SCIENTIFIC CENTER OF ZOOLOGY AND HYDROECOLOGY
OF NAS RA, LABORATORY OF APPLIED HYDROECOLOGY
HELMHOLTZ CENTER FOR ENVIRONMENTAL RESEARCH,
DEPARTMENT OF LAKE RESEARCH

HELMHOLTZ ZENTRUM FÜR UMWELTFORSCHUNG UFZ

Cyanobacterial Proliferations in Lake Sevan: Historical and Current Dynamics and Future Expectations

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Goal of Study

The aim of the present study was to characterize harmful cyanobacterial proliferations and their drivers in Lake Sevan.

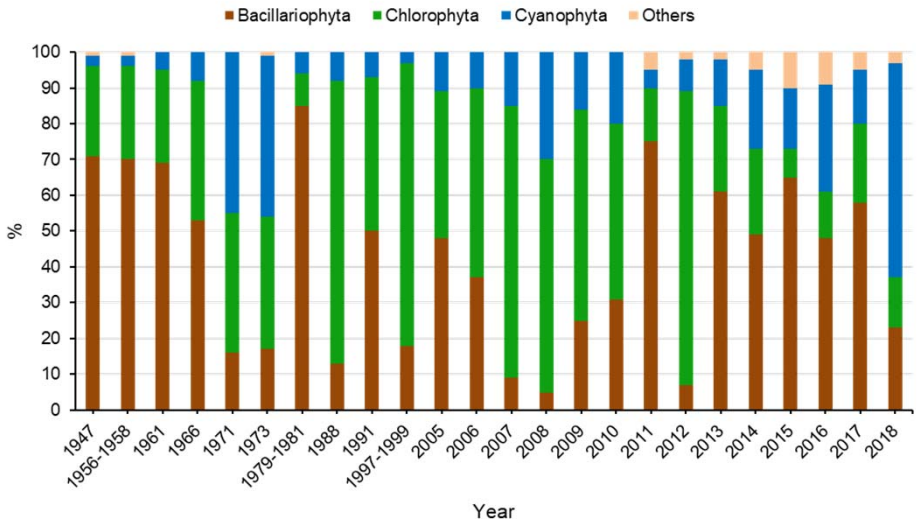
Main Problems to Solve

1. Review on historical dynamics of cyanobacterial blooms in the lake
2. Observations of current cyanobacterial blooms in the lake
3. Observations of potential drivers of cyanobacterial blooms in the lake
4. Investigation of growth characteristics of cyanobacteria blooming in the lake

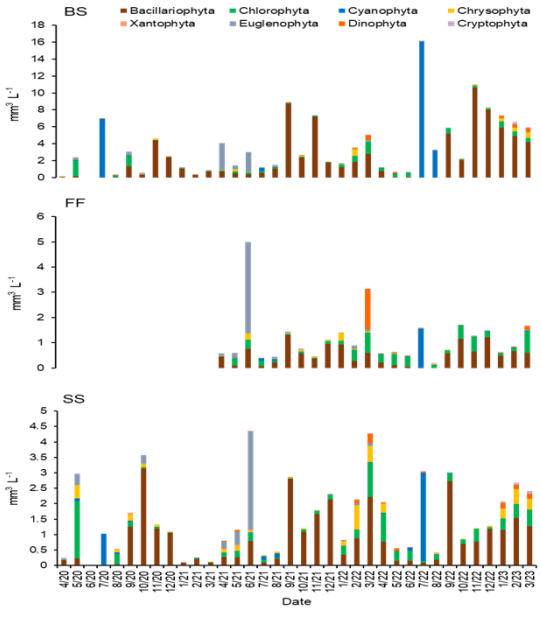
Lake Monitoring Sites

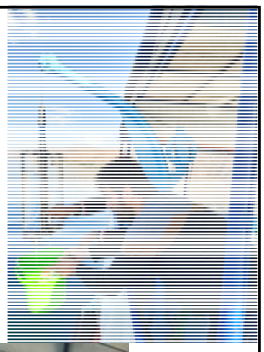
Historical and Recent Dynamics of Phytoplankton Quantitative Composition

