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Characteristics of Phytoplankton Community Structure and Eutrophication in Hasu Sea

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Abstract: In this paper, we first obtained the data of each water quality monitoring point in May and July of Hassel Sea in 2021, and analyzed the spatial distribution of each element of total phosphorus (TP), total nitrogen (TN), transparency (SD), high manganese index (CODmn) and chlorophyll a (Chl. a) in the data, and then used the integrated trophic state index method and algal species quotient method to evaluate the trophic state of the lake. The results of the integrated trophic state index method and the algal species quotient method were then used to assess the lake's trophic status. The results of the integrated trophic state index method showed that the measured value in July was 1.15 times the value in May, in which the points H1, H2, and H3 were moderately eutrophic, H4, H5, and H6 were mildly eutrophic, while the six monitoring points in July were all moderately eutrophic, indicating that the eutrophication in summer was higher than that in spring, and there was a trend of gradual deterioration during the interannual variation, which needed attention and It is necessary to pay attention to and strengthen the management. Comparing the nutrient status index values of each parameter, chlorophyll (Chl. a), transparency (SD), and total phosphorus (TP) play a significant role in the eutrophication degree of Hassel Sea, accounting for 23.94%, 23.05%, and 20.18%, respectively. The evaluation results of the algal species quotient method showed that all monitoring points were heavily eutrophic when the green algae quotient was applied, and the rest of the points were heavily eutrophic when the composite algae quotient was applied, except point H4 which was heavily eutrophic (located in Xianglu area). Comparing the results of the two evaluation methods, it can be found that the results evaluated by applying the algal species quotient method are more serious, indicating that the algae are more sensitive to the response of the eutrophication degree of the lake, and there is a great chance of water bloom disaster in the late stage of Hassel Sea.

1. Introduction

Lake eutrophication refers to the presence of high concentrations of nutrients in the water body (TN, TP, Chl. A et al.), showing the rapid growth of algae and other aquatic plants[1]. Y ao J i P ing[2]People et al. suggested that lake eutrophication is characterized by multiple indicators, including nitrogen and phosphorus concentrations, chemical oxygen demand, and transparency.C hen S hun[3]And others believe that the environmental changes, water flow conditions and their combined effects of aquatic plants play a key role in lake eutrophication.

The eutrophication degree of water bodies is deepening continuously. For eutrophication governance, must be accurate evaluation, however, eutrophication governance full of uncertainty, has not been well solved, this paper adopts the general comprehensive nutritional status index and algae species business evaluation of the seawater eutrophication, from the biological point of view higher explain the main cause of lake eutrophication. Xie Huiyu[4]The water quality of Panyang Lake was analyzed by using the comprehensive nutritional status index. Wang Shihuan[5]et others concluded that a single evaluation method may not truly show the authenticity of Inner Mongolia plateau lakes, Liu Lu[6]They al concluded that the succession characteristics of phytoplankton could reflect the real state of water environment more than the comprehensive nutrient state index.

Hasuhai is located in Tumet Left Banner of Hohhot city, which is an important guarantee for the surrounding industrial and domestic water, and plays an important role in agriculture, animal husbandry, fishery, tourism and other aspects. The special geographical environment and historical background have formed a unique lake ecosystem[7]. However, because of the rapid economic development, human beings continue to increase the development of resources, leading to nutrient pollutants entering the lake water in various ways, increasing and accumulating in the lake, rapidly deteriorating the water environment and aggravating the eutrophication characteristics[8]. In this study, the sea sea was selected as the research object to clarify the main pollutant types and distribution rules of the sea, and to analyze the causes of eutrophication and its main water environmental impact factors. The algae species, total nitrogen (TN), total phosphorus (TP), and high fierce acid index (COD were analyzed$_{mn}$), Chlorophyll a (Chl. A) And the spatial change law of transparency (SD), the evaluation and analysis of the comprehensive nutrient state index method and algae species commercial method, to provide a certain theoretical basis for the treatment of the lake water environment, so that the lake resources can be better protected and utilized.

2. Materials and Methods

2.1 Overview of the study area

Hasuhai is located in Tumet Left Banner of Hohhot city (east longitude 110°56 '~111°01', 40°57 '~40°64'), with the widest width of 9.5km from north to south, the widest width from east to west, and the average width of hasuhai is 3.1km. The water surface area is about 32km^2, The shoreline is 24.1km, the deepest depth is 3m, and the average depth is 2.5m[9], The estimated volume is about 80 million m^3. The survey shows that the annual average storage capacity is 34.5667 million m^2, The lowest point is located in the lake basin near the center of the lake at 988.5m, the highest point of the embankment is 993m, and the elevation difference is 4.5m[10]. Many rivers and channels flow in the basin, among which the Yellow River intake channel, Wanjiagou drainage channel, and Xihou River provide the main water supply support for the Hasu Sea[11]. The monitoring points in the HasuSea are shown in Figure 1.

