Nitrogen and Phosphorus Storage of Baiyangdian Wetland influences and Threats on the ecology factors

RuiKang LI, QingYun DAI, HongMei ZHANG
Tianjin International Engineering Institute, TIEI, 300072, China; University of Melbourne, Australia; Hebei University of Engineering, China.
Email: 2019229118@tju.edu.cn

Abstract: Baiyangdian is the north China plain, the largest and most typical freshwater lake wetland, has important effects on the ecological environment in north China, called the kidney of north China, therefore, strict protection of Baiyangdian wetland is of great practical significance. This Baiyangdian wetland’s study aims to understand the different ecological communities and wetland ecological health assessment in wetland system, and to analyze and study the water quality and biodiversity of Baiyangdian wetland. Then through analyses of nitrogen and phosphorus storage, advantages and disadvantages of Baiyangdian among the wetland are clarified. Finally, based on the successful experience of some other wetland, some suggestions on the future development of wetland are put forward for Baiyangdian.

1. Introduction

1.1. The study site
Baiyangdian is the largest lake in Hebei province. The main body is located in Anxin county, Baoding city, Hebei province. It is located in the north latitude 38°43'–39°02', east longitude 115°11'–116°07'. The population here is 393113. The main industries here are nonferrous metals, which are commonly used in mechanical manufacturing, construction, electronics, aerospace and nuclear energy. The location of our sampling is the Post-tang lake, which is one of the four main deposits of Cattail. Cattail is located in the southeast of Baiyangdian, north of Anxin county, south of Renqiu city; The total area of Cattail is 0.6 square kilometers and the whole village is 3000 people. 98% of the population lives on the island, or north island, or south island; The area of the four lakes is more than 5000 mu.

We collected samples here and conducted four experiments with samples:
1. Determination of fecal coliform.
2. Determination of nitrogen content.
3. Determination of phosphate content.
4. To determine the microbial content of bottom mud and water under microscope.

From these four experiments, I found that the biodiversity of Baiyangdian is very rich. However, it can be found that the water pollution and eutrophication in Baiyangdian are very serious from the measured nitrogen and phosphate content and the data compared with other samples.

1.2. Catchment area, tributaries and important biodiversity
Baiyangdian mainly has four sub-basins: Longmen reservoir catchment area, the reservoir catchment area of Anzhuangzhuang reservoir, western ocean reservoir catchment area and Wang kuang reservoir catchment area. Surface evaporation of Baiyangdian is very large. For maintenance of wetland
ecosystem balance, adjust the Hebei plain and the Beijing-Tianjin region climate, improve humidity conditions, supplementary groundwater and protect biodiversity and rare species resources play an important role.

And there are abundant plant resources and animal resources. Plant resources mainly include reeds, white flowers, lotus root, lotus seeds and so on. Animal resources mainly include crabs, round fish and so on. At this monitoring point, we capture phytoplankton, zooplankton, benthic animals, fish and shrimp.

1.3. The influences and threats on the ecology and water quality of the lake
The influences on the ecology and water quality of the lake are season, climate, topography, hydraulic regulation, pollution control. The threats of biodiversity are insufficient water, unsteady water levels, water pollution, silting, and serious pollution caused by planting, aquaculture and tourism.

The ecology is affected by sewage discharge, biological invasion, overfishing, climate change and so on.

Water quality is affected by environmental factors such as season, climate and topography, and it will also change due to the role of artificial means such as hydraulic regulation and pollution control.

2. Methods

2.1. The map of sample site

2.2. Field collection and sampling methods
Because of Baiyangdian lake is a representative in polluted area, and Baiyangdian lake is China's important wetlands, so we choose Baiyangdian lake as an object of our research and analysis to improve the environmental quality of Baiyangdian lake after lay the foundation.

The sampling site of our group is Post-tang Lake in Baiyangdian wetland. It is noon on April 1. In the study of Baiyangdian wetland were searched for five monitoring stations since time is limited, only measuring the water quality and water depth of the five monitoring stations, a collection of plankton, zoobenthos and phytoplankton.