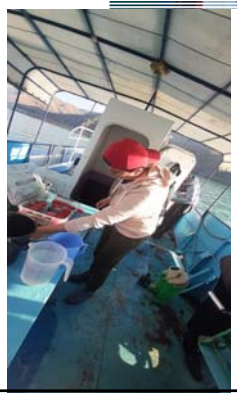
Source: Vladimirova, 1947; Stroykina, 1952; Meshkova, 1962; Parparov, 1979; Nikulina & Mnatsakanyan, 1984; Mikayelyan, 1996; Hambaryan, 2001; Hovsepyan, 2012, 2013; Hovsepyan et al., 2010, 2013, 2016, 2017, Gevorgyan et al., 2020



Current Dynamics of Surface Phytoplankton

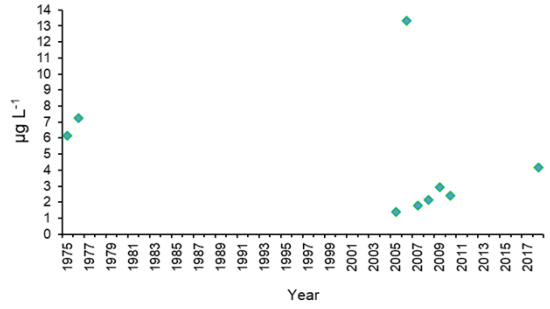


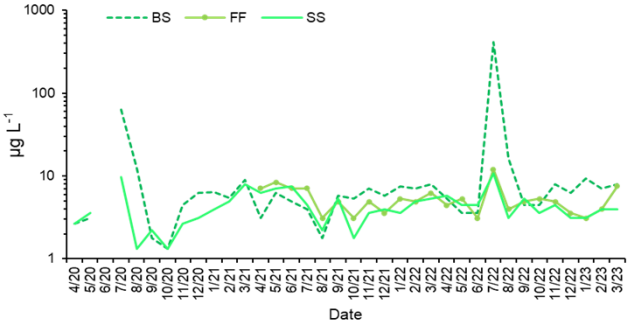




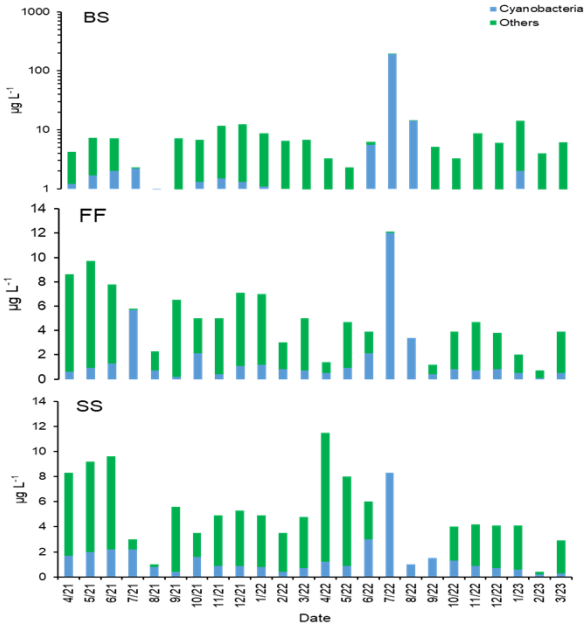
Historical and Current Dynamics of Surface Chlorophyll-*a* Measured in Laboratory

Source: Parparov, 1979; Hovsepyan, 2013; Gevorgyan et al., 2020

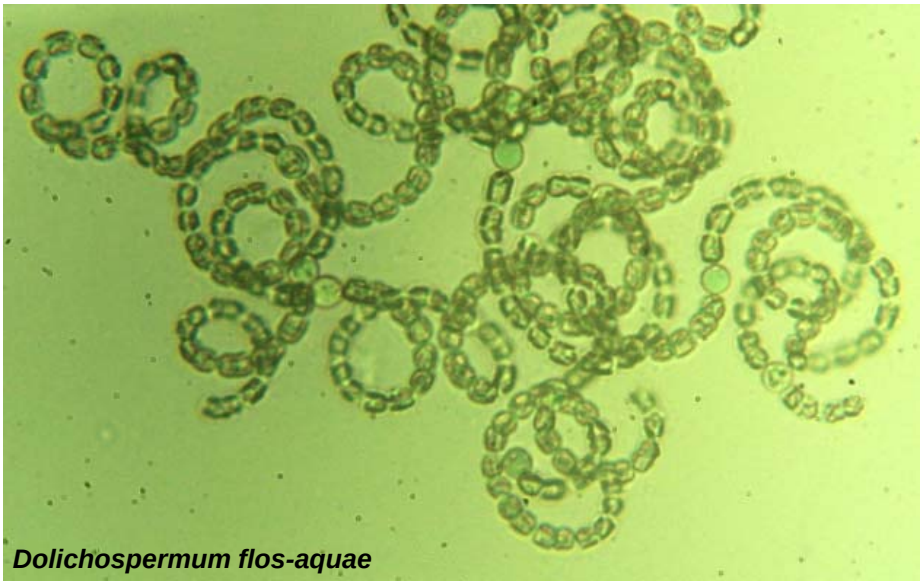




Current Dynamics of Surface Cyanobacterial and Total Chlorophyll-*a* Measured on Site

