DECADAL PHYTOPLANKTON DYNAMICS IN LAKE MAGGIORE BETWEEN TROPHIC EVOLUTION AND CLIMATIC CONSTRAINTS

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Lake Maggiore

- Altitude: 193.85 m a. s. l.
- Drainage basin area: 6599 km²
- Lake surface: 212.5 km²
- Max depth: 370 m
- Mean depth: 177.5 m
- Volume: 37.5 km³
Lake's trophic evolution

![Graph showing changes in TP and Chl-a over time.](image)
Assemblages basic structure

Graph showing the relationship between the number of species and diversity index over time. The graphs indicate fluctuations in species diversity and cell volume from 1981 to 2011, with a notable increase in species diversity and a decrease in mean cell volume.
Seasonal succession of diatoms and cyanobacteria (1984-2011)
Phytoplankton and TP

Diatoms

\[ y = 46.213x + 825.62 \]
\[ R^2 = 0.051 \]

\[ y = 142.6x - 489.92 \]
\[ R^2 = 0.5354 \]

- BV tot diato 84-94
- Bvtot diato 95-03
- Bvtot diato 04-11

Lineare (BV tot diato 84-94)
Lineare (Bvtot diato 95-03)
Focus on diatoms...

CCA with Monte Carlo permutation test

Si p-value 0.002
TP p-value 0.002
Zmix p-value 0.026
Zmix*TP p-value 0.048
Air T p-value 0.07
Wind p-value 0.176
SRP p-value 0.194

Variance explained for species-environment relation: 79% for axis 1-2
The mixing regime can control the fluxes of P and Si to epilimnetic waters. Moreover, a high input of Si can be due to a huge supply from the watershed, such as during floods.

Since the early nineties, three of the major floods in the last two centuries took place.

These mechanism of nutrient supply are related with climatic factors.
Recent cyanobacterial blooms in an oligotrophic lake: looking for responsible…

- The first bloom of cyanobacteria, observed at the end of sixties, during the eutrophication phase, was due to *Planktothrix rubescens*.
- That record remained almost unique until summer 2005, when, being now the lake oligotrophic, an intense bloom of *Anabaena lemmermanni* took place. The strain proved to be toxic.
- A new bloom of *A. lemmermanni* developed in summer 2006.
- Blooms of the same species, which affect a very thin (few cm) surface layer, appeared in the recent years also in Lake Garda and were classified as “oligotrophic blooms” (Salmaso, 2000).
- The reasons of such a bloom are unknown: an hypothesis under testing is that they could be related to the mineralization of organic matter accumulated on the lakeshore, favoured by the low level of the lake during droughts periods.
- Nutrients can reach the water by runoff.
Blooms of *A. lemmermannii*: stimulated by runoff?

![Graph showing rainfall, water level, and *A. lemmermannii* growth over June '05 to August '05.](graph.png)
Mougeotia bloom - Summer 2011
1. Phytoplankton response was clear since the end of 1980s, with a decline in chlorophyll and productivity together with a reduced P availability (Ruggiu et al., 1998. Hydrobiologia, 369-370).

2. Biomass decrease was coupled with an increased biodiversity and a reduction of mean cell size (Kamenir & Morabito, 2009. J.Limnol., 68).

3. TP availability at mixing controls mainly spring diatoms growth, less important for cyanobacteria, with a stronger link between trophic and climatic drivers after the lake reached a stable oligotrophic status (role of mixing).

4. Moreover, in the most recent period an increased runoff, related to peculiar meteorological events, lead to the increase of nutrients supply to the lakes affecting phytoplankton dynamics and composition (Morabito et al., 2012. Hydrobiologia, 698).