2.2.1. Water samples and measuring the water quality
Our group’s water samples were taken from the Post-tang Lake, and the instruments we used was pump, which was put into the water by the bow, and the other was connected to the water bucket with
the water sample. The water sample pump was closed and sealed well after extraction of about 2L, and the water sampling was finished.

The next step is to measure the water quality. We first use Hydrolab multi-parameter water quality analyzer to monitor the parameters: The content of ibuprofen in water (TBU), Sodium percarbonate (SpC), Dissolved oxygen concentration (DO), Chlorophyll content (CHL), Turbidity (Tur), Hydrogen ion concentration (pH), Salt (Sal), Total dissolved solids (TDS) and so on. In order to ensure the accuracy of the data, we test for two times, each time for a few minutes. And because the water temperature is an important water quality factor variables, and the water temperature can affect the growth of bacteria in water and water of natural purification effect, so wait to read the data again after constant temperature.

2.2.2. Collection of wetland animal
Take some water from fishing nets and put different species in different test tubes. Adding alcohol causes animals to lose their vital signs and preserve them.

2.2.3. Collection of zooplankton and phytoplankton
The collection of zooplankton is collected by a 112-size zooplankton collection network. First, tighten the bottom valve, put the net to a depth of about one meter. After walking back and forth a few times, took out network, opened the bottom valve, to combine the zooplankton in the net to the test tube and sealed, then labeled.

Phytoplankton collection is the same as zooplankton. It's just a small collection of nets, and the phytoplankton use a 64-size collection network.

2.2.4. The collection of benthic animals
First, we collect the bottom mud with the grasping bottom mud collector, and then put the bottom mud into the sieve mesh. Use water to flush the mud off the screen and place a basin in a sieve to catch some water. When the water and mud in the sieve are reduced, remove the mosquito larvae from the bottom with tweezers and place them in the prepared test tube, then labeled.

2.3. Analytical methods and statistical methods

2.3.1. Determination of fecal coliform
The main experimental method is multi-tube fermentation. It is based on statistical theory to estimate the density of e. coli and health quality in water.

First, due to the limited time of our experiment, prior to the experiment, the senior had prepared 15 fermentation tubes containing single lactose peptone medium for each group. We inoculated the water samples into the fermentation tube containing the lactose peptone medium, and was cultured at 37℃ for 24h.

Second, we slightly shocked the fermentation tube of the positive results of the initial fermentation test, and then transferred the culture to the EC medium with a 3mm inoculation ring and was cultured at 44.5℃ for 24h. Then put all the fermentation tubes into the water bath. After cultured and observation, if the fermentation tube was generate bubbles, it proved to be positive for fecal coliform.

2.3.2. Determination of nitrogen content
The water samples were removed by 10ml respectively in the two digestion tubes with two catalysts and 10.0ml concentrated sulfuric acid. In order to minimize errors, a blank experiment was prepared. The two digestive tubes were then placed on the graphite furnace, and when the keeldahl was heated up to 200 degrees for 120 minutes, most of the water was volatilised. After the digestion is complete, cool the sample to room temperature. After that, the parameters were set with titration instrument to measure the nitrogen content in the water sample.
2.3.3. Determination of phosphate content
The phosphate standard solution 0ml, 0.50ml, 1.00ml, 2.00ml, 4.00ml, 6.00ml, 8.00ml, and 10.00ml were respectively absorbed into the 50ml colorimetric tube. Add pure water to 50ml, then take 50ml water sample in colorimetric tube, and add 4ml ammonium aluminate - sulfuric acid solution, shake well, add 1 drop of tin solution, shake well. After 10min, the absorbance was measured at the wavelength of 650nm, measured three times, and averaged.

2.3.4. Determination of wetland animal diversity
Observe and determine the species.

2.3.5. Determination of the microbial content of bottom mud and water
Use a microscope to observe plankton, phytoplankton, and mosquito larvae in the sediment and water.