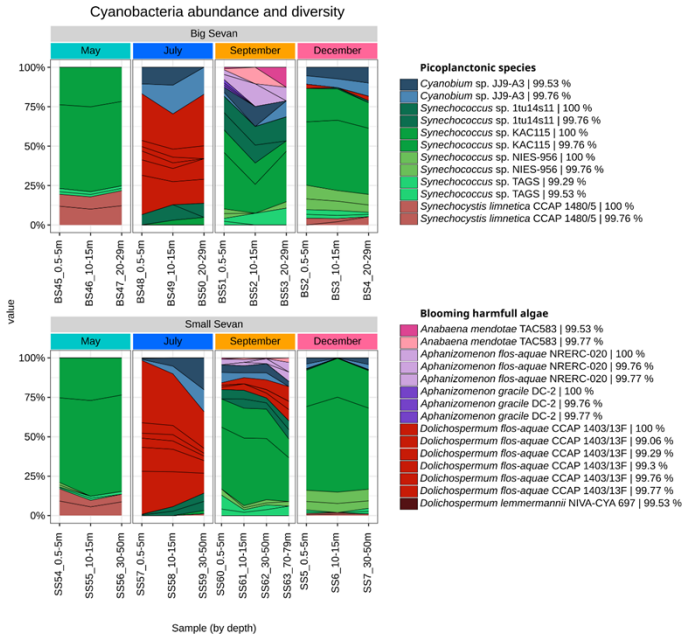


Microscopic Inspection of Blooming Cyanobacteria



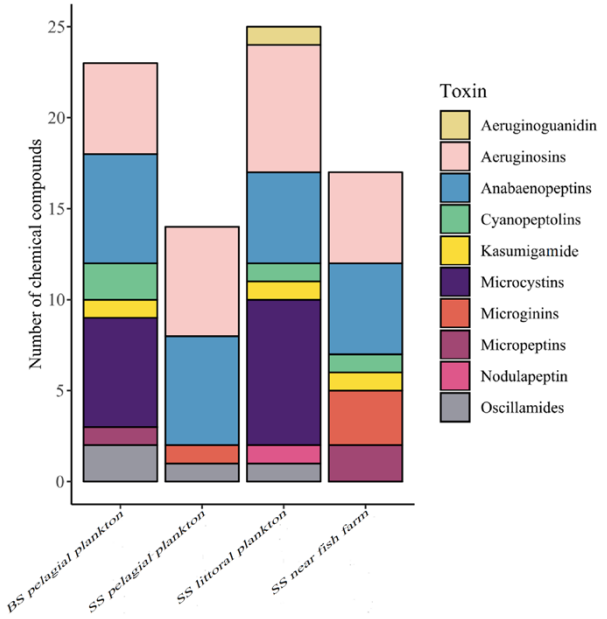
Dolichospermum flos-aquae

Molecular Inspection of Blooming Cyanobacteria

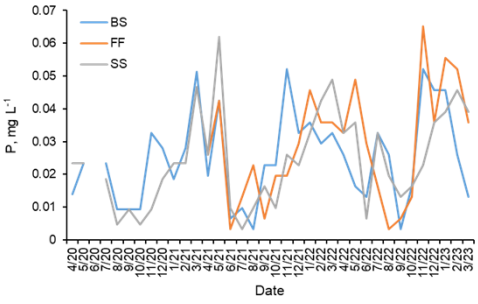


Toxin Production by Blooming Cyanobacteria

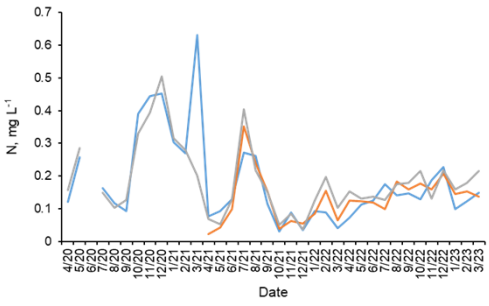
Source: Gevorgyan et al., 2020



Dynamics of Surface Mineral Phosphorus and Nitrogen



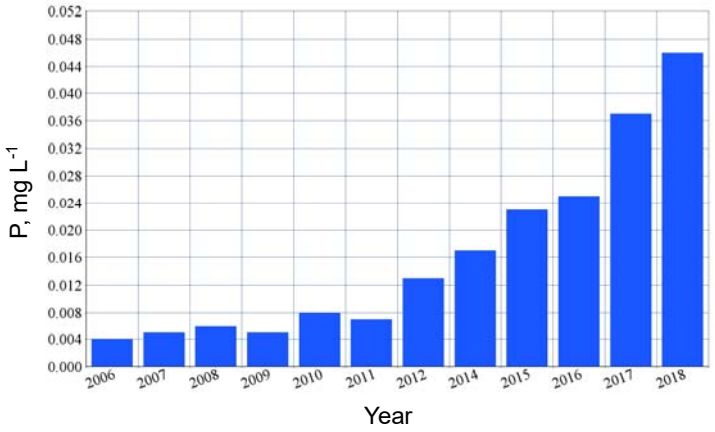
High concentration of mineral phosphorus can be considered as a driver of cyanobacterial blooms in the lake, while low nitrogen content gave an advantage for the development of a nitrogen-fixing cyanobacterium



