Effects of Calcium Supply and Sediment on Phytoplankton Community Structure in Pengxi River, Three Gorges Reservoir Area

Yemei Kong[1], Lei Zhang[1, 2, 3, *]

[1]College of Resources and Environment, Southwest University, Chongqing, China

[2]The National Base of Water Environmental Monitoring and Simulation in Three Gorges Reservoir Region, Southwest University, Chongqing, China

[3]Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada

Email address:

1599588931@qq.com (Yemei Kong), zhanglei@uwindsor.ca (Lei Zhang)

[*]Corresponding author

Abstract

In this study, we used a typical water body in the reservoir area of Three Gorges, Pengxi River, Kuwan Basin, as the study area, and carried out an outdoor water ecosystem mesocosmic experiment on calcium supply of substrate from April 30 to May 19, 2023, setting up a control group (substrate of Pengxi River+river water) as well as three treatment groups: a sterilized group (sterilized substrate of Pengxi River+river water), a low-calcium group (substrate of Pengxi River mixed with 100mg/L $CaCl_2$ + river water), high calcium group (Pescadores River substrate mixed with 200mg/L $CaCl_2$ + river water), the river bottom substrate was analyzed by 16SrRNA and 18SrRNA high-throughput sequencing technology using the universal parsimony primers of planktonic algae. 20 days after the test, the water samples were microscopically identified and counted, and in terms of the species, there were 117 species of 12 phylums in the control group, 65 species of 11 phylums in the sterilization group, 171 species of 13 phylums in the low-calcium group, and 171 species of 13 phylums in the high-calcium group. In terms of species, the control group had 117 species in 12 phylums, the sterilization group had 65 species in 11 phylums, the low-calcium group had 171 species in 13 phylums, and the high-calcium group had 189 species in 13 phylums, and the planktonic algae in the sterilization group had 1/3-1/2 of that in the other experimental groups. In terms of the number of algal densities in the water, the experimental group was 6.9×10^4ind. Ł$^{-1}$, the sterilization group was 60.2×10^4ind. Ł$^{-1}$, the low-calcium group was 26.9×10^4ind. Ł$^{-1}$, and the high-calcium group was 20.5×10^4ind. Ł$^{-1}$, and the number of algae in the low-calcium and high-calcium groups was roughly comparable to each other, and both of them were about 3 to 4 times of the average density and the average biomass of the control group, however the sterilization group However, in the sterilized group, the algal population was almost 10 times that of the control group. The nutrient indexes of the substrate were measured, and compared with the control group, the sterilized and high calcium groups showed an increase in total nitrogen and minus alkaline nitrogen, while the low calcium group showed a decrease in total nitrogen and minus alkaline nitrogen. The identification of plankton in the substrate showed that there were significant differences in the microbial community structure among the experimental groups, with the diversity and abundance of bacteria being higher than that of fungi, and the interspecies relationship of bacteria being more complex. In the identification of bacteria, the control group and the three experimental groups were dominated by Firmicutes, Actinobacteriota, and Proteobacteria; in the identification of fungi, the four groups were dominated by Arthropoda,

Chlorophyta, Rotifera, and Rotifera. Arthropoda, Chlorophyta, Rotifera, and Ascomycota were the dominant species in all four groups. However, the dominant species in the low-calcium group also included Microsporidia and Gastrotricha, and in the high-calcium group, Platyhelminthes and Microsporidia were also dominant. The results showed that the richness of the community as well as the degree of community diversity were Sterilization group < Control group < High calcium group < Low calcium group, and the similarity of the dominant species groups in the high calcium and low calcium groups was higher than that in the control group, and the difference in diversity between the low calcium group and the sterilization group was the greatest. In summary, calcium supply had little effect on the community structure of planktonic algae in Pengxi River in the Three Gorges Reservoir Area, while the nutrients of the bottom sediment had an important effect on the community structure of planktonic algae in Cuwan of Pengxi River in the Three Gorges Reservoir Area, which not only facilitated the promotion of the growth of planktonic algae and the increase of community abundance, but also had a relationship of inhibition with the growth and development of the planktonic populations in the water body. This paper can provide a scientific reference for further in-depth study of the algal community structure and influencing factors in different tributaries of the Three Gorges Reservoir Basin, for the monitoring and management of the maintenance of river substrate ecosystems, and for the formulation of ecological environmental protection and restoration of water bodies in the Three Gorges Reservoir Basin under the dual role of natural-anthropogenic.

Keywords

Three Gorges Reservoir Area, Calcium Supply, Endogenous, Middle Universe, Phytoplankton Community