3. Results

3.1. Water quality

|         | The first time | The second time | Average |
|---------|----------------|----------------|---------|
| D/T     | 033118103930   | 033118103958   | 7.8     |
| IBU     | 7.8            | 7.8            | 7.8     |
| Tem     | 13.97          | 14.59          | 14.28   |
| SpC     | 1578           | 1577           | 1576    |
| DO      | 12.03          | 12.23          | 12.13   |
| CHL     | 25.34          | 14.03          | 16.69   |
| Tur     | 3.1            | 2.8            | 3.0     |
| pH      | 8.36           | 8.37           | 8.37    |
| Sal     | 0.84           | 0.84           | 0.84    |
| TDS     | 1.010          | 1.009          | 1.010   |

According to the data in the table, the PH of water quality is 8.37, the national water quality standard stipulates that the pH should not exceed 9; After the measurement, DO is 12.13mg/L, the saturated dissolved oxygen content was about 10.35mg/L, dissolved oxygen saturation was 117% and the water quality standard of the national lake provides that the saturation ratio of dissolved oxygen is greater than or equal to 90%; The water temperature is 14.28, relatively normal; And there is not a lot of industry around the pond, and the pollution of industrial sewage is not serious. From the above analysis, it can be concluded that the water pollution in Baiyangdian is not serious.

3.2. Determination of nitrogen content

| Sample number | 0048 |
|---------------|------|
| The sample weight | 50.0000g |
| Standard acid concentration | 0.0206mol/L |
| The titration volume | 0.2200mL |
| Blank volume | 0.0000mL |
| Protein coefficient | 6.2500 |
| Nitrogen content | 0.0001% |
| The protein content | 0.0008% |
| The test of time | 18/04/03 15:43:27 |

According to the data in the table, the nitrogen content is 0.0001%, about 0.2 mg/L, the water quality standard of the national lake provides that the nitrogen should not exceed 0.5mg/L. It can be concluded that the eutrophication of Baiyangdian is low and the water quality is better.
3.3. Determination of phosphate content

Table 3 Data of Phosphate absorbance on April 3, 2018

|       | 0mL  | 0.5mL | 1mL    | 2mL    | 4mL    | 6mL    | 8mL    | 10mL   | Water |
|-------|------|-------|--------|--------|--------|--------|--------|--------|-------|
| First | 0.089| 0.117 | 0.120  | 0.151  | 0.221  | 0.283  | 0.300  | 0.428  | 0.096 |
| Second| 0.091| 0.118 | 0.122  | 0.148  | 0.222  | 0.279  | 0.300  | 0.425  | 0.094 |
| Third | 0.090| 0.122 | 0.120  | 0.145  | 0.229  | 0.283  | 0.300  | 0.423  | 0.099 |
| Average| 0.090| 0.119 | 0.121  | 0.148  | 0.224  | 0.282  | 0.330  | 0.425  | 0.096 |

![Phosphate absorbance graph](image)

By formula:
\[ \rho(HPO_4^{2-}) = \frac{m \times 1000}{V} \]

can be calculated the mass concentration of phosphate in water samples is: 0.0434mg/L. The water quality standard of the national lake provides that the phosphorus content should not exceed 0.02mg/L. It can be concluded that the eutrophication of Baiyangdian is serious.

3.4. Determination of the microbial content of bottom mud and water

![Zooplankton number graph](image)

It can be seen from the figure that there are more zooplankton in the fifth sample point, and less zooplankton in the first sample. The water quality of the fifth sample is good, and the water quality of
the first sample is poor. It can be concluded that the species and quantity of zooplankton are affected by water quality and environmental factors.

As can be seen from the figure, the number distribution of benthic animals in five sites is relatively uniform. There were more benthic animals in the second sample, and fewer benthic animals in the third sample. The water quality of the second sample point is good and the water quality of the third sample is poor. The investigation of benthic animals is the basic work in water quality monitoring, which has its important and unique role in the monitoring of eutrophication.

4. Discussion

4.1. The relationships between the communities found in the lake and the ecosystems they were found in

Biological community is at the same time gathered together in the same location on the populations of each species, including animals, plants, microorganisms, and other species populations, together form a part of life is in the ecosystem.

Ecological system refers to the nature of a certain space, biology and environment constitute a unified whole, in the unified whole, mutual influence and mutual restriction between biology and environment, and in a certain period of time in a relatively stable state of dynamic balance.