Dynamics of Mineral Phosphorus

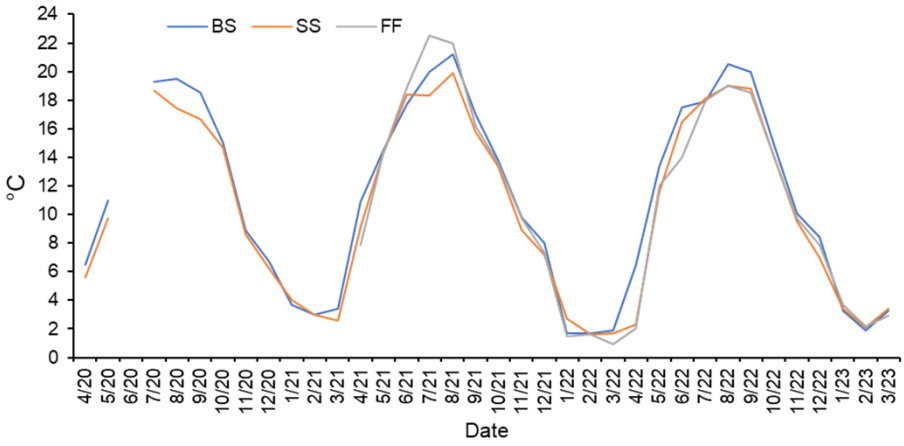
Source: Reports of Environmental Monitoring and Information Center of the Ministry of the Environment of the RA

Phosphorus pollution caused by household discharges constitutes a primary driver of the unfavorable developments of phytoplankton.

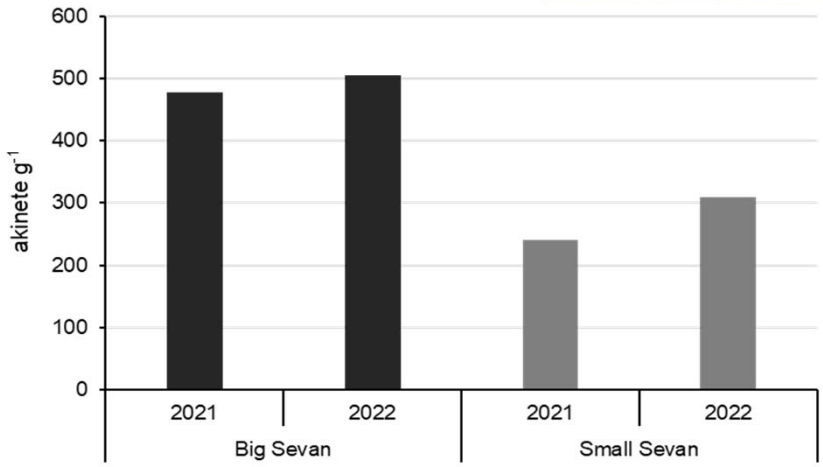


Dynamics of Surface Water Temperature

High water temperature also constitutes a driver of cyanobacterial blooms in the lake, probably by facilitating a competitive superiority of cyanobacteria in comparison to other algae.



Data on Akinetes in Sediment

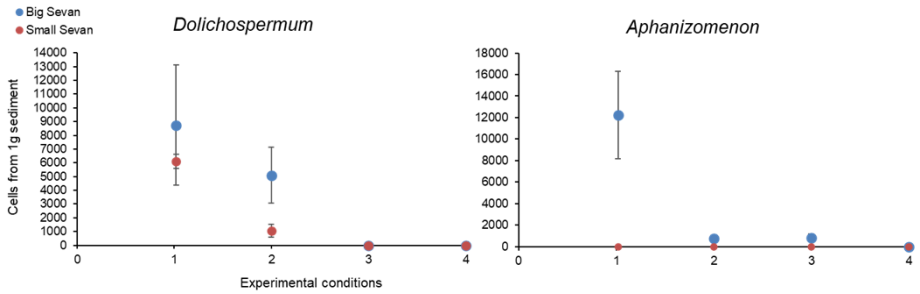


Akinete germination also can be concluded as a factor favouring the cyanobacterial blooms.

Experiments on Akinete Germination

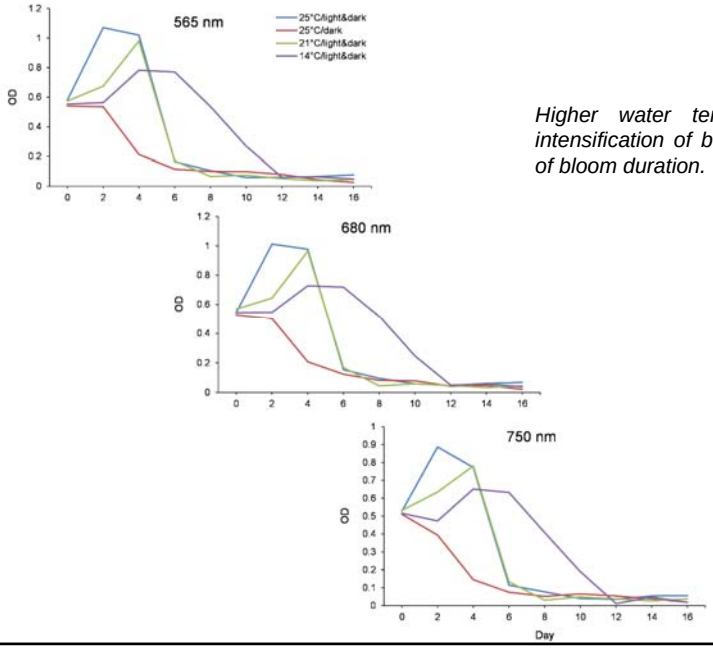
Germination of akinetes is inhibited by the absence of light, however low nutrient concentrations also negatively affect the growth of akinetes.

Aphanizomenon akinetes are more sensitive to environmental conditions particularly nutrient concentrations compared to *Dolichospermum* akinetes.



1 – grown in sampled lake water under 14/10 light/dark cycle conditions, 2 – grown in sampled lake water under 10-time nutrient dilution and 14/10 light/dark cycle conditions, 3 – grown in sampled lake water under dark conditions, 4 – grown in sampled lake water under 10-time nutrient dilution and dark conditions (akinetes were grown at 22°C during 28 days)

Growth Characteristics of Blooming Cyanobacteria



Higher water temperature causes intensification of bloom but reduction of bloom duration.

A Good Question Raised

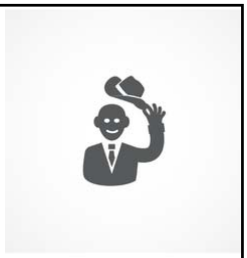
Higher summer temperature, stronger but shorter bloom

OR

Lower summer temperature, weaker but longer bloom?

Conclusion

The findings of this study indicate that Lake Sevan shows harmful cyanobacterial blooms driven by high phosphate and low nitrogen availability as well as thermal regime. Continuous pollution and global warming will favor the unfavorable developments of the lake cyanobacteria in the future. As little can be done in the short term to mitigate the expected global and regional warming, the nutrient input reductions are the only instrument to control such unfavorable dynamics of cyanobacteria in the long-term and need to be initiated as soon as possible.



Acknowledgments

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THANK YOU!
Any Questions?
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