well as industrial cities, while most of the villages and hills are less affected by industrial activities, and the ecological environment is relatively good [12]. However, due to insufficient investment in environmental protection funds, the province and prefectures have poor environmental monitoring and pollution control capabilities, making it difficult to adapt to the needs of environmental management in the new century [13].

2.3 Strategies for the Protection of Aquatic Organisms in Poyang Lake

First of all, the sand mining industry is strictly controlled. In recent years, disordered sand mining is one of the main factors that destroy the fishery habitat of Poyang Lake. At present, the sand dredging area is mainly concentrated in the area of the Tongjiang waterway, and the sediment has been seriously damaged. Affect the survival of aquatic organisms [14-15]. The sand mining industry should be regulated and illegal sand mining should be banned. Secondly, the high pollution load of the Poyang Lake water is the fundamental cause of affecting the quality of the habitat. The pollution sources mainly come from urban domestic sewage and industrial waste water. Non-point source pollution is discharged into [16-17]. Finally, it is an economical and effective way to carry out manual restoration and treatment for the more seriously polluted areas, and plant decontamination plants. For example, plants such as windmill grass and broadleaf cattail have high economic value [18].

3. Investigation and Research on the Structure of Aquatic Biocommunity and Ecological Effects of Environmental Pollution in Poyang Lake

3.1 Study Area

The total area of the Poyang Lake basin is 16.2x106km2, most of which are located in Jiangxi Province. The geographic coordinates are east longitude 115954'~116°12', north latitude 29°02~29919'. Shahu Lake is one of the nine lakes in the Poyang Lake Nature Reserve. It is an artificially adjusted drainage lake with an area of 5.618 square kilometers. The drainage channel is connected to the Xiuhe River, the high water level is connected to the Xiuhe River, and the low water level becomes an independent butterfly-shaped lake. Due to the inundation of seasonal floods, it becomes a typical Xiuhe floodplain lake.

3.2 Biological Evaluation of Water Quality

BI biological index is a biological water quality evaluation index established according to the anti-pollution value of zooplankton. It comprehensively considers the anti-pollution ability and the number of people of each species, and can more accurately judge the degree of water pollution. The formula for calculating the BI index is:

$$BI = \sum_{i=1}^{s} n_i t_i / N \quad (1)$$

Where ni is the total number of individuals of the ith species, ti is the pollution tolerance value of the ith species, S is the number of species at the sampling point, and N is the total number of zooplankton individuals at the sampling point.

Shannon-Wiener Diversity Index (H′):

$$H' = -\sum_{i=1}^{S}(n_i / N) In(n_i / N) \qquad (2)$$

where S is the number of taxa in the community, N is the total number of individuals in the community, and ni is the number of individuals of species i.

4.Analysis and Research on the Structure of Aquatic Biocommunity and Ecological Effects of Environmental Pollution in Poyang Lake

4.1 Zooplankton Community Structure

The zooplankton community structure in Poyang Lake is shown in Figure 1 and Table 1.

Table 1. Composition of zooplankton species

type	kind	Genus	The proportion of species
rotifer	28	30	56
Cladocera	12	6	24
copepods	10	6	20

