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Preface

Cyanobacterial blooms in China: ecology, toxicity, and treatment

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Cyanobacterial blooms are one of the major threats to the health of aquatic ecosystems, and are increasing globally due to the synergistic effects of human activities and global climate change. The 7th National Cyanobacteria Bloom Forum was successfully held in May 28–30, 2021 in Guiyang, Guizhou Province, China. The forum established a platform for exchanging views on the concerns of cyanobacterial blooms from Chinese researchers, lake managers, and treatment engineers. This special issue, "Cyanobacterial blooms in China: ecology, toxicity, and treatment" in Journal of Oceanography and Limnology, presents a collection of 14 papers on the physiological features and the influence on their concurrent aquatic biology of different cyanobacterial groups.

Microcystis blooms are pervasive in temperate and tropical freshwater bodies throughout the world. We have six papers focused on *Microcystis* related to the detection, the function of bound extracellular polymeric substances (bEPS), the effect on submerged macrophyte and the reed wetland, as well as the control strategy in the littoral area for emergency purposes. It is an essential task to conduct correct identificaiton of *Microcystis* species in ecological studies and water bloom control. Zu et al. (2022) established an immunological method to identify *Microcystis*, and they used *Microcystis aeruginosa* PCC7806 lysates as coated antigens for screening specific *Microcystis* nanobodies based on the human domain antibody display library. The bEPS play an important role in the proliferation of *Microcystis*. Wang et al. (2022) found that at certain light intensities, *M. aeruginosa* grow quickly than *M. flos-aquae* along with the increase of negative charges, bEPS contents, growth, and tryptophan-like substance contents. Another study related to EPS in *Microcystis* performed by Duan et al. (2022), identified key physiological traits and chemical components of EPS for colony formation in *Microcystis*. Their results further presented that the major physiological strategies for *Microcystis* to produce excess EPS enhancing colony formation, as increasing number for both photosynthetic reaction center and light-harvesting antenna in the PSII and reducing the growth rate.

Microcystis biomass can be largely accumulated to form heavy scums in large eutrophic lakes, posing a potential risk to public health. Gao et al. (2022) explored how decomposed *Microcystis*-dominant cyanobacterial blooms affect submerged macrophytes by exposing *Myriophyllum spicatum* to the cell extracts from microcystin (MC)- and non-MC-producing *Microcystis* strains in a laboratory experiment. Both *Microcystis* cell extracts exerted obvious damages to plant biomass, photosynthesis, primary and

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secondary metabolism measures, and resistance of plant antioxidant systems, as MC-producing *Microcystis* has stronger effects due to the presence of MCs. Meanwhile, planktonic bacterial communities have the potential to use and degrade substances derived from *Microcystis* cell extracts, which may be beneficial for *M. spicatum* to alleviate damages from *Microcystis*. Ma et al. (2022a) investigated the concentration of chlorophyll *a* and nutrients in reed-covered littoral zones and unvegetated littoral zones of Chaohu Lake, and revealed that reed wetlands in the littoral zone of large eutrophic lake could trap and accumulate algal biomass. To alleviate ecological disasters in littoral zones, Liu et al. (2022) compared three flocculants for heavy *Microcystis* bloom mitigation and subsequent environmental impacts. Polyaluminum chloride (PAC) was shown to be an efficient flocculant through rapid reduce of cyanobacterial blooms at chlorophyll-*a* concentrations over 1 500 μg/L within 15 min. Furthermore, the high accumulation of nutrients in sediments after the settling of cyanobacteria can cause high internal phosphorus and total organic carbon of the sediments, which can threaten lake restoration achieved by planting submerged macrophytes.

Raphidiopsis raciborskii is becoming a cosmopolitan species in freshwater systems around the world and attract interest due to its invasion, expansion, and toxicity. We have three papers dealing with *R. raciborskii*. Wu et al. (2022) presented an overview of *R. raciborskii*'s global distribution and adaptation strategy and demonstrated that the expansion of its geographical distribution could be linked to its genome, toxicity, and ecophysiology. Shi et al. (2022a) reported *R. raciborskii* to cope with P deficiency at coordinated and complex cellular and physiological responses, reflecting the multi-faceted machinery of *R. raciborski* dealing with environmental P fluctuations. Ma et al. (2022b) performed bialgal cultures at different initial ratios of biomasses of *R. raciborskii* and microcystins (MCs)-producing or non-MCs-producing *M. aeruginosa* strains, and revealed that *R. raciborskii* in the co-cultures stimulated the growth of both MCs-producing and non-MCs-producing *M. aeruginosa* strains, comparing to *M. aeruginosa* monoculture. Such a result indicated *M. aeruginosa* to outcompete *R. raciborskii* and gradually become into dominant species even at a lower initial concentration.

Aphanizomenon is a common filamentous and bloom-forming cyanobacterial group. Wen et al. (2022) used the co-culture experiment at different ratios of initial biomass, to confirm that temperature as the dominating factor in the succession of *A. flos-aquae* and *M. aeruginosa*. *A. flos-aquae* was shown at a specific higher growth rate even the coexistence of the both species at 15 °C, however the growth of *A. flos-aquae* at 25 °C was inhibited by the biomass of *M. aeruginosa*.

Eutrophication and climate warming have intensified the global expansion of *Cylindrospermopsis* spp. and *Chrysosporum* spp., two potential producers of Cylindrospermopsin (CYN). Yin et al. (2022) explored the effect of CYN on the structure and function of the bacterioplankton community based on high-throughput sequencing. High concentrations of CYN (40 μg/L) caused a significant decrease in microbial abundance and functional groups. Actinobacteria had the strongest tolerance to CYN. High CYN concentrations were shown to reduce the correlation among different bacterioplankton groups, and inhibit the abundances of some bacterial taxa functioning in the process of denitrification and carbon transfer in the microbial food web. Dissolved organic phosphorus could be used by cyanobacteria via alkaline phosphatase. Wan et al. (2022) review the current knowledge of extracellular phosphatase excreted by cyanobacteria, highlighting the development of detection method and its ecological roles in regulating phosphorus cycling in freshwater systems, which is based on reports for around 100 species of cyanobacteria.

Shi et al. (2022b) investigated the dynamics of the abundance and diversity of aerobic anoxygenic phototrophic bacteria (AAPB) based on *pufM* gene in Taihu Lake. The ratios of AAPB to total bacteria varied from 3.4% to 11.5% and peaked in winter in both sites. AAPB abundance was positively correlated with dissolved organic carbon (DOC) concentration. AAPB community compositions showed a difference between warm seasons and cold seasons.

Zheng et al. (2022) investigated the phytoplankton communities both in a semi-closed lake and a closed lake in the Oujiang River mouth in Zhejiang Province, to explore the effect of tides-induced water exchange on aquatic ecosystem. In the closed lake, cyanobacteria were the dominant species. However, in the semi-closed lake, the diversification of the dominant species was greater, and some species of diatoms and green algae became dominant. Water exchange driven by local tidal movement was shown to increase salinity and decrease transparency of

water, consequently shaping the phytoplankton community structures and reducing the occurrence of cyanobacterial blooms in the semi-closed lake.

We thank editors of Journal of Oceanology and Limnology for giving us the opportunity to edit this special issue and supervise the whole editorial process, and we also thank all reviewers that have thoroughly reviewed these manuscripts. We hope that this collection of papers will be of interest for a broad scientific audience and will bring about new ideas and new research programs from a wide range of water bodies.

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