Temporal and Spatial Distribution Characteristics of Nitrogen and Phosphorus in Baisha River

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Abstract: The eutrophication of water bodies has always been the key to the governance of rivers and lakes. The nutrient characteristics of different water bodies are often closely related to factors such as geospatial characteristics and hydrological characteristics, and they change with seasons. This paper takes the Baisha River as the research object and arranges 6 sampling points in corresponding locations according to the geographical characteristics of the Baisha River to study the temporal and spatial distribution characteristics of nitrogen and phosphorus nutrients in the river. The results show that the concentration of TP, NH_4^+-N meet the national surface water level III standard, but the total nitrogen exceeds the level III water standard. The concentration range of TP in Baisha River is 0.013-0.150mg/L; the range of ammonia nitrogen concentration is 0.006-0.416mg/L; the range of total nitrogen concentration is 0.458-3.260mg/L. By analyzing the eutrophication of Baisha River's water quality through the N/P ratio, it is found that there are 8 months N/P between 8 and 30 throughout the year, which is suitable for algae growth, and Baisha River has the conditions for eutrophication.

1 INTRODUCTION

Nitrogen and phosphorus are key nutrients and limiting elements that affect the eutrophication of water bodies. In most biogeochemical cycles, rivers are the vital link between the continent and the ocean. Most of the nutrients produced by human activities are transported to the ocean via rivers. Therefore, the transportation of river nutrients has become a biogeochemical cycle. Sensitivity indicator. At present, Chinese scholars are conducting a large number of studies on the temporal and spatial characteristics of river nitrogen and phosphorus pollution and the sources of pollution, with fruitful results. Research on the water quality of Beiluo River by Yu Songyan et al. showed that the structural factors of TN spatial heterogeneity distribution are agricultural land and forest land, and agricultural land is the structural factor controlling the spatial distribution of NO_3^--N. Existing studies have shown that non-point sources have a greater impact on total phosphorus pollution, but the changes in the concentration of total nitrogen and phosphorus are similar. The concentration of total nitrogen and phosphorus around the city is generally higher in winter and spring than in summer and autumn, and the concentration of total nitrogen in areas dominated by agriculture is higher in summer and autumn than in winter and spring. The main reason is that the water supply source of rivers around the city is mainly domestic sewage and industrial wastewater tail water during the dry season. The input of nitrogen and phosphorus is the same but the dilution effect of rainwater is weak, and the pollutant concentration is higher than that during the wet season. However, the agricultural area has more rain in summer. The large amount of nitrogen and phosphorus in the farmland has been eroded and lost, causing the total nitrogen in the river to be higher than that in the dry season; the water quality in the upper and lower reaches of the space is better, and the concentration of pollutants in the middle and lower reaches is gradually increasing.

In summary, although domestic and foreign experts and scholars have carried out more studies on the temporal and spatial characteristics of nitrogen and phosphorus nutrients in rivers for different temporal and spatial scales and different objects, due to regional differences in physical geography, environmental conditions, aquatic ecology, and pollution sources, etc. There are still some differences in the research conclusions. Therefore, for specific rivers, exploring the temporal and spatial characteristics of nitrogen and phosphorus nutrients

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is of great significance to the protection of river water quality. Therefore, this study took the Baisha River as the research object, selected TP, TN, NH_4^+ -N water quality indicators, and arranged 6 monitoring points on the main stream and main tributaries of the river. From February 2017 to January 2018 the water quality of the Baisha River is continuously monitored at the end of each month. On this basis, the temporal and spatial distribution characteristics of nitrogen and phosphorus in the Baisha River are analyzed, which can provide a reference for the prevention and control of nitrogen and phosphorus pollution in the Baisha River.

2 DATA SOURCES AND RESEARCH METHODS

2.1 Overview of the Study Area

Baisha River is located in Guichi District, Chizhou City, Anhui Province (Fig.1). It is one of the three rivers flowing into Pingtian Lake. The upstream originated near Longtouzhang Village, Guichi District, Chizhou City. The Baisha River is about 9.3 kilometers long and flows through about 13 villages. The Baisha River Basin has a subtropical monsoon climate. The average temperature is around 4℃ during the coldest period and around 28℃ during the hottest period. The land use in the Baisha River Basin is dominated by forest land, accounting for 46.12%, followed by cultivated land, accounting for 21.42%, and construction land accounting for 16.29%.

2.2 Sampling Point Setting

According to the topography and landform characteristics of the Baisha River, the monitoring points are arranged on the basis of consideration of the distance between the monitoring points and the convenience of sampling (Fig.1). A total of 6 points are arranged along the main stream of the Baisha River, named A1 to A6 from upstream to downstream. The sampling time is from February 2017 to January 2018, with sampling at the end of each month.

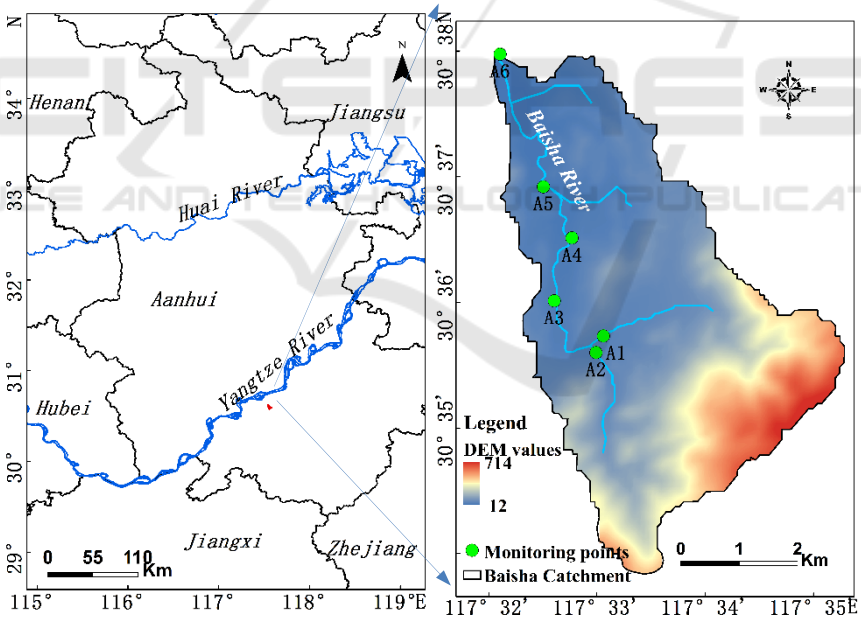


Figure 1: Location of Baisha River Basin.

2.3 Sample Collection and Analysis

The polyethylene plastic bottles washed with clean water are collected 1 to 2 meters from the shore, depending on the depth of the river, water samples are collected 10 to 40 cm below the surface of the water, and the entire sampling time lasts for one day each time. The collected water samples are placed in a refrigerator and the measurement is completed within 24 hours. Total nitrogen was determined by ammonium moly bdate spectrophotometry, total phosphorus was determined by alkaline potassium per sulfate digestion ultraviolet spectrophotometry, and ammonia nitrogen was determined by rapid digestion spectrophotometry.

3 RESULTS AND DISCUSSIONS

3.1 Characteristics of Nitrogen and Phosphorus Nutrients

TN is the main pollutant of rivers (Table 1). The concentration of TN is 0.458-5.320mg/L, with an average value of 1.400mg/L, which exceeds the Class III standard for surface water. The average value of TP and NH_4^+-N is lower than the surface water class III standard, where the concentration of NH_4^+-N is 0.010-0.416mg/L, the average value is 0.142mg/L; the concentration of TP is 0.013-0.093mg/L, the average value I is 0.035mg/L.

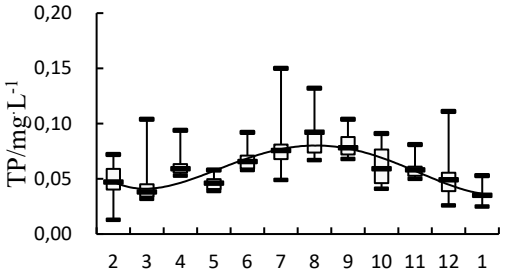
Table 1: Overall characteristics of Baisha River water quality (mg/L).

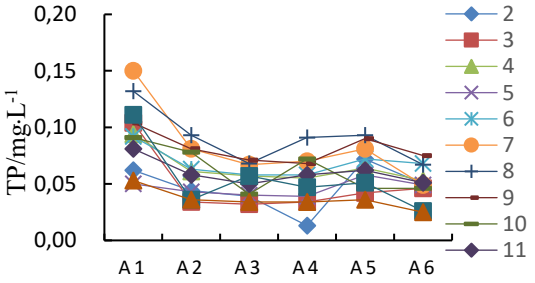
Water quality index	Reach	Minimum	Maximum	Mean	SD	III
TN	Upstream	0.572	3.203	3.616	1.277	1
	Midstream	0.485	3.260	3.100	1.396	
	Downstream	0.543	5.320	3.252	1.520	
NH_4^+-N	Upstream	0.006	0.353	0.107	0.139	0.2
	Midstream	0.010	0.259	0.104	0.111	
	Downstream	0.031	0.416	0.162	0.177	
TP	Upstream	0.034	0.150	0.076	0.044	1
	Midstream	0.013	0.091	0.052	0.031	
	Downstream	0.025	0.093	0.057	0.030	

3.2 Temporal and Spatial Distribution Characteristics of Total Phosphorus

In terms of space, the monthly concentration of total phosphorus at the monitoring points is less than 0.2mg/L (Fig.2), which meets the requirements of surface water class III. Among them, the water quality at the monitoring point A1 is the worst, and the water quality at the monitoring points A3 and A4 is the best. Through the analysis of the surrounding environment of each monitoring point, we found that the monitoring point A1 is located at the intersection of the two main tributaries, and the population located on both sides of the east and upstream tributaries along the riverbank is the most densely distributed. The discharge of domestic sewage from residents may be related to the total phosphorus content of point R1. Higher related.

In terms of time, from February 2017 to January 2018, the total phosphorus concentration of Baisha River showed a trend of first rising and then falling. The total phosphorus concentration is the highest in summer, followed by spring and autumn, and the lowest in winter. This is because the area where the original Baisha River flows is mainly agricultural farming areas. Summer is a period when agricultural fertilization is concentrated, and there is more rain. Under the effects of rainwater leaching and soil erosion, the phosphate fertilizer in the farmland enters In the river, the total phosphorus content is therefore high.





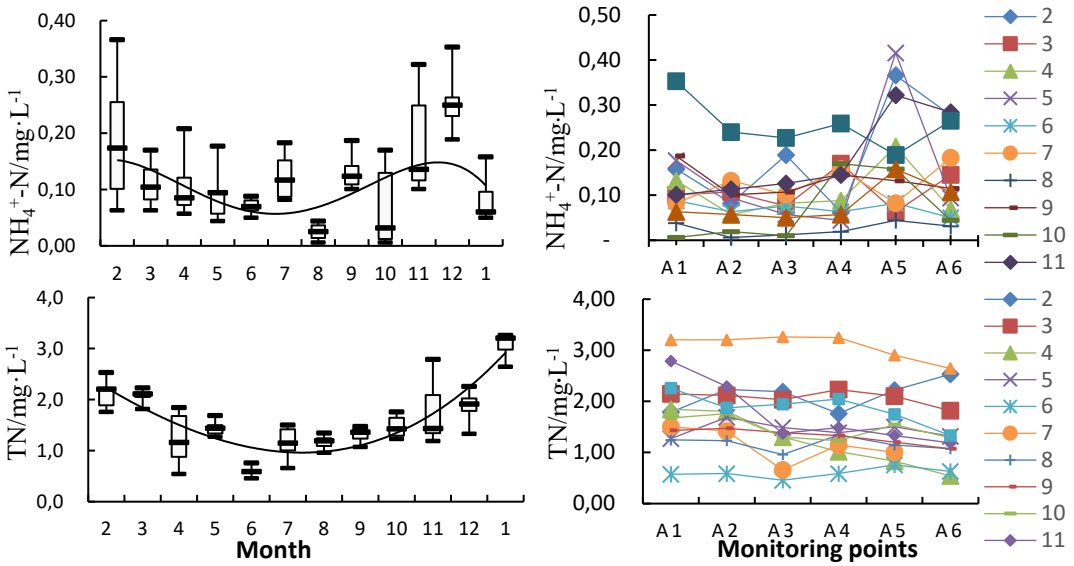


Figure 2: Temporal and spatial distribution of nitrogen and phosphorus.

3.3 Temporal and Spatial Distribution Characteristics of Ammonia Nitrogen

From a spatial point of view, the average monthly ammonia nitrogen concentration at each monitoring point during the monitoring period was better than the Class III water quality standard. Among them, monitoring point A2 has the smallest concentration value of 0.089mg/L, and the highest concentration is monitoring point A5, which is 0.164mg/L, and fluctuates greatly with seasonal changes. The water quality at other points has little difference. Ammonia nitrogen is the reduced state of nitrogen, and an increase in ammonia nitrogen indicates that the water body has recently been polluted. Through the analysis of the surrounding environment at more A5 points, it can be found that the largest source of ammonia nitrogen is agricultural non-point source pollution.

From the time point of view, the ammonia nitrogen content of Baisha River is the lowest in summer. This may be because there are more algae growth in summer, resulting in insufficient dissolved oxygen in the lake. NH_4^+-N can be converted into NO_3^--N under the action of anaerobic microorganisms; on the other hand, summer rainfall is abundant, A large amount of precipitation made the ammonia nitrogen in the water body of Baisha River be greatly diluted. In February and December, the ammonia nitrogen content increased significantly. There are no large-scale enterprises near the Baisha River, so it is unlikely that the external input of industrial wastewater will cause an increase in the concentration of ammonia nitrogen. Therefore, the reason for the significant increase in the concentration of ammonia nitrogen may be due to the significant decrease in precipitation in the month and the large amount of river water evaporation during the dry season, thus causing the concentration of ammonia nitrogen in Baisha River increased significantly.

3.4 Temporal and Spatial Distribution Characteristics of Total Nitrogen

The concentration of total nitrogen in Baisha River belongs to Class IV water standard. The variation range of total nitrogen concentration is 0.458-3.26mg/L. Among them, the monitoring points A5 and A6 have the lowest concentration, and the other points have little change. This may be because points A5 and A6 do not belong to agricultural farming areas, and agricultural non-point sources have little impact on them.

From the time point of view, the total nitrogen concentration is highest in winter and lowest in summer. Among them, the total nitrogen concentration was the lowest in June. The increase in precipitation in June and the increase in water temperature are conducive to the activity of microorganisms in the water body. The intensity of denitrification increases and consumes the inorganic nitrogen that migrates to the water body, so that a large amount of inorganic nitrogen is converted into nitrogen and discharged into the water body. The total nitrogen concentration is highest in January and

December. This is due to the decrease in winter precipitation and the release of nitrogen from soil and vegetation in the submerged water-level fluctuating zone into the water body, followed by the release of nitrogen in the sediment into the water body through hydrodynamic changes.

3.5 Water Body Eutrophication Evaluation

N/P is the main indicator for investigating the structure of nutrients. The growth of plants in water is controlled by elements such as nitrogen, phosphorus, and potassium. At the same time, the ratio of various nutrients in the water body is also important to the composition of aquatic communities. The N/P value of ocean water is generally close to 16/1, which is the Redfield ratio, and the absorption of nutrients by phytoplankton is basically close to this ratio. Redfield ratio is a value used to evaluate the occurrence of red tides in the ocean. In recent years, many studies at home and abroad have also applied it to freshwater bodies such as lakes and rivers. When Redfield is used in freshwater water bodies, nitrogen will usually limit the growth of algae when N/P<7, and when N/P is 8-30, it is suitable for algae growth. N/P>30, P will become the limiting factor for algae growth.

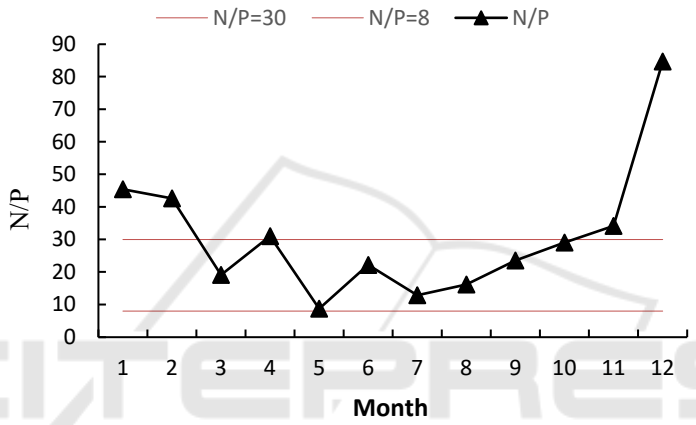


Figure 3: N/P Seasonal changes of Baisha River.

It can be seen from Fig.3 that the Redfield ratio of N/P in the Baisha River water body is between 8 and 30 for 8 months throughout the year, which is suitable for algae growth. Therefore, it can indicate that the Baisha River water body has the conditions for water bloom.

4 CONCLUSION

Based on the results and discussions presented above, the conclusions are obtained as below:

(1) The indexes of total phosphorus, ammonia nitrogen in the Baisha River water body are all lower than the Class III water standard, and the total nitrogen index exceeds the Class III water standard. Seasonal water volume changes have an important impact on changes in its concentration. The content of total nitrogen and ammonia nitrogen in summer is lower than that in winter and autumn, while total phosphorus presents the opposite characteristics of the other three standards, and autumn is significantly higher than the other three seasons.

(2) From a spatial perspective, the concentrations of total nitrogen show a decreasing trend from upstream to downstream. The concentration of total phosphorus is the lowest in the midstream, followed by the upstream and the highest downstream.

(3) Although the monitoring indicators of total phosphoru and ammonia nitrogen in the water body are lower than the standard value, the evaluation of the eutrophication of the water quality of the Baisha River found that the conditions for blooming in the water body of the Baisha River are sufficient. Therefore, the water quality of the Baisha River should be controlled to prevent the occurrence of eutrophication of the water body.

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