Because Hasu Sea is located in the Inner Mongolia Plateau, deep inland, far away from the ocean, the humid air blowing from the ocean can not be reached, at the same time, affected by the Mongolian high pressure, so the year is dry and less rain, the temperature and annual difference, is a temperate continental monsoon climate[12]. Hasuhai has four seasons, the temperature changes rapidly between hot and cold in spring, windy weather, dry and less rain; due to the influence of monsoon, the rainfall is abundant and concentrated, the high temperature duration is short, more thunderstorms; the autumn temperature gradually decreases, and the rainfall decreases; due to the cold air in the north, the winter is longer, less snow and low temperature duration is long, dry[13]. The maximum wind speed of Hasu Sea can reach 40 m/s, and the annual average wind speed is 2.05 m/s. The temperature difference between day and night is large, and the daily temperature difference reaching 13.2℃. Meanwhile, it can be seen in Figure 2 that the temperature of the coldest month and the hottest month also varies greatly. The average temperature of the coldest month is-12.3℃, the annual average temperature is 6.5℃, the extreme minimum temperature is-36.6℃, and the extreme maximum temperature can reach 39.3℃[14]. The Harbin Marine Sea annual rainfall is less than the annual average evaporation, more wind and less rain, the rainfall can only reach one-fifth of the evaporation. Figure 3 shows that the average evaporation reaches the maximum in May, the average rainfall reaches the maximum in September, and the annual average rainfall is 391.8mm. Rainfall is mostly concentrated in the May to October months of each year. According to the historical data, the maximum annual rainfall can reach 697.7mm, and the minimum value is 207mm[15]. In the winter, there is only snow and very little evaporation.

