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Comparative analysis of the community structure of macroinvertebrates in reservoir and river ecosystems in Jinan

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ABSTRACT

The benthic fauna of the Jinan reservoir ecosystem and river ecosystem is dominated by Insecta species, followed by Gastropoda species, and the species of Insecta and Gastropoda are more in rivers than in reservoirs. Judging from the seasonal changes of benthic species in the two ecosystems, both showed a trend of high in spring and low in autumn. Judging from the changes in the density of benthic invertebrate in the water bodies of the two ecosystems, the total density of benthic invertebrate in the water bodies of the reservoir is low, and the monthly density changes are small, the total density of benthic invertebrate in the river ecosystem is higher than that in the reservoir ecosystem, and the density fluctuation is relatively large. The fluctuation range of benthic diversity in the reservoir ecosystem is smaller than that in the river ecosystem.

KEYWORDS

Benthic invertebrate; Community distribution; River ecosystem; Reservoir ecosystem

1. INTRODUCTION

Benthos are important biological groups in freshwater ecosystems, and the living environment prefers to inhabit the bottom of the water, therefore, it is more sensitive to changes in the water environment, and benthic fauna is often regarded as important indicator organisms for water ecological health assessment at home and abroad [1-2]. Among the benthic fauna of the reservoir ecosystem, the flow velocity of water body in reservoir ecosystem is slow and the sediment is usually silt, the representative benthic species that often inhabit here are the patina ring snail, Hof water worm, stream chironomid, etc[3-4], On the other hand, the water flow rate of the river ecosystem is fast, and the substrate is usually large-sized stones, which means that the benthic animal species are mainly Insecta species, common species include oriental mayfly, tiger skin moth, Jiangji larvae, etc [5-7], the water body of river ecosystem is less stable than the water body of reservoir ecosystem, so river-type benthic cleaning species are more sensitive to water bodies. Jinan, as the central city in the south wing of China's Bohai Rim region, its freshwater ecosystems can be roughly classified into reservoir type and river type, by studying the benthic fauna of the two types of water bodies, a more comprehensive understanding of the benthic fauna in the region can be obtained, dig deep into the environmental information hidden behind biological data, So as to objectively reflect the health status of Jinan water ecology.

2. MATERIAL AND METHODS

2.1. Jinan Benthic Collection Sampling Site Layout

According to the distribution of the Jinan water system, 12 sampling points for reservoir ecosystems and 34 sampling points for river ecosystems were determined. MAGELLAN global positioning system (eXplorist-200) was used to measure the latitude and longitude of each sampling point (Figure 1).

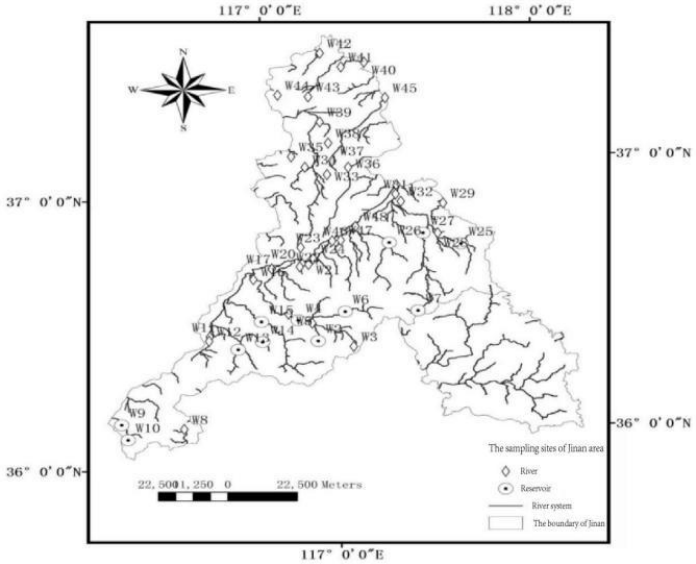


Figure 1. Stations for collection and deployment of benthic invertebrate in water bodies of different ecosystems in Jinan River Basin

2.2. Benthic Sample Collection

The benthic invertebrate was collected six times, and six sampling surveys were carried out in May, August, and November in 2014 and 2015; The Sauber net was used as the sample collection tool, quantitative samples of macrobenthos were collected using Sauber. According to the different river habitats of the sampling points, several representative sampling points were randomly arranged to collect the samples. The collected samples were mixed and filtered with a 60-mesh sieve. Animals and photographing individuals living, the collected samples were put into 100mL plastic bottles and added with 95% alcohol to fix the samples, transported to the laboratory, added with 10% formaldehyde solution for preservation, and classified, identified, and counted in the laboratory with the help of a microscope or dissecting microscope[8-11]

