Relationship between Phytoplankton Community and Environmental Factors in Spring in Jinan, China

Hua Xiang¹, Xiao Han¹, Shuqin Shang¹, Jingjing Liang¹, Xuwang Yin² and Mi Wang²,*

¹Jinan hydrographic office, Jinan, China
²College of Fisheries and Life Science, Dalian Ocean University, Dalian, China

*Corresponding author: wangmi@dlou.edu.cn

Abstract. The study was to show the relationship between the community structure of phytoplankton and the associated environmental factors, based on Shannon-Weiner index, classification of phytoplankton community and CCA analysis and other methods in Jinan Region in May 2018. We identified 39 phytoplankton species in spring. The average values of phytoplankton number, density, Shannon-Wiener index and Pielou index was 7.00, 4.63×10⁵ cells/L, 2.80 and 0.76 in spring, respectively. CCA analysis results showed that phytoplankton community structure was largely determined by the interactions between CODₘn in spring in Jinan Region.

1. Introduction
With the emergence of series problems such as environmental pollution and deterioration of water ecological environment, the health of water ecosystem and its related research are receiving wide attention. In the study of aquatic ecosystem, the investigation and study of aquatic organisms has always been an important method to evaluate the impact of natural ecological processes and human activities on aquatic ecosystems [1-2]. Phytoplankton community is one of the most important aquatic communities in recent years, which is closely related to water environment factors. Phytoplankton community characteristics are used in many water ecological surveys to evaluate the health of water ecology [3-4].

This study takes Jinan area as the research area, analyzes the phytoplankton community characteristics, and analyzes the relationship between phytoplankton and water environment factors, hoping to provide help for the protection and management of water ecological environment in Jinan area.

2. Materials and methods

2.1. Sampling Point Setting in Jinan
Jinan region at a middle latitude zone is surrounded by mountains at three sides, whose height gradually declines from the south to the north. According to the natural landform of Jinan region, it can be divided into three areas: southern mountain area, central plain urban area and northern plain area. To favorably distinguish spatial differences of structures of fish communities in the region, 20 provincial and municipal monitoring points for water environment were set in some representative...
areas in urban district and various counties of Jinan. The monitoring points were set according to physical geographical characteristics and pollution condition of Jinan region. Afterwards, sampling survey was carried out in spring (May), 2018.

2.2. Phytoplankton sample collection, identification and determination of water environmental parameters

Using MAGELLAN Global Positioning System (eXplorist-200) to record the latitude and altitude of sampling points in Jinan. There are two kinds of samples collected in field investigation: water environmental factors and aquatic organisms. Water environmental factors can be divided into field and laboratory testing, the field measurements included water temperature (Temp), electrical conductivity (Cond), dissolved oxygen (DO), turbidity (SS), ph and water depth (Depth). Other factors were measured in laboratory, such as (SO)\(^2\), (CO)\(^3\), Total nitrogen (TN), ammonia nitrogen (NH\(^4\))(NO\(^3\)), nitrate nitrogen( (NO\(^3\))), fluoride (F), total phosphorus (TP), alkalinity (Alk), hardness (TD) and permanganate index (COD\(_{Mn}\)) [5-6].

3. Results

3.1. Characteristics of Phytoplankton Community Structure

3.1.1. Composition of Phytoplankton Community. There were 39 species of phytoplankton in Jinan, 15 species of diatom, 10 species of green alga, 6 species of cyanobacteria, 5 species of euglenophyta, 2 species of cryptophyta and 1 species of dinoflagellate. In this sampling survey, the density of cyanobacteria gate was the highest, accounting for 69.92% of the total density, followed by diatom, accounting for 13.55% of the total density, other species density was relatively small, green algae density accounted for 10.95% of the total density, cryptophyta density accounted for 4.54% of the total density, euglenophyta density accounted for 0.95% of the total density, and dinoflagellate density accounted for 0.08% of the total density.

3.1.2. Diversity of phytoplankton. The average species number of phytoplankton community at each sampling site is 7.00, the highest point of species is located at the J5, lowest point in the J13. The average density of phytoplankton community is 4.63×10 5 cells/L, highest point is located at the J18,
lowest point located at the other points of the J13. The average of the Shannon Weiner index for phytoplankton communities is 2.80, the highest point is located at the J5, lowest point in the J13. The average of the Evenness index for phytoplankton communities is 0.76, and the highest point is located at the J5, lowest point in J13 (fig.2).

Figure 2. Distribution of community diversity in Phytoplankton.

3.2. Correlation analysis of phytoplankton and water environmental factors

A total of 18 water environmental factors were determined in this sample survey. The results demonstrate that the average water temperature is 25.79°C. The average pH value is 8.35. The average turbidity in water is 14.69 degrees, the conductivity average is 951.67ms/m, the chloride average is 97.32mg/L, the sulfate average is 104.85mg/L, the average carbonate is 2.45mg/L, the total alkalinity average is 178.19mg/L, the total hardness is 321.67mg/L, the average oxygen is 321.67mg/L, the average oxygen is 9.17mg/L, total nitrogen average is 4.36mg/L, ammonia nitrogen mean is 0.94mg/L, nitric acid nitrogen average is 0.11mg/L, nitric acid nitrogen average is 2.54mg/L, total phosphorus average is 0.14mg/L, sulphide average is 0.01mg/L, fluoride average is 0.45mg/L.

By using canonical correspondence analysis, phytoplankton community structure and water environment factors were analyzed in Jinan area in May. The results showed that the main water environment factors affecting phytoplankton community structure were potassium permanganate index (P=0.001). Turbidity and total hardness also have a certain effect on phytoplankton communities. Transparency was negatively correlated with phytoplankton communities, and total hardness was positively correlated with phytoplankton communities (Fig.3).

Figure 3. Relationship of Phytoplankton and Environmental Factors by Analysis CCA.
4. Discussion
Phytoplankton, as the primary producer and the important nutrition level representative of the ecosystem in Jinan area, its species, density and diversity directly affect the structure and function of the ecosystem in Jinan area [7-10]. In terms of species distribution in the whole area of Jinan, the number of species on the north and south sides of water ecology in Jinan is more than that in the main urban area of Jinan. These two points are located on the south and north sides of Jinan respectively, both belong to reservoir type area. From the distribution of phytoplankton diversity in the whole area of Jinan, the diversity of phytoplankton in the tributaries near the ferry is relatively high. The main species are the nutrient-poor species such as actinomycetes, chlamydomonas, and dinoflagellate algae. When the water enters the pollutants, these species will disappear, so they should be protected emphatically. From the analysis of the correlation between phytoplankton and water environmental factors in Jinan, it can be seen that potassium permanganate index, turbidity and total hardness also have certain influence on phytoplankton community. There was a positive correlation between total hardness and phytoplankton community. Potassium permanganate index has certain influence on algae such as navicular algae. Turbidity has a certain effect on the sensitive phytoplankton species vibrato. The influence of total hardness on alga and other algae [11-14].

5. Conclusion
We identified 39 phytoplankton species in spring. The average values of phytoplankton number, density, Shannon-Wiener index and Pielou index was 7.00, 4.63×10^5 cells/L, 2.80 and 0.76 in spring, respectively. CCA analysis results showed that phytoplankton community structure was largely determined by the interactions between COD_{Mn} in spring in Jinan Region.

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