



Effects of climatic fluctuations and vertical mixing on the interannual trophic variability of Lake Garda, Italy

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ABSTRACT: A linked chain of causal factors [namely, winter air temperature, spring lake temperature, extent of the spring lake overturn, and extent of surface nutrient enrichment] had significant effects on the annual development of phytoplankton structure and biomass in Lake Garda, a large ($49 \times 10^