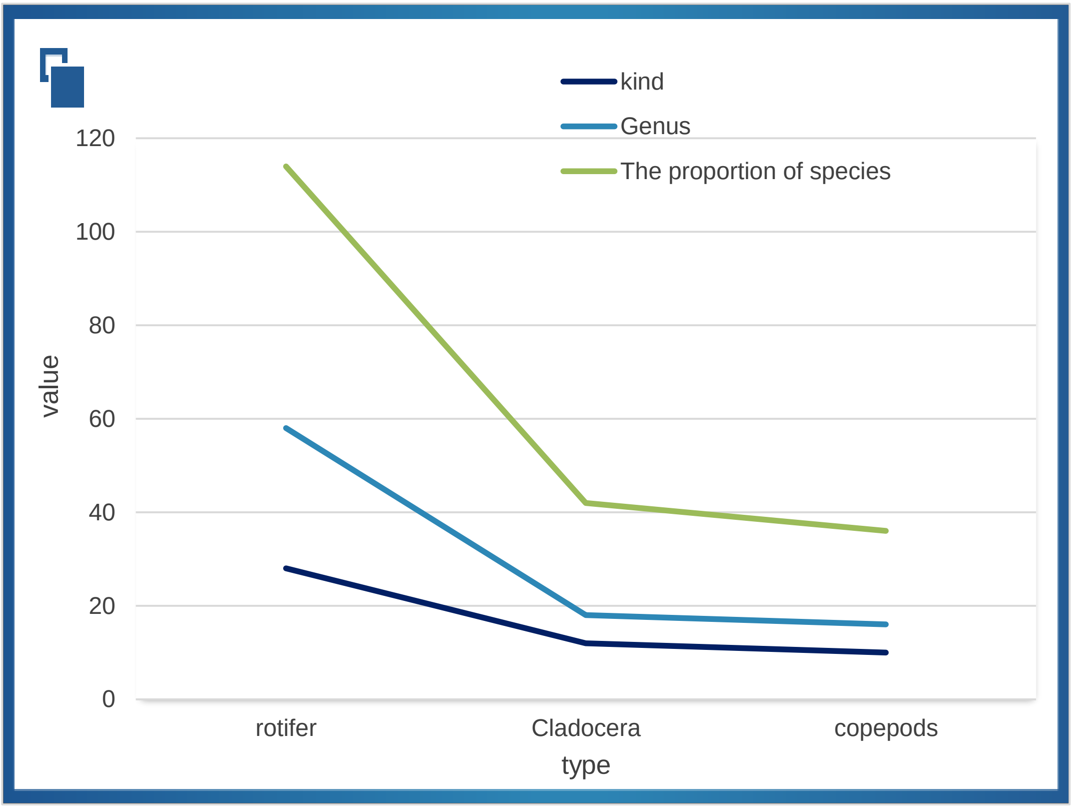

Figure 1. Zooplankton community structure

There were 50 species in spring, 40 species in autumn, and 33 species in winter. In summer, only two points were collected in the river entering the lake, so there were relatively few species, 28 species. The variation of rotifer richness was the same as the total number of species, which was higher in spring, with 50 species, followed by autumn (43 species), and less in winter and summer, with 39 species and 20 species respectively; the species richness of planktonic crustaceans The seasonal changes were more in spring and autumn (10 species and 6 species), and fewer in winter and summer (5 species and 3 species).

4.2 The Relationship between Zooplankton and Environmental Factors

The community distribution in spring is relatively scattered, overlapping with other seasons. In terms of intra-group differences, there was no significant difference between summer and winter points, and the two groups with relatively large intra-group differences were spring and autumn ($P<0.01$). The results of environmental factor analysis showed that water temperature, chlorophyll a, pH and chemical oxygen demand were the main environmental factors affecting the zooplankton community in summer, followed by spring and autumn.

In order to explore the environmental factors that cause the differences in the zooplankton community structure in different seasons, the cluster analysis of the community structure in each season was carried out. The spring community structure characteristics are shown in Table 2. The average abundance of zooplankton in the community Sp-I was the lowest, which was 108.6ind./L, and only three zooplankton species including Daphnia vulgaris were detected in this community. The zooplankton abundance (398.6ind./L) and biodiversity (H'=2.98) of the community Sp-II were the highest among the three groups, and the community structure of the dominant species was relatively complex, and it was a multi-limbed rotifer type community. .

Table 2. Spring community structure characteristics

community characteristics	Sp-I	Sp-II	Sp-III
Species richness (pieces)	3	12	5
Shannon-Wiener Diversity Index	1.75	2.98	1.67
Evenness Index	0.72	0.76	0.84
Abundance (ind/L)	108.6	398.6	211.8

The zooplankton community structure in summer is divided into Su-Ⅰ-Su-Ⅳ groups, and the four groups have obvious community types. The zooplankton community structure in autumn was divided into Au-Ⅰ-Au-Ⅳ groups, and the community characteristics of four groups were more obvious.

