# 4th European Large Lakes Symposium

## Ecosystem Services and Management
## in a Changing World



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2010. The vacant niche of smelt was partially occupied by young perch in 2011, but cladocerans, nevertheless, reached high biomasses. The smelt stock gradually recovered in 2012-14, while cyprinids did not increase in the pelagial. Percids dominance over cyprinids persisted in the entire basin, both in pelagial and littoral. The biomasses of cladocerans and predatory zooplankton increased over the course of the three study years and also the body size of cladoceran grazers increased. The age structure of smelt population turned into the prevalence of young-of-the-year fish. The changes in pelagic fish and zooplankton communities seem to be largely driven by the fluctuation of smelt population, which is strongly impacted by variations in summertime temperatures. Pumping appears to enhance these changes.

**Unravelling anatoxin-a in the large lakes south of the Alps: Occurrence and toxic potential of Tychonema (Cyanobacteria)**

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The investigations carried out in the largest lakes south of the Alps (Garda, Iseo, Como and Maggiore) have demonstrated, besides the widespread occurrence of microcystins (MCs), the presence of significant concentrations of anatoxin-a (ATX). Genetic analyses and metabolomic profiling of strains isolated from Lake Garda allowed excluding both *Dolichospermum lemmermannii* and *Planktothrix rubescens* among the potential producers of ATX. *P. rubescens* is the dominant cyanobacterium in the deep subalpine lakes. From the other side, extended surface blooms of *D. lemmermannii* were recorded for the first time in Lake Garda in 1990/91, and successively in the other deep southern subalpine lakes. The problem arising from the production of ATX without the apparent identification of a toxin producer was elucidated in Lake Garda in the spring 2014. During the isolation of cyanobacteria filaments, several strains of *Tychonema bourrellyi* (Oscillatoriales) were identified and cultivated. Successive analyses demonstrated that this species was able to produce consistent amounts of ATX. This was confirmed also by the amplification of genes involved in the biosynthesis of ATX and by the discovery of ATX producing populations of *T. bourrellyi* and *T. bornetii* in Norwegian waterbodies. Preliminary analyses, still in progress, are demonstrating that similar populations of *Tychonema* able to synthetize ATX are present also in the other largest lakes south of the Alps. In this contribution we will evaluate i) the taxonomic attribution of several Oscillatoriales strains in the subalpine lake district by phylogenetic analyses, and ii) the toxic potential of populations by metabolomic profiling and genetic analyses.

**Assessing the potential of remote sensing derived variables to explain spatial variation in fish distribution and assemblage composition in large lakes**

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A number of ecological indicators can be measured with remote sensing techniques with a higher temporal and spatial resolution than with traditional water monitoring methods. We have tried to test if this auxiliary information can be used to: i) explain patterns in fish distribution and assemblage composition, ii) optimize the design of fish monitoring programs and iii) assess ecological status in large water bodies. We have used images from the MERIS satellite (active from 2002-2012) which was developed specifically for water color measurements. MERIS derived layers describing chlorophyll *a* (chl *a*), total suspended matter (TSM) and

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