Evaluation of Eutrophication Degree for Inland River in Haikou

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Abstract

Eutrophication is a common and urgent problem for rivers, lakes and reservoirs. Based on the monitoring data, using comprehensive nutrition state index method, TLI (∑) of inland river in Haikou was deduced 50~70 in 2019, which can show the water has been in mild-to-moderate eutrophication state, and the water was moderately polluted. Therefore, countermeasures including monitoring the nutrient such as nitrogen and phosphorus content have been proposed.

Keywords — *Eutrophication, Eutrophication salt, Comprehensive nutrition state index*

I. INTRODUCTION

Eutrophication refers to a large number of the biological nitrogen and phosphorus and other nutrients to enter the slow flow water bodies such as rivers, lakes, et al, which cause rapid reproduction of algae and other plankton, decreasing of dissolved oxygen, the phenomenon of death of fish and other creatures. Inland water bodies are in excess of nutrient elements which was caused by the discharge of large amounts of sewage, and each parameter is mutual influence and restriction, to cause the eutrophication of water bodies[1, 2].

Comprehensive nutrition state index method has been widely used to evaluate the degree of eutrophication in rivers by chlorophyll a (chl-a), total phosphorus (TP), total nitrogen (TN) as evaluation index [3,4], which can provide the theory basis for environmental protection and its ecological service function [5]. Compared with other methods (carlson nutritional status index (TSI) [6] and nutrition index method [7], et al), this method does not require prior assumption model or subjective regulations, which makes the evaluation model have generality and eliminate the application difficulties and human assume for conclusions.

This study calculated the nutritional status of each single factor by detecting total nitrogen (TN), total phosphorus (TP), permanganate index (COD_{Mn}) as three indicators, finally all single factor were synthesized for continuous evaluation of nutrient status with different grade to evaluate the degree of eutrophication, which provides a way to understand the eutrophication process and predict the development trend.

II. EXPERIMENTAL SECTION

A. Reagents and instruments

All reagents and solvents are commercially available and used directly

UV-Vis spectra were obtained on a Hitachi U-2910 spectrophotometer. pH values were measured with a pH-meter PBS-3C (Shanghai, China).

B. Measurement

Measurement of total nitrogen (TN), total phosphorus (TP), potassium permanganate index (COD_{Mn}) is according to GB11894-89, GB11893-89, GB11892-89, respectively.

C. Sample

The setting of sampling points refers to the reported method [8].

Water collection time was from February 2019 to November 2019, and the sample was collected once a month. The water sample below the water surface at 0.1 m to 0.5 m was collected with a deep water sampler, then it was put into a polyethylene plastic bottle, fixed with concentrated H_2SO_4, and stored at 4 ^oC.

III. RESULTS AND DISCUSSION

A. Evaluation of eutrophication degree

Monitoring results and evaluation results for three points of eutrophication index were displayed as Table 1. Using comprehensive nutrition state index method, TLI (∑) of the water was deduced 50~70 in 2019, which can show the water has been in mild-to-moderate eutrophication state, and the water was moderately polluted. The eutrophication of the inland water body may be caused by: (1) The abundant sunlight resource in Hainan and oxygen content. It is suitable for the growth of algae, at the same time, the river ecological system is fragile to produce eutrophication easily by environmental factors. (2) The discharge of domestic sewage around the city. As the urban drainage network and distribution of rain and sewage is not complete, a large amount of municipal domestic sewage overflows to the water body, which will increase the nutrient load of the inland river, eutrophication is easy to occur; (3) Man-made pollutants. Some as automobile exhaust, enter into the water body as the rainwater falls, and increase the pollutant content.