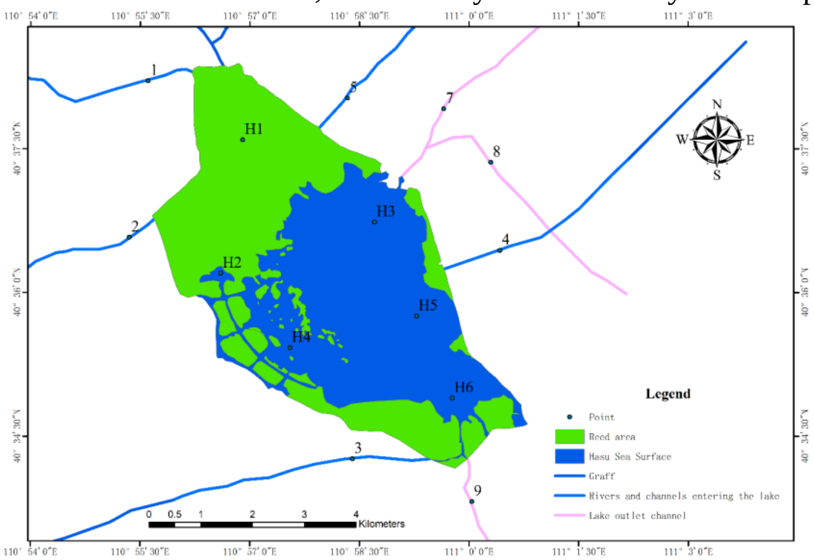


Figure 1: Monitoring point of Hasuhai in the study area

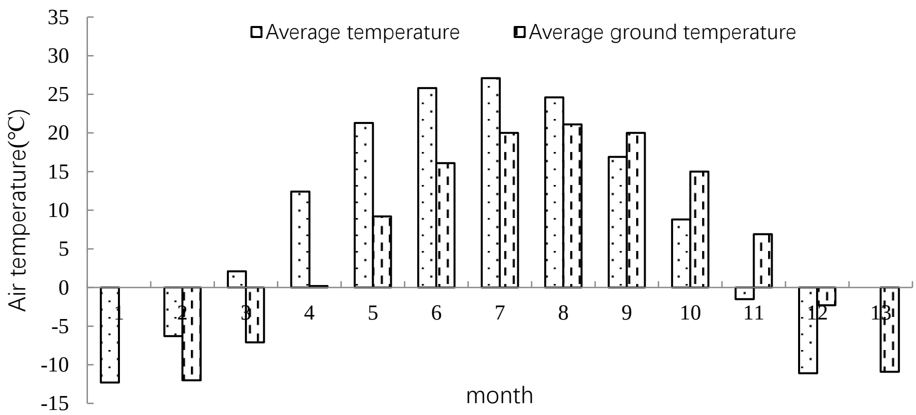


Figure 2: Multi year average temperature of Hasuhai

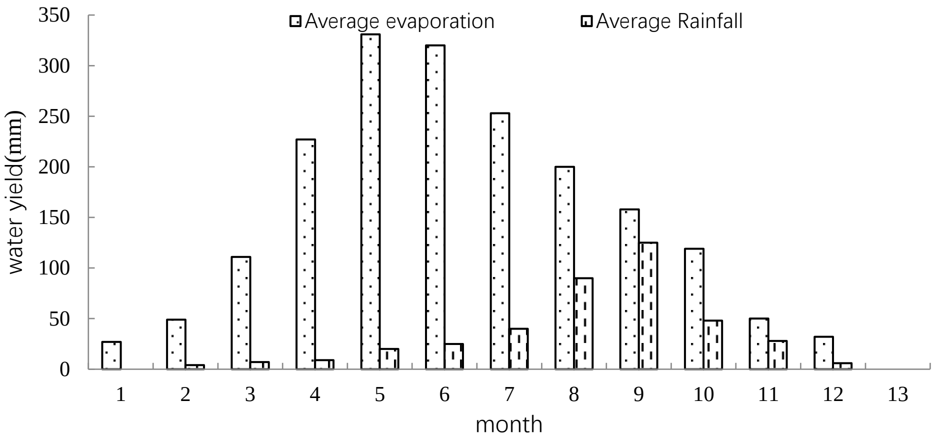


Figure 3: Annual average rainfall and evaporation in Hasuhai

2.2 Sample collection and analysis methods

Because the water of Hashai is shallow, the water intake device is used to take the lake 50cm below the lake surface, and directly monitor the temperature, pH, transparency, DO and other indicators, and then bring it back to the laboratory to determine TN, TP and COD_{Mn}, Chl. A and many other water quality indicators. Water bodies: TN, TP, and COD_{mn}reach Chl. A concentration were determined by alkaline potassium persulfate digestion ultraviolet spectrophotometry, molybdenum antimony resistance spectrophotometry, potassium permanganate titration and acetone extraction spectrophotometer method, pH value, temperature, etc are using the Swiss metel parameter instrument directly at the sampling site, transparency, mud thickness and water depth, using the plug plate method, rod and sonar, respectively[16].

The qualitative and quantitative collection methods of phytoplankton refer to the Observation and Analysis of Lake Ecological Survey[17].5. Qualitative sample collection uses 25 # plankton net in the surface water as "" shape drag collection, placed in 100 mL sample bottle, and added 6~10ml of 1% formalin solution for preservation. For quantitative sample collection, 1L water samples were collected at 0m depth of the water surface, fixed with 10~15ml of Glu reagent, stored in brown sampling bottles, and brought back to the laboratory for testing at 4℃. After 48 hours of precipitation, the samples were concentrated to 30-50ml by siphon, and the water samples were stored to 50 ml bottles for quantitative counting of phytoplankton[5].

2.3 Sample analysis and method

Phytoplankton quantitative counting was performed using an light microscope (Z eiss A xioskop microscope) using direct assignment to assess phytoplankton populations in lakes and reservoirs using an algal density index. Algae density index refers to the number of algae per unit volume of water in a lake reservoir. Take 1ml sample to be measured to 100ml. After full uniformity, remove 0ml onto a glass sheet and count one by one under a high power microscope. The formula is as follows: 1

$$N = \frac{C_S}{F_S \times F_n} \times \frac{V}{U} \times P_n \tag{1}$$

Where: N: number of phytoplankton in 1L sample; Cs: counting box area; Fs: single area of visual field; Fn: number of visual field; V: 1L sample concentrated volume, mL; U: counting box volume; Pn: number of phytoplankton in each count box.

According to Freshwater algae in China: System, Classification and Ecology[18], Cell count according to the Technical Specification for Investigation of Freshwater Biological Resources[19]H'(DB43/T 432-2009). Phytoplankton diversity was analyzed by the Shannon-W iener diversity index, Margalef species richness index (), Pielou evenness index (), and dominance () indexDJY[20].

$$H' = -\sum_{i=1}^{n} P_i Ln P_i \tag{2}$$

$$D = (S-1)/Ln\ N \tag{3}$$

$$J = \frac{H'}{ln\ S} \tag{4}$$

$$Y = f_i \times P_i \tag{5}$$

$$P_i = \frac{n_i}{N} \tag{6}$$

$H'P_i$In the diversity index; the proportion of species i to the total number of individuals; the species richness index; the number of algae in the community; J uniformity index; the algal dominance; 0.02 is the dominant species; the frequency of the i th species at the sampling point; and the number of individuals in the i th species$DSNYYf_i n_i$[5].

