The Influence Mechanism of Nutrient Release from River Sediment on Algal Community Succession

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Abstract

Pengxi River is the largest tributary of the north bank of the Three Gorges Reservoir area, and it is also one of the most eutrophic tributaries since the impoundment of the reservoir area. Since the impoundment of the Three Gorges Dam, blooms frequently broke out in Pengxi River from April to May every year, showing the dynamic characteristics of alternating dominance of cyanobacteria and dinoflagellates. In order to explore the mechanism of sediment nutrition on algal blooms and algae competition, sampling sections PX1-PX7 were set up from the lower reaches of the Pengxi River to the upper reaches of the Quma section, and continuous sampling was carried out in the annual bloom season (April-May). The data of sediment, water nutrients and algae community in stratified water bodies in the spring bloom season of Gaoyangping Lake site from 2021 to 2024 were analyzed. The results showed that: (1) Total nitrogen, total phosphorus and organic matter in sediment were in a high level for a long time (50% higher than the normal range), and increased year by year, indicating that sediment nutrients continued to accumulate. (2) The concentration of nutrients in the bottom water was generally higher than that in the surface water, and the change trend was positively correlated with the nutrient release of the sediment ($R2 = 0.72$, $p < 0.05$), indicating that the sediment continued to release nutrients to the water body to form the bottom ' nutrient pool '; (3) There was a significant negative correlation between cyanobacteria and dinoflagellates in the surface and middle layers ($R = -0.65$, $p < 0.01$), while they increased synchronously in the bottom layer ($R = 0.58$, $p < 0.05$). The total nitrogen release from the sediment increased by 12-18% during the mass death of cyanobacteria, and the biomass of dinoflagellates increased by 2-3 times during the same period, indicating that there was a secondary release of sediment nutrients and driving the conversion of bloom types. In summary, the long-term accumulation and dynamic release of sediment nutrients provide a material basis for algal blooms through vertical gradient upward transport of nutrients, and promote algal bloom succession by regulating the competitive relationship between cyanobacteria and dinoflagellates.

Keywords

Three Gorges Reservoir Area, Pengxi River, Water Bloom, Endogenous Nutrition, Community Succession