Table 1 Evaluation of eutrophication degree

Month	River section	COD_{Mn} (mg/L)	TP (mg/L)	TN (mg/L)	TLI (Σ)	Eutrophication Evaluation degree
	1#	3.6	0.30	3.50	56.45	mild
Feb.	2#	3.2	0.23	3.21	58.91	mild
	3#	3.3	0.18	2.50	61.9	moderate
	1#	3.6	0.31	4.00	56.15	mild
Mar.	2#	3.2	0.29	3.19	60.16	moderate
	3#	3.3	0.17	2.51	62.82	moderate
	1#	3.2	0.32	3.70	55.52	mild
Apr.	2#	3.0	0.27	3.20	59.21	mild
	3#	3.3	0.15	2.54	61.52	moderate
	1#	5.3	0.34	4.50	61.56	moderate
May.	2#	5.5	0.21	3.24	63.26	moderate
	3#	5.5	0.20	2.50	67.41	moderate
	1#	5.0	0.36	5.08	59.33	mild
Jun.	2#	4.1	0.24	3.02	61.00	moderate
	3#	4.0	0.22	2.53	67.88	moderate
	1#	4.8	0.30	3.30	59.55	mild
Jul.	2#	4.0	0.31	3.18	62.49	moderate
	3#	4.2	0.21	2.55	64.13	moderate
	1#	4.5	0.29	3.93	58.54	mild
Aug.	2#	4.0	0.30	3.22	62.38	moderate
	3#	3.6	0.22	2.60	64.33	moderate
	1#	3.7	0.28	4.73	56.92	mild
Sep.	2#	3.4	0.31	3.33	61.31	moderate
	3#	3.5	0.18	2.48	63.42	moderate
	1#	4.3	0.32	3.65	58.45	mild
Oct	2#	4.2	0.31	3.36	63.23	moderate
	3#	4.0	0.19	2.50	64.07	moderate
	1#	4.5	0.27	3.47	57.11	mild
Nov	2#	4.1	0.24	3.16	61.26	moderate
	3#	3.8	0.16	2.53	63.25	moderate

B. The monthly changes of comprehensive nutritional status index

The monthly changes of comprehensive nutritional status index of each sampling point for the river in 2019 were shown in Figure 1. TLI(∑) of three sampling point displayed a basically consistent change trend. TLI(∑) value of 1# was higher, which showed that the eutrophication degree of this segment was higher. Moreover, the trough period of nutritional status index appeared in April, September and November, and peaked in May and October. It could be due to differences in rainfall which effected the nutrient load of the inland river.

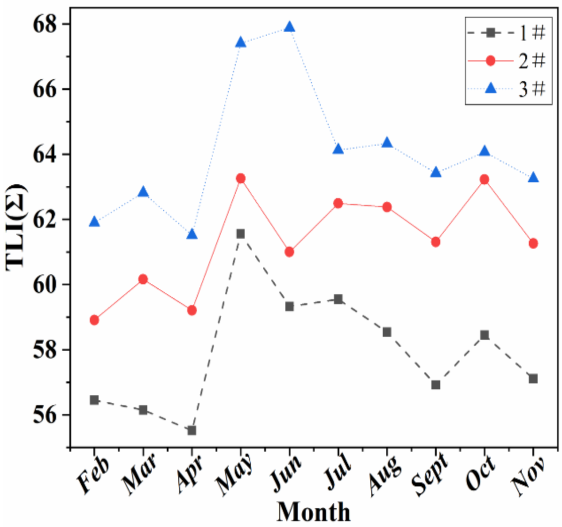

Figure 1 The monthly changes of comprehensive nutritional status index.

IV. CONCLUSIONS

The management of eutrophication of water body should be considered from the level of construction planning. (1) Growing aquatic plants in accordance with local climate and ecological conditions has been designed to efficiently absorb nutrients such as nitrogen and phosphorus. (2) Inoculation of microorganisms capable of denitrification and dephosphorization has aimed to remove nutrients such as nitrogen and phosphorus from water through the synergistic action of aquatic plants and microorganisms. (3) Promote comprehensive river management and ecological restoration, which has aimed to build diversified ecological shorelines integrating aquatic plants and animals, and realize a benign ecological cycle.

The treatment of eutrophication of river waters is a long-term process, which requires the formulation of scientific and effective prevention measures and strengthening of public awareness of environmental protection.

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