In the Baiyangdian wetland survey, the sampling of fish and shrimp, benthic animals and other organisms was carried out. Through group discussions, we found that the biodiversity of Baiyangdian is abundant. Aquatic plants, algae, zooplankton, mammals, geese and ducks and other animals, and the surrounding environment (sunlight, air, etc.) form a ecological system, has formed the food chain. The life of residents near Baiyangdian is closely related to Baiyangdian. Therefore, once the ecosystem is destroyed, the water will be destroyed, and the biodiversity will be reduced and more harmful to mankind. Therefore, people should have environmental awareness, reduce the emission of household garbage and waste water, not only to the protection of plant and animal diversity, but also to improve the water quality of Baiyangdian.

4.2. Difference from east to west

Through group discussions, I found there a difference from east to west. The water in the east is better than the water in the west. The five sample points monitored are basically running through Baiyangdian, from west to east. For example, the fifth and the first sample points are far apart, and the diversity of zooplankton and benthic animals at the fifth point is greater than that of the first. Therefore, the water quality of the two samples is very different, that is, the water quality of the fifth sample is better than that of the fourth sample. The explanation is related to its location, because the first sample point is closer to the shore, more residents around, and the discharge of domestic garbage.
and domestic sewage is more. The fifth is located in the center of the lake, far from the residential area, so the water quality is better.

4.3. Gradients observed in the data
By comparing the water quality standards of the national lakes, we found that the nitrogen content, phosphate content and fecal coliform of our group were relatively low. However, after comparing the data with other groups, we found that the data in our group was higher. Because the position of each monitoring point is different, the fifth sample points and the same points as an example, found that is located in the east of the fifth sample of zooplankton and zoobenthos and the content of nitrogen and phosphate is far greater than the number of the first a sample point is located in the west. It can be concluded that the pollution level of the east sample points is different from that in the west. The water quality of the fifth sample is good, and the water quality of the first sample is poor. Because the first monitoring point is close to the residential area, the emission of "three wastes" more. To sum up, from the west to the east, pollutants show a decreasing gradient.

From all the data, each point contains phosphates, keidine and fecal coliforms. This indicates that the water in Baiyangdian has been polluted, and through discussion, it is believed that the pollution sources are mainly from the "three wastes" of residents' emissions. Therefore, people should be encouraged to raise awareness of environmental protection and jointly protect the environment of our lives.

4.4. Discuss the problems in practice and experiment
1. Water quality in Baiyangdian
According to the above experimental data and analysis, the water quality in Baiyangdian is not very good, although the pollution is not very serious. Because the surrounding enterprises are relatively small, the waste and sewage discharged are not many, so the main source of pollution in Baiyangdian is not the factory emissions. And the residents around the baiyang lake is more, so we according to the analysis and research of the theories, the experimental data of Baiyangdian polluters are mainly residents of life garbage and waste water pollution and a large number of tourists. There is also the unrestrained development and utilization of Baiyangdian resources. Therefore, the destruction of water quality is mainly due to human activities. Protecting and improving the water quality in Baiyangdian is conducive to our healthy development.

2. The biodiversity of Baiyangdian
It can be concluded from the experimental data that the biodiversity of Baiyangdian is rich. The aquatic organisms are mainly copepods and endopods. However, compared with previous years of biodiversity data, the biodiversity of Baiyangdian has declined. This reflects that Baiyangdian is polluted.

4.5. Summary of the main findings of the study and what the study results mean
Through group discussions, in recent years, due to environmental pollution and vegetation destruction, the ecological environment of Baiyangdian has deteriorated rapidly. In August 2012, the fish seedlings in Baiyangdian 130 hm waters died due to environmental pollution, which is a typical example of the destruction of the ecological environment. It is a key task to protect ecological environment of Baiyangdian wetland, implement strict protection measures, preventing the destruction of wetland ecological environment and the degradation of ecological function.

Among them, the content of nitrogen, phosphate and total fecal coliform was an important parameter to evaluate. The more these substances, the more serious the eutrophication. And biodiversity is also an important aspect of water quality. The less biodiversity, the worse the water quality.

Through this practice, I learned:
How to use sampling devices.
How to sample and process them.
Through these four experiments, I learned:
1. How to measure absorbance and obtain corresponding results by absorbance.
2. How to determine nitrogen with kjeldahl.
3. How to develop fecal coliforms.
4. How to use a microscope to observe microorganisms.

5. Conclusion
Through the investigation and research on the water quality and biodiversity of baiyangdian wetland, it can be found that the water quality of baiyangdian is poor and the biodiversity is reduced. The causes of pollution are mainly human activities. Therefore, in terms of baiyangdian governance, I believe that the comprehensive treatment of baiyangdian pollution should be strengthened to reduce pollution emission and protect the ecological environment.

How to protect the Baiyangdian wetland?
Through discussion and literature review, several suggestions to protect Baiyangdian were obtained:
1. In order to maximize the ecological protection of Baiyangdian, actively plan and implement the gradual relocation project of the precipitation area. Reduce the number of residents nearby to achieve the least amount of waste and waste water.
2. Actively explore and promote the scientific adjustment of Baiyangdian zoning and management. Increase the similar projects with the south-to-north water diversion project, increase water project construction, achieve the purpose of improving water quality.
3. Early studies should be conducted to establish a long-term water replenishment mechanism for Baiyangdian to maintain the stability of the water level in Baiyangdian. Due to the frequent occurrence of drought in the north, the water level in Baiyangdian decreased. Therefore, the water supply policy should be adopted to bring the water level of Baiyangdian to a normal state. This can also reduce the occurrence of drought.
4. Upstream environmental governance. Because of the number of enterprises in Hebei, the discharge of sewage is more. This will result in some sewage flowing into the Baiyangdian, resulting in the water quality of Baiyangdian decline. Therefore, the effluent should be treated effectively before discharge. Or reduce the number of enterprises to improve the environment.
5. Environmental governance, greening the countryside. Where there are many trees, there is good water. Many trees can reduce desertification and improve air quality and water quality.

Reference
[1] Zhou Yang. (2017) Evaluation of wetland ecosystem health in Baiyangdian nature reserve based on RS and GIS [D]. Hebei university.
[2] Li yunhu, Liu bingliang. (2013) Current situation and protection measures of ecological environment in Baiyangdian wetland [J]. Jiangsu agricultural science, 41(10):350-353.
[3] Feng Ru, Agnes lee, Wang Bei, Wang yan, Zeng-qiang liu. (2013) Baiyangdian wetland ecological problems and ecological restoration measures [A]. China environmental science society. 2013 academic essays of China environmental science society (6) [C]. China environmental science society, 2013:4.
[4] Xu mengjia, Zhu xiaoxia, Zhao yanwei, Xu fei. (2012) Health evaluation of Baiyangdian wetland based on benthonic animal integrity index [J]. Journal of agricultural environmental science, 31(09):1808-1814.
[5] Cheng chaoli, Zhao junqing, Han xiaodong. (2011) Analysis on the change of water quality in Baiyangdian wetland in recent 10 years [J]. Haihe water conservancy,(03):10-11+18.
[6] Chen qian. (2011) A brief analysis of problems and countermeasures of ecological environment in Baiyangdian waters [J]. Scientific and technological information,(08):382.
[7] Liu C Q, Li A, Li B, et al. 2012. Dynamics of biomass, nitrogen and phosphorus storage of Phragmites australis in Baiyangdian Lake [J]. Acta Scientiae Circumstantiae, 32(6): 1503-1511.

[8] Ou W X, Yang G S, Gao J H. 2006. Retention effect of wetland for nitrogen and phosphorus nutrients in the coastal zone of the Yancheng [J]. Wetland Science, 4(3): 179-186 (in Chinese)

[9] Wu C D, Shen M X, Chu J Y, et al. 2006. On the capacity of accumulation and transfer of nitrogen and phosphorus in Phalaris arundinacea Linn. in Mount Beigu Wetland [J]. Acta Scientiae Circumstantiae, 26(4): 674-678 (in Chinese)