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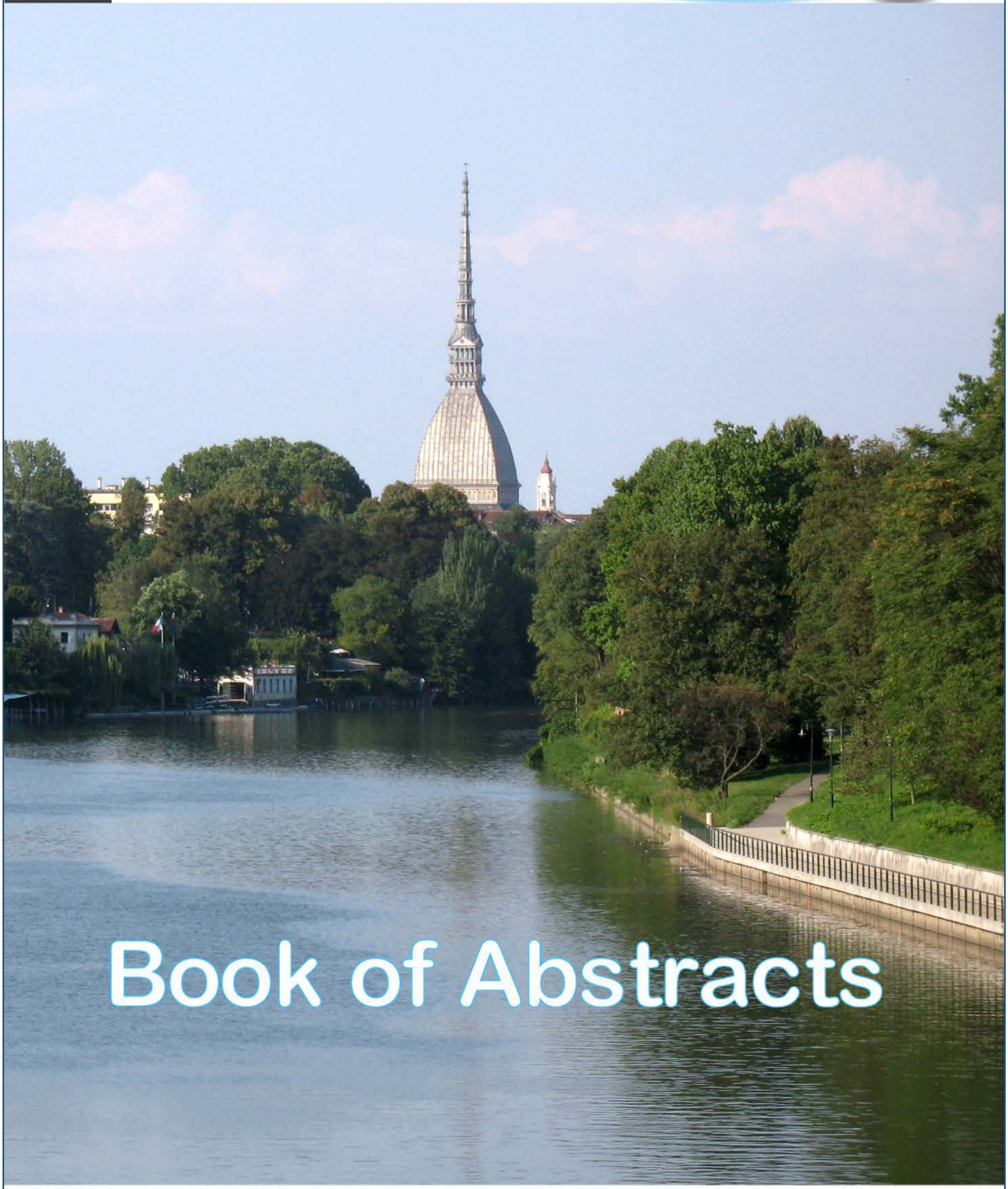

Book of Abstracts

SIL International Society of Limnology

32-O How does climate change affect the response of cyanobacteria to nutrients?

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It is widely believed that climate change acts synergistically with eutrophication to exacerbate the problems of algal blooms in lakes. This theory is based on the positive direct effects of higher temperatures and reduced rainfall (long retention times) on phytoplankton growth and loss processes. However, changes in temperature and rainfall have many indirect effects on phytoplankton, through effects in the catchment, lake physics and water quality and other communities that compete with, or consume, phytoplankton. This multitude of factors make it difficult to predict whether the effects of multiple stressors will be additive, synergistic or antagonistic. One approach for unravelling this complexity is to examine responses in long-term lake monitoring datasets.
Here we present results from 26 European lakes, sampled for at least 10 years between 1964 and 2014. In total 705 lake years of data were analysed, using Generalised Linear Mixed Models (GLMM), to examine the effects of three stressors (total phosphorus (TP), temperature and retention time) acting individually and their interactions. The analysis examined responses in the whole dataset (global model) and in lakes individually.
The most striking result was the large among-lake variability in responses to the three stressors. In the global model, spring TP had a significant positive effect on summer cyanobacteria biovolume. Weak negative relationships were observed in a few time series, although this was largely due to short TP gradients over a lake's monitoring period or sites where other factors limit algal biomass (e.g. in hypertrophic lakes). Both mean summer temperature and the frequency of "extreme" temperatures (the no. of summer days when daily averages exceeded 20 °C; Days>20°C), showed weak relationships with cyanobacteria. At the individual lake level, correlations between cyanobacteria biovolume and Days>20°C were generally more positive than relationships with mean summer temperatures, but relationships were generally not significant and there were some negative relationships. Responses to summer retention time were similarly weak in the global model and very variable at the individual lake level. We found no significant interactive effects of stressors on cyanobacteria abundance. Further analysis examines whether there are clearer responses to multiple stressors in particular functional lake types (e.g. deep-stratified vs shallow-mixed). In summary, the analysis highlights the significant effect of TP in driving potentially harmful blooms of cyanobacteria and suggests that, in general, summer air temperatures could have a smaller effect on this relationship than has previously been suggested. It does, however, also highlight that management needs to incorporate sensitivities at an individual lake level, as both strong synergistic and antagonistic relationships are apparent in some lakes.

32-O Amplified toxicant effect caused by additional stressors.

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Anthropogenic toxicants are a major factor contributing to the biodiversity crisis: the decline of amphibians, loss of wild bees, honeybees; and the decline of aquatic biodiversity. These effects in the wild are often observed at unexpected low doses were the established risk assessment framework is not predicting a biological responses. Additional stressors have been identified as a major cause for these amplified toxicant effects. The talk reviews aquatic studies that empirically identified toxicant effects in the presence of additional stressors. These studies reveal that the combined effects of toxicants and additional stressors synergistically exceed the additive effects of individual stressors. Accordingly, environmental stress, as food deficiency, that alone may not exert significant effects can magnify toxicant-related mortality.