4.3 Biological Evaluation of Water Quality in Poyang Lake

In this paper, Shannon-Wiener diversity index and BI index were selected to evaluate the water quality of Poyang Lake. Due to the obvious seasonal changes of zooplankton in Poyang Lake, two biological index values calculated from the annual average density of each point were selected to evaluate the water quality of Poyang Lake.

The evaluation results of the BI index show that the water quality of 4#, 6# and 8# is the best, and its pollution level is average; 5# and 7# are light pollution levels; 2# is the most serious pollution, which is heavy pollution; other 3 1 point is the medium pollution level, as shown in Table 3. After Pearson correlation analysis, it was found that the Shannon-Wiener index and the BI index had a significant negative correlation, indicating that the two evaluation results had good consistency, as shown in Figure 2.

Table 3. Evaluation results of zooplankton water quality at each monitoring point in Poyang Lake

point	H′	pollution level	BI	pollution level
1	1.12	medium pollution	8.16	medium pollution
2	0.64	heavy pollution	8.96	heavy pollution
3	1.08	medium pollution	7.99	medium pollution
4	1.95	medium pollution	5.12	generally
5	1.59	medium pollution	6.97	light pollution
6	2.87	light pollution	5.75	generally
7	1.64	medium pollution	7.18	light pollution
8	2.77	light pollution	5.89	generally
9	1.37	medium pollution	8.05	medium pollution

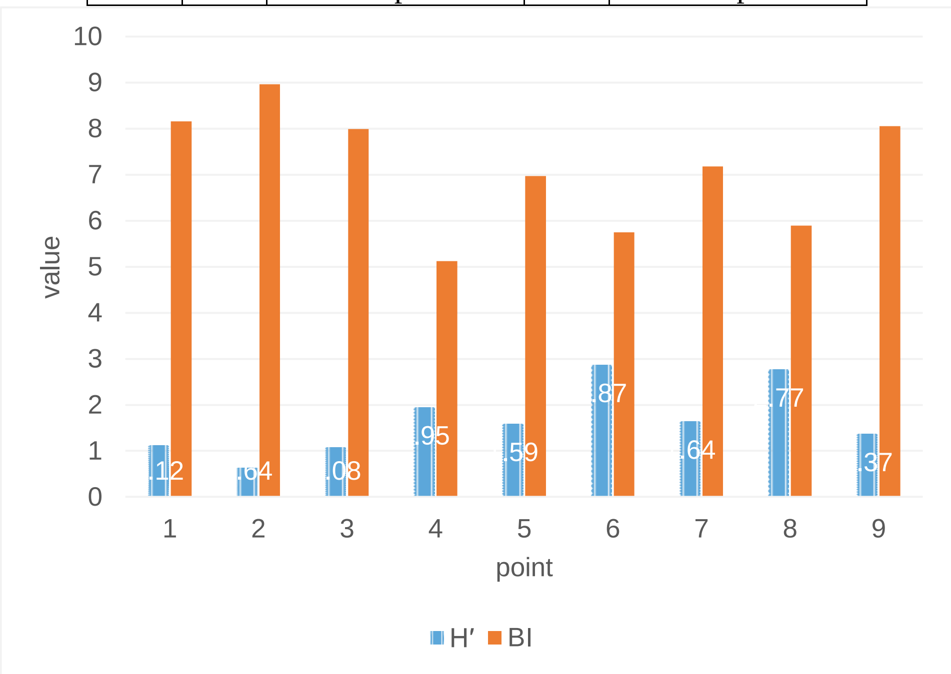

Figure 2. Water quality evaluation by Shannon-Wiener index and BI index

5.Conclusions

Biodiversity is the basis for evaluating the impact of environmental stress and ecological health. How to quickly monitor species diversity is a huge challenge in future environmental management. In addition, the interaction between organisms is a key factor in maintaining the stability of the ecosystem, and how to comprehensively assess the interaction between species in aquatic ecosystems is also the focus of future ecological assessments. In this study, the structural characteristics of the water biological community in Poyang Lake were studied, and the status of water ecology was evaluated. The public policy system and conditional support to promote the environmental governance of the Poyang Lake Basin are proposed. The ecological value of Poyang Lake should be fully valued, and the state should strengthen the ecological construction of the Poyang Lake basin through various forms.

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