2.3. Data collation, Analysis And Processing

The benthic sampling point map in the Jinan watershed was completed on ArcMap 9.3. The benthic invertebrate was identified by the microscope, and the data were sorted and analyzed by WPS. Among them, the calculation of benthic Shannon Wiener diversity index H'[12-13]:

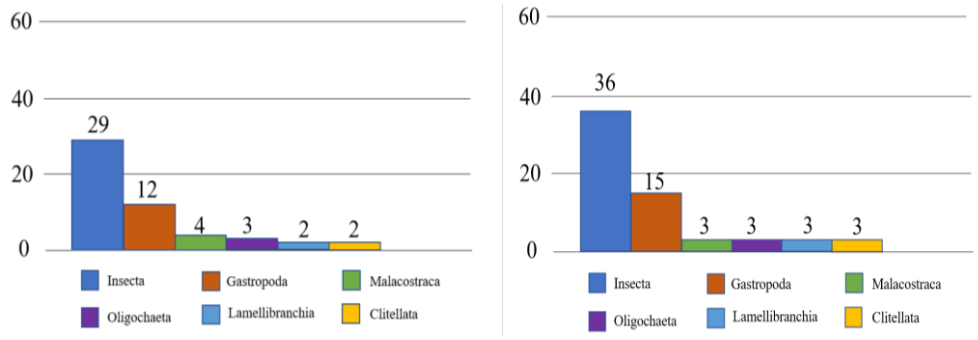
$$H' = -\Sigma Pi \times log2Pi \quad (1)$$

Where Pi represents the percentage of the number of individuals of the ith species in the community to the total number of individuals.

3. RESULTS

3.1. Distribution Of Benthic Invertebrate Species In Jinan

A total of 52 species of benthic animals were collected from the Jinan Reservoir ecosystem. Among them, there are 29 species of Insecta, accounting for 56% of all species; 12 species of Gastropoda, accounting for 23% of all species; 4 species of Malacostraca, accounting for 8% of the total number of species; 3 species of Oligochaeta, accounting for 6% of the total number of species; 2 species of Lamellibranchia, accounting for 4% of the total number of species; 2 species of Clitellata, accounting for all species 4% of the number. A total of 63 species of benthic animals were collected in the water body of Jinan river ecosystem. Among them, there are 36 species of Insecta, accounting for 57% of all species; 15 species of Gastropoda, accounting for 24% of all species;3 species of Malacostraca, accounting for 5% of the total number of species; 3 species of Oligochaete, accounting for 5% of the total number of species; 3 species of Lamellibranchia, accounting for 5% of the total number of species; 3 species of Clitellata, accounting for 5% of the total species 5% of the number (Figure 2).



Reservoir River

Figure 2. The composition map of benthic fauna in Jinan reservoir and river ecosystem

3.2. Changes In The Diversity Of Benthic Invertebrate In Jinan

The six sampling results of Jinan Reservoir ecosystem showed that the number of benthic species fluctuated less, basically showing a trend of higher in spring and lower in autumn (Figure 3). The number of benthic species collected in the river ecosystem water body in May 2014 was the largest, and the number of benthic species collected in the other five times fluctuated within a small range. In the Jinan Reservoir ecosystem, the density of benthic invertebrate was the highest at the end of May 2014, followed by October 2014, and the changes in the density of benthic invertebrate in the other four times were relatively small. The results of the three sampling data in 2015 showed that the density of benthic invertebrate was low. In the river ecosystem, the density of benthic invertebrate was the highest in May 2014, and the other five changes in benthic fauna density were less fluctuating, showing a normal distribution trend (Figure 3). The change in the benthic diversity index of the Jinan Reservoir ecosystem was small. The water body of the river ecosystem had the highest value of the biodiversity index at the end of May 2014, and the results of the remaining five samplings showed that the change in the biodiversity index of benthic invertebrate was relatively small (Figure 3).

