DO INITIAL CIRCUMSTANCES FORGE ENDPOINT EFFECTS?

Influence of climatic conditions on carbon, nitrogen and microcystins concentration in plankton biomass

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INTRODUCTION

Microcystins are hepatotoxins produced by numerous species of cyanobacteria, widely dispersed in aquatic ecosystems. Recent studies have found significant correlations between MCs and several variables like total nitrogen (TN), dissolved organic carbon (DOC), and meteorological factors..

AIM

Assess whether MCs in plankton biomass are related to DOC and TN content in plankton biomass and to climatic variables. We hypothesized that meteorological factors in the pre-bloom period would influence the levels of carbon, nitrogen, and MCs in plankton biomass. The nitrogen and carbon content in plankton biomass is also thought to influence MCs

METHODS

Selected climatic variables, MCs, DOC and TN in plankton biomass were analyzed over a four-year period (April-October 2019-2022) in three water bodies in Kraków (southern Poland) in the pre-bloom and cyanobacterial bloom season. Temperature, wind speed, cloud cover, and precipitation were derived from the open-access database of the Institute of Meteorology and Water Management National Research Institute in Poland.

RESULTS

- steady decrease in concentration of microcystins in plankton biomass in subsequent years with highest records observed in 2019 and lowest in 2022
- decline of TN and DOC content in plankton biomass (Fig. 1)
- significant positive correlation between microcystin concentration and carbon and nitrogen content in plankton biomass (Fig. 2)
- significant positive correlation between temperature and DOC and TN in plankton biomass in the pre-bloom period (April, May, June)
- wind speed negatively affects TN and DOC in plankton dry mass during the cyanobacterial bloom (July, August, September, October) (Fig. 3)
- no significant relationships between precipitation and cloud cover and the concentration of MCs and N and C content in plankton biomass.

CONCLUSIONS

Nutrient availability is critical for cyanobacterial development, bloom formation, and toxic compound release. However, a simplified approach may not be sufficient to understand how nutrient-related changes interact with shifts in environmental factors. Weather conditions at different stages of the growing season also appear to be important. Our results suggest that temperature in the pre-bloom period affects the amount of C and N in the plankton biomass. Higher wind speeds during the bloom period result in more intense mixing of water, which could be unfavorable for cyanobacteria that form dense surface blooms.

FIGURES

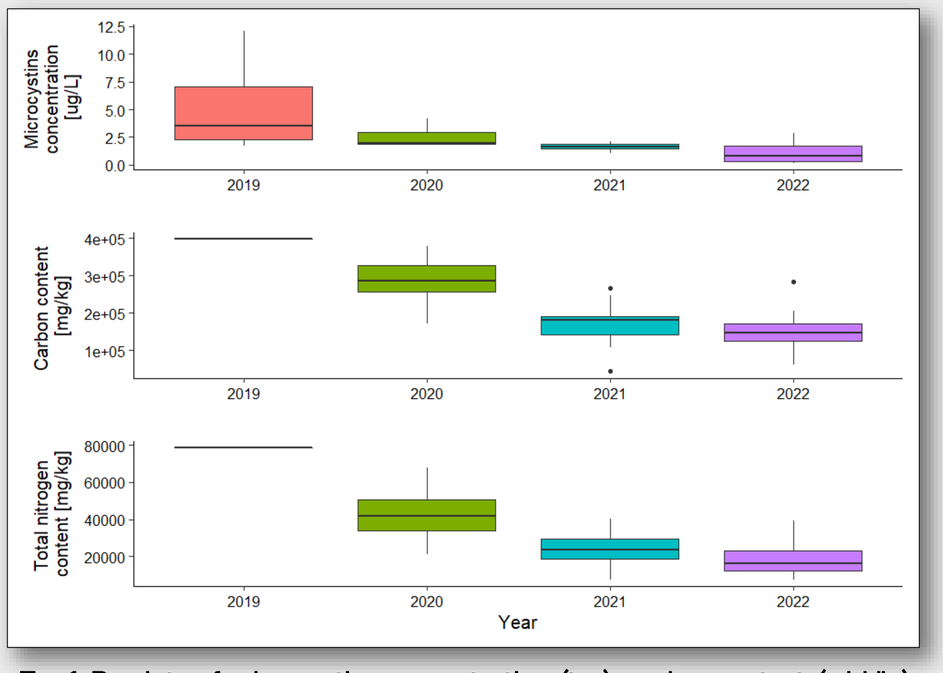

Fig. 1 Boxplots of microcystins concentration (top), carbon content (middle) and total nitrogen content (bottom) in dry mass of plankton in analysed waterbodies in subsequent years.

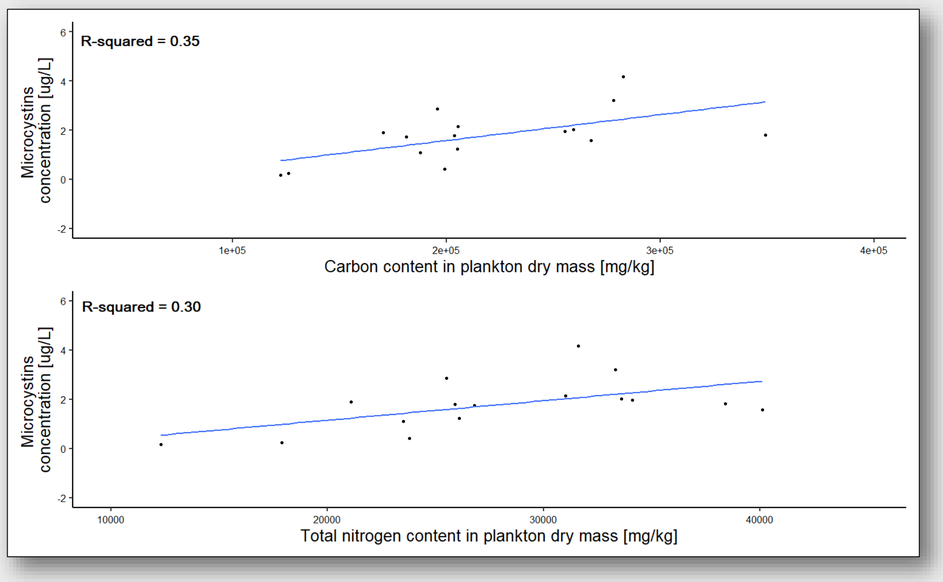

Fig. 2 Pearson correlation between total microcystins concentration and carbon content (top) and total nitrogen content (bottom) in plankton dry mass.

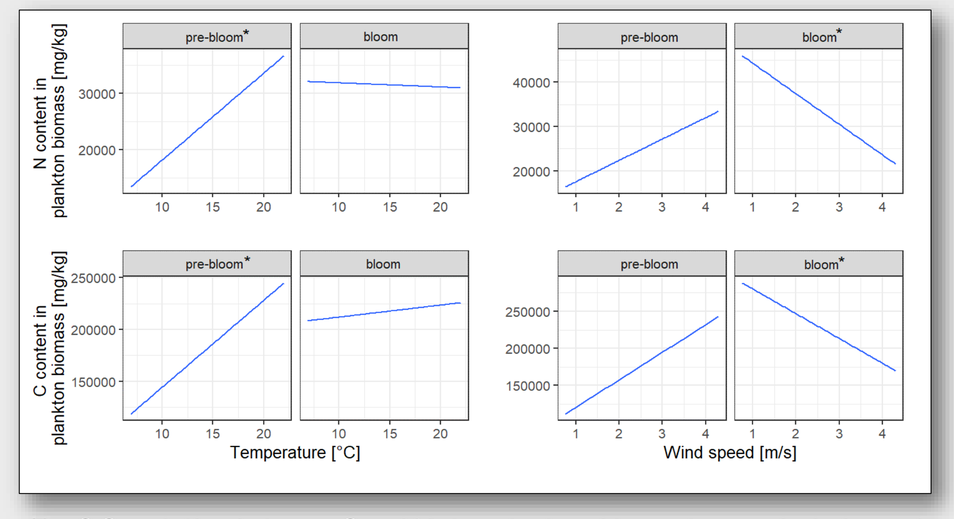

Fig. 3 Correlation between C and Ntot content and teperature and wind speed in pre-bloom and bloom season.

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