The commercial law of algae species. The the number of different algae to calculated calculated formula formula formulas ations 7 and 8:

Green algae merchant

$$\text{Green algae merchant} = \frac{\text{Number of green algae}}{\text{Nuber of algea species}} \tag{7}$$

$$\text{Composite algae merchant}=\frac{\text{blue green algae+chlorolla+Central shell diatoms+Number of naked algae species}}{\text{Number of algae species}} \tag{8}$$

Evaluation by green algae quotient: 0-1 is oligotrophic; 1-5 is eutrophic; 5-15 is heavily eutrophic.

Using compound algae quotient assessment: 0-1 was oligotrophic; 1-2.5 was weakly eutrophic; 3-5 was moderately eutrophic; 5-20 was severely eutrophic; 20-43 was heavily eutrophic.

Table 1: Water quality evaluation criteria based on phytoplankton density and biomass

Density/(10^6cells/L)	Biomass volume/(10^{-3}mg/L)	Water quality evaluation results
≤0.5	<0.1	Very poor nutrition
0.5~1	0.1~1	Poor nutrition
1~10	1~3	Poor-medium nutrition
10~40	3~5	In nutrition
40~80	5~7	Medium-eutrophication
80~100	7~10	eutrophy
≥100	≥10	Very nutritious

Table 2: Water quality evaluation criteria based on phytoplankton diversity index

The Shannon-W iener diversity indexH'	The M argalef Index$D$	Pielou Uniformity index J	Water quality evaluation results
>4	>5	>0.8	cleaning
3~4	4~5	0.5~0.8	Mild pollution
2~3	3~4	0.3~0.5	β -Contamination
1~2	1~3	0.1~0.3	α -Contamination
<1	<1	<0.1	Heavy pollution

$YY.02H'H'.6.5$According to Mc N aughton dominance, species> 0 were the dominant species, and according to the Shannon-W iener diversity index, <0,0.6 to 1.51.5,1.6 to 2.5,2.6 to 3.5 and> 3 indicated poor, general, good, abundant, and very abundant species, respectively[21]. The criteria for evaluating water quality by phytoplankton density and water biomass and diversity index are shown in Table 1 and Table 2 respectively[22].

The water nutrition status was evaluated by using the comprehensive nutritional status index method. TN, TP, and COD were selected$_{mn}$, Chl. A As the benchmark parameter for evaluating lake eutrophication, the scoring criteria are shown in Table 3, and the evaluation formula is as follows:

$$TLI(TN) = 10 \times (5.453 + 1.694 \times ln(TN)) \tag{9}$$

$$TLI(TP) = 10 \times (9.436 + 1.624 \times ln(TP)) \tag{10}$$

$$TLI(COD_{Mn}) = 10 \times (0.109 + 2.66 \times ln(COD_{Mn})) \tag{11}$$

$$TLI(Chl.a) = 10 \times (2.5 + 1.086 \times ln(Chl.a)) \tag{12}$$

$$TLI(\sum) = \sum_{j=1}^{m} W_j \times TLI(j) \tag{13}$$

$TLI(TN) TLI(TP) TLI(COD_{Mn}) TLI(Chl.a) TLI(\sum) W_j$ Formula is the total nitrogen nutrient index; the total phosphorus nutrient index; the permanganate nutrient index; the nutrient index of chlorophyll a; the comprehensive nutrient state index; the weight of the nutrient state index of j th parameter; the nutritional state index of j th parameter; m is the number of evaluation parameters.$TLI(j)$

Table 3: Classification of Comprehensive Nutritional Status Index

grade	Poor nutrition	In nutrition	eutrophy	Mild eutrophication	Moderate eutrophication	Heavy nutrition
T LI()∑	<30	30~50	>50	50~60	60~70	>70

3. Results and discussion

3.1 Analysis of eutrophication indicators

Table 4: Test results of Hasuhai surface water test on May 20, 2021

	H1	H2	H3	H4	H5	H6
Permanganate Index (mg/L)	7.0	6.7	6.7	5.6	5.7	5.5
Total phosphorus (mg/L)	0.430	0.249	0.135	0.130	0.099	0.104
Total nitrogen (mg/L)	0.581	2.452	2.849	0.872	0.940	0.251
Chlorophyll a (ug/L)	12.811	9.460	9.072	14.157	4.694	5.473
pellucidity (cm)	20	18	20	30.5	44	24

As can be seen from Tables 4,5: in May, the permanganate indexes of H1, H2 and H3 exceeded the specified water class standards in the surface water environmental quality standard (GB3838-2002); in July, the permanganate index of the six monitoring sites exceeded the standard value of stipulated water type in the quality standard; the points with the highest P levels in May and July are both point to H1, the highest value was 0.43 mg/L, which surpassed the class V water standard value specified in the surface water environmental quality standard; the phosphorus concentration of the monitoring sites, H2 in May and H2 and H6 in July, exceeded the stipulated water standard value in the surface water environmental quality standard; the highest nitrogen concentration in May was point to H3, the highest nitrogen concentration in July is point to H4. In May, the total nitrogen concentration of H2 and H3 exceeded the class V water standard value stipulated in the surface water environmental quality standard. In July, the total nitrogen concentration of monitoring H3 exceeded the prescribed standard value of water class, and H4 of the monitoring point exceeded the prescribed standard value of water class V. Chl. in July and May. A average concentration of 40 ug/L and 9 ug/L respectively, may only a little H1 and H4 concentration exceeds the surface water environmental quality standard, the concentration of the other points are below the water standard value, the concentration of chlorophyll A at the monitoring point except point H4 exceeds the surface water environmental quality standard, the concentration of chlorophyll a H4 below the water standard value. At the same time, it can be seen that the chlorophyll a content in July is much higher than that in May, about 4.44 times that in May.

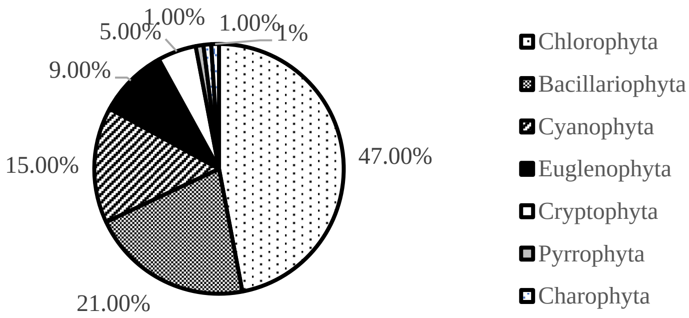
Table 5: Test results of Hasuhai surface water test on July 29, 2021

	H1	H2	H3	H4	H5	H6
Permanganate Index (mg/L)	14.1	13.2	13.1	13.6	13.1	13.6
Total phosphorus (mg/L)	0.430	0.217	0.178	0.148	0.183	0.212
Total nitrogen (mg/L)	0.630	0.914	1.610	2.090	0.669	0.581
Chlorophyll a (ug/L)	39.495	34.979	48.701	22.037	49.796	48.244
pellucidity (cm)	20	18	20	30.5	44	24

3.2 Community composition of the HasoSea phytoplankton

A total of 100 phytoplankton species in 8 phyla, 38 families and 58 genera were identified in July, Among them, 13 families, 15 genera and 21 species; One family of dinoflagellae (multicone family), one genus (multicone genus) and one species (one species); 15 species in 11 genera and 9 families; 1 family (spindle algae) 1 genus (spindle algae) 1 species (spindle algae); 3 genera and 9 species of 1 family (naked algae family); 11 families, 24 genera and 47 species; 5 species of 1 families (cryptoflamellates and cyanobellates) (cryptoalgae and stable algae). The hasu Sea phytoplankton are mainly green algae, diatoms and cyanobacteria, and the three species account for 83% of the total species (Figure 4).

Figure 4: Phytoplankton composition in Hasuhai Lake



The points of phytoplankton community composition see table 6: A4 sampling point is the biggest in sea phytoplankton, a total of 61 species of six categories, accounting for 61% of the total number of all detected phytoplankton, A2 area is the smallest within Athe monitoring range, a total of six categories of 44 species, accounting for 44% of the total number of detected phytoplankton species.

Table 6: Phytoplankton species at 6 monitoring points in Hasuhai

sampling point	Cyanophyta	Pyrrhophyta	Bacillariophyta	Cryptophyta	Euglenophyta	Chlorophyta	Bruins phylum	Charophyta	amount to
A 1	6	0	12	3	4	22	1	1	49
A 2	5	0	9	2	6	21	1	0	44
A 3	4	0	12	4	3	20	1	1	45
A 4	14	1	11	2	2	30	1	0	61
A 5	11	0	9	2	3	19	1	0	45
A 6	8	0	10	1	2	23	1	1	46

3.3 The dominant Hassea phytoplankton species

There are 7 dominant species, including 2, Microcystis and Pseud, with dominance of 0.03 and 0.04 respectively; 2, Cross, and 0.03 and 0.02; 2, Arbitum, 0.05 and 0, 0.03 respectively; 1, including Para, with a dominance of 0.21 (Table 7).

Table 7: Dominance of phytoplankton

door	category	dominance
Cyanophyta	Microcystis kutz	0.03
	Pseudosaurus genus	0.04
Chlorophyta	Crossalgae genus	0.03
	Tetraspora	0.02
Bacillariophyta	Elbow algae genus	0.05
	Nitzschia Hass	0.03
Pyrrhophyta	Peridinium	021

3.4 Phytoplankton abundance and biomass in the Hasin Sea

The average total abundance of Hasosea phytoplankton was 30.7910^{6}individual/L. The abundance of cyanobobacteria phyla at each point ranged from 5.54 to 9.7810^{6}Individual/L, mean abundance of 7.7410^{6}Individual/L, accounting for 25.14% of the mean total abundance; the abundance of the dinoflagellum at each point ranged from 3.93 to 9.1010^{6}Individual/L, the mean abundance was 6.6810^{6}Individual/L, accounting for 21.70% of the average total abundance; the abundance of the diatom gate at each point ranged from 4.65 to 5.6710^{6}Individual/L, mean abundance of 4.9410^{6}Individual/L, 16.04% of the mean total abundance; the abundance of the phylum at each point ranged from 0.72 to 2.4610^{6}Individual/L, the mean abundance was 1.3110^{6}Individual/L, 4.25% of the mean total abundance; the abundance of each point ranged from 0.17 to 0.4410^{6}Individual/L, mean abundance of 0.2910^{6}Individual/L, 0.94% of the mean total abundance; each point ranged from 7.42 to 11.0710^{6}Individual/L, mean abundance of 8.9010^{6}Individual/L, accounting for 28.91% of the mean total abundance; the abundance of brown algae at each point ranged from 0.66 to 1.8510^{6}Individual/L, mean abundance of 1.1510^{6}Individual/L, accounting for 3.73% of the mean total abundance; the abundance of the phylum at each point is 0.~0.2510^{6}Individual/L, mean abundance of 0.0510^{6}Individual/L, representing 0.16% of the mean total abundance (Table 8).

According to Table 9, the minimum value of phytoplankton abundance in the Hasu Sea was measured in site A6 and the maximum value in site A1, and the abundance of two points was 24.6210^{6}Individual/L and 38.4710^{6}individual/L. The abundance of other monitoring sites is shown in Table 2, and the proportion of phytoplankton abundance in the Harbin Sea is cyanobacteria, dinoflagellates, green algae and diatom. In the 6 monitoring points, the green algae is the main algal species, including Microcystis and Pseudena are the main algae.

Table 8: Phytoplankton abundance at each sampling point in Hasuhai Unit: 106/L

sampling point	Cyanophyta	Pyrrhophyta	Bacillariophyta	Cryptophyta	Euglenophyta	Chlorophyta	Bruins phylum	Charophyta	amount to
A 1	9.78	9.10	5.67	1.14	0.17	11.07	1.52	0.021	38.47
A 2	6.51	5.88	5.13	0.72	0.31	7.79	0.76	0.00	27.11
H3	5.54	5.25	4.72	2.46	0.20	7.94	1.19	0.25	27.545
A 4	8.66	8.17	4.67	1.67	0.30	10.13	1.85	0.00	35.43
A 5	8.33	7.74	4.65	0.56	0.31	9.08	0.90	0.00	31.56
A 6	6.01	3.93	4.79	1.31	0.44	7.42	0.66	0.04	24.62
mean	7.47	6.68	4.94	1.31	0.29	8.90	1.15	0.05	30.79

Table 9: Abundance of phytoplankton in the Hasu Sea

classify	Cyanophyta	Pyrrhophyta	Bacillariophyta	Cryptophyta	Euglenophyta	Chlorophyta	Bruins phylum	Charophyta	amount to
Abundances (10^6individual/L)	7.47	6.68	4.94	1.31	0.29	8.90	1.15	0.05	30.79

3.5 Hasosea phytoplankton community diversity index

The average H value of the six monitoring sites in the Hasu Sea was 3.146, indicating that the overall phytoplankton diversity in the Hasu Sea was rich, with the exception of H4, which was very rich, and other sites were rich. The mean value of Margalef index D was 2.805, with little difference in other monitoring points except H4. The mean value of Pielou evenness index J was 0.839, in which the J value of point 1 was significantly lower than that of the other 5 monitoring points, and the other 5 points had little difference. See Table 10 for specific values.

Table 10: Community Diversity Index of Phytoplankton in Hasuhai Sea

monitoring site	The S hannon-Wiener diversity index, H	evenness index J	Richness index, D
H1	3.146	0.808	2.792
H 2	3.008	0.781	2.675
H 3	3.130	0.822	2.600
H4	3.595	0.875	3.504
H 5	3.314	0.871	2.590
H 6	3.358	0.877	2.671
mean	3.258	0.839	2.805

3.6 Water quality evaluation of Hasosea phytoplankton

According to the index H of phytoplankton in the Hasu Sea, the six monitoring sites were slightly polluted. According to the Maigalef index D, except H 4 is β -medium contamination, other monitoring points were α -medium contamination. According to the Pielou uniformity index J, except H 2 are clean. According to the phytoplankton abundance, the whole plant is mesotrophic. According to the overall phytoplankton biomass as being extremely eutrophic, the comprehensive nutrient status indication was evaluated as moderate eutrophication.See Table 11 for specific values.

Table 11: Phytoplankton based water quality assessment of Hasuhai Lake

monitoring site	The Shannon-W iener diversity index, H	The M argalef index, D	Pielou Uniformity index J	abundance	biomass
H1	Mild pollution	α -Contamination	cleaning	In nutrition	Very nutritious
H2	Mild pollution	α -Contamination	Mild pollution	In nutrition	Very nutritious
H3	Mild pollution	α -Contamination	cleaning	In nutrition	Very nutritious
H4	Mild pollution	β -Contamination	cleaning	In nutrition	Very nutritious
H5	Mild pollution	α -Contamination	cleaning	In nutrition	Very nutritious
H 6	Mild pollution	α -Contamination	cleaning	In nutrition	Very nutritious
synthesize	Mild pollution	α -Contamination	cleaning	In nutrition	Very nutritious

3.7 Evaluation of Hasosea eutrophication based on comprehensive nutritional status

By comparing the calculated results and the bar chart of the two groups of data, although the values of the comprehensive nutrient status index are different, it still reflects that the seawater environment eutrophication is more serious. The average comprehensive nutrient status index can be monitored as 58.18, the average nutritional status of mild eutrophication, and the average comprehensive nutrient status index in July as 67.12, moderate. The average nutrient status in July was higher than that in May, and the eutrophication of elemental seawater environment had a tendency to deteriorate gradually. See Table 12 for specific values.

Table 12: Analysis of calculation results of monitoring data on July 29, 2021

PT	The TLI in May	Nutritional status	The TLI in July	Nutritional status
H1	62.106	Moderate eutrophication	69.022	Moderate eutrophication
H2	64.091	Moderate eutrophication	67.767	Moderate eutrophication
H3	62.189	Moderate eutrophication	69.427	Moderate eutrophication
H4	57.388	Mild eutrophication	66.043	Moderate eutrophication
H5	52.375	Mild eutrophication	64.106	Moderate eutrophication
H6	50.957	Mild eutrophication	66.373	Moderate eutrophication

3.8 Evaluation of eutrophication based on algae quotient assessment method

Table 13: Green algae quotient calculation results

PT	The number of algae species	Number of green algae species	Green algae business	Nutritional status
H1	2	22	11	Heavy nutrition
H2	2	21	10.5	Heavy nutrition
H3	2	20	10	Heavy nutrition
H4	2	30	15	Heavy nutrition
H5	2	19	9.5	Heavy nutrition
H6	2	23	11.5	Heavy nutrition

Table 14: Compound quotient calculation results

PT	Number of cyanobacteria species	Number of green algae species	Number of diatom species in the central shell order	Naked algae species	The number of algae species	Compound algae quotient	Nutritional status
H1	6	22	1	4	2	16.5	Severe eutrophication
H2	5	21	1	6	2	16.5	Severe eutrophication
H3	4	20	1	3	2	14	Severe eutrophication
H4	14	30	1	2	2	23.5	Heavy nutrition
H5	11	19	1	3	2	17	Severe eutrophication
H6	8	23	1	2	2	17	Severe eutrophication

In order to make the evaluation results more convincing, the green algae commercial method and algae species commercial method were used to determine the eutrophication of Harbin in July. By analyzing the data, the green algae quotient and compound algae quotient were obtained. The calculated data are shown in Table 13 and Table 14 and Table 14, and the number map of algae species at each point is shown in Figure 5. Using the green algae quotient assessment, all the monitoring points were heavily eutrophic, and except that the point H4 was heavily eutrophic, the other points were heavily eutrophic.

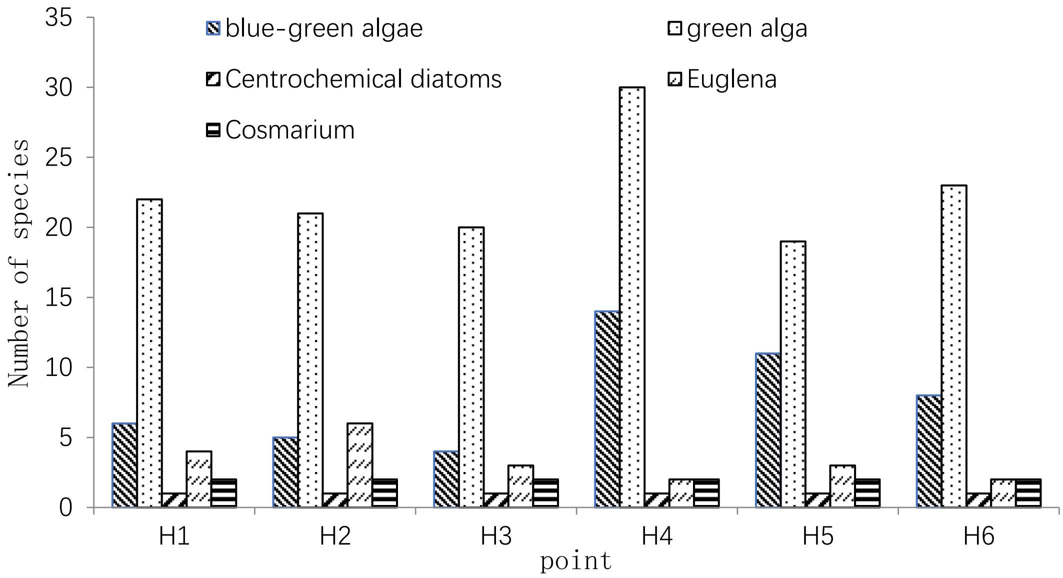


Figure 5: Species and quantity of algae at each point

4. Discussion

For lake eutrophication, the drivers of different lakes are not only the same, Savvas K afouris[23]And et al suggested that the main drivers of diatom composition, diversity and biomass are major factors in marine eutrophication and identified benthic diatom assemblages and specific biologic taxa as reliable predictors of coastal eutrophication, T homas S teinsberger[24]People et al. believed that the carbon-nitrogen ratio was the main indicator that triggered lake eutrophication, and that the carbon-nitrogen ratio and phytoplankton biomass were important indicators to change productivity. According to the water quality index of Hasin Sea in May and July, the eutrophication of hasin seawater in July was more serious, among which Chl. A, SD and TP of eutrophication proportion than other parameters, in view of the water eutrophication in July, the water phytoplankton analysis, microechocystis, false fish, cross algae, elbow algae, diamond and more for element sea main dominant species, the algae using green algae commercial assessment and use composite algae quotient assessment its eutrophication belongs to severe eutrophication, than the comprehensive nutritional state index of moderate eutrophication is more serious. Comparing the results of green algal quotient assessment and composite algal quotient assessment, it can be seen that more algae species are counted due to the composite alga quotient assessment to make the data more representative. Through the analysis of the number of different algae species, the eutrophication of different points is more intuitive than that of green algae quotient. Meanwhile, because the classification of composite algae quotient is more detailed, the accuracy of compound algae quotient assessment is higher than that of green algae quotient. Thu -H uong T hi H oang[25]People et al. suggested that the nutrient index was the best predictor to identify the level of lake eutrophication, and this paper suggested that the algae evaluation may be more representative than the water quality evaluation.

There are overall spatial differences in phytoplankton community composition in the Hasu Sea, with more A4 phytoplankton in the southwest and less in the west. It can be seen from the distribution map of the monitoring points that H4 is closer to the town, and also close to the pu area. It is possible that the environment in the pu area is more suitable for the growth of algae, while other points are close to the inlet and outlet, with better hydrodynamic conditions, which is not conducive to the growth of algae. Another reason why H4 is richer than other points may be that there are large areas of farmland in the west and south banks near point H4 and more domestic sewage discharge, so that the nutrient pollutant content in the vicinity of Point H4 is higher, which is more conducive to the growth of algae, thus making the algae species more abundant[26]. A .C aen[27]et al noted that weakening lake eutrophication could reduce the use of P content by changing surrounding farms.Annika[28]And others believe that the industry and agriculture around the lake bring great pressure on the eutrophication of the lake and the habitat of animals.

5. Conclusion

(1) According to the water quality data of Hasuhai in May and July, the concentration of each element in each monitoring point in Hasuhai in May and July was mostly between the specified standard value of class water and the standard value of Class V water. The total nitrogen concentration of H2 and H3 in May and the total phosphorus concentration of H1 in May and July exceeded the standard value of class V water. In July, water eutrophication was more serious, including chlorophyll (Chl. A), Transparency (SD), and total phosphorus (TP) play a major role in eutrophication.

(2) The phytoplankton in the Hasu Sea are mainly green algae, diatoms and cyanobacteria, and the number of species accounts for 83% of the total species. Microcystis, false fish algae, cross algae, elbow algae, diamond algae and polylamina are the main dominant species in the Hasu Sea.

(3) The comprehensive nutritional status indication indicates that the water quality in July was moderately eutrophication, while the calculation results of green algae quotient and compound algae quotient were severely eutrophication. Compared with the evaluation results of water quality eutrophication, the level of algae eutrophication was more serious.

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