The Driving Effect of Environmental Factors on the Succession of Dinoflagellate Blooms on the Time Scale

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Abstract

After the impoundment of the Three Gorges Reservoir area, the tributaries such as Pengxi River changed from flowing water type to still water type, and blooms from cyanobacteria to dinoflagellates often occurred in spring. In order to explore the driving mechanism of environmental factors on the succession of dinoflagellate blooms, this study carried out high-frequency day and night continuous sampling and in-situ device experiments in Gaoyangping Lake of Pengxi River in the spring bloom period of 2025, and analyzed the temporal variation characteristics of algae biomass, nutrients, water temperature and photosynthetically active radiation in different water layers. The study found that : (1) Dinoflagellates showed a significant diurnal vertical migration rhythm, and the biomass was negatively correlated with the surface light intensity ($R = -0.68$, $p < 0.01$). From night to early morning (22:00 ~ 8:00), a large number of dinoflagellates gathered in the surface layer, and the biomass could reach 3 ~ 5 times of that in the daytime. During the daytime (14:00), it migrates to the middle and lower levels. (2) The vertical structure of water temperature showed obvious diurnal variation. The temperature difference between the surface layer and the bottom layer reached 2.5°C during the day, and the water body formed a stable stratification. Nighttime stratification weakened. The weakening of stratification at night was synchronized with the disappearance of light, and a large number of dinoflagellates floated to the surface, indicating that stratification changes and light rhythms jointly regulated their vertical migration behavior. (3) The water temperature was low (< 22°C) in the early stage of water bloom, and cyanobacteria were dominant. After the water temperature rose to 24-26°C, the biomass of dinoflagellates increased rapidly and reached the peak at the most stable stage of stratification, indicating that the increase of water temperature and stratification strengthening were important conditions for triggering dinoflagellate blooms. In summary, dinoflagellates achieve the temporal and spatial coupling of light avoidance and nutrient acquisition through the vertical migration of day and night. The stratification of water temperature provides a physical basis for its migration, and the increase of water temperature directly drives the occurrence and succession of algal blooms.

Keywords

Three Gorges Reservoir Area, Pengxi River, Water Temperature Stratification, Algae Succession