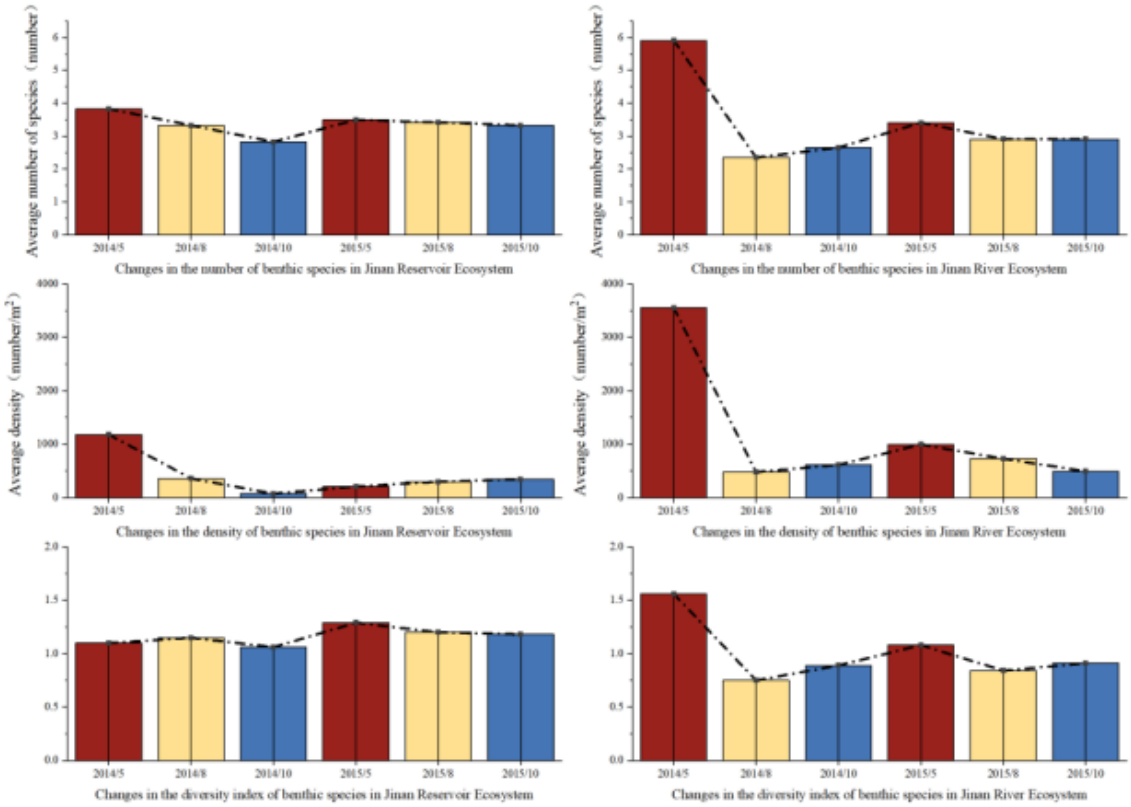


Figure 3. Changes in the average number of species, density and diversity index of benthic invertebrate in Jinan reservoir and river ecosystems

4. DISCUSSION

The benthic fauna of the two ecosystems in Jinan is dominated by Insecta, and common species are Ephemera Orientalis Ulmer, Chironomus riparius Meigen, Chironomus salinarius Kiffer, and Macromia Clio et al. The species structure of benthic animals in the reservoir ecosystem was similar to that in the river ecosystem, and the number of benthic species in the river was slightly higher than that in the reservoir. Interestingly, the number of Insecta species in river water is higher than that in reservoir water, which may be due to the complex habitat of river water, such as rapid flow area, slow flow area and still water area according to the flow rate; According to the type of substrate, it can be divided into sand, gravel, silt, pebbles, boulders, etc. This is conducive to the survival of more insect species, and the movement ability of insect species is stronger than that of other classes, and the river water body has a wider range of activities, predation on insects is opportunistic, and the flow rate of river water is more conducive to their predation. However, there are few habitat types in the reservoir water body, the range of insect species is limited, and the predation is slightly limited, so the number of species may be slightly lower than that of the river water body[14-15]. Secondly, there are slightly more gastropod benthic invertebrate in river water than in reservoir water, this may be because the riparian zone of river water is higher than that of reservoir water. The wider the riparian zone, the more attachment habitats can be provided for gastropods. In general, the diversity of habitats provides a certain foundation for species diversity.

On the other hand, the total number of species in the river ecosystem was slightly higher than that in the reservoir ecosystem, and the number of major species Insecta and Gastropoda were also higher in rivers than in reservoirs. This may be due to the higher degree of eutrophication of river water, the water body of the urban river ecosystem has a wide flow area, is more likely to be polluted, and has a higher degree of eutrophication. The water body of the reservoir ecosystem is mainly still water, the degree of pollution is relatively low, and the degree of eutrophication is relatively low. The

eutrophication of water bodies will lead to aggravation of water pollution, which may lead to the increase of benthic pollutant-tolerant species, and most of the pollutant-tolerant species are mainly benthic species of Insecta and Gastropoda.

From the perspective of the dynamic distribution of benthic fauna in the water bodies of the two ecosystems, the overall diversity of benthic animals is poor, and the diversity of benthic animals in reservoirs has a smaller fluctuation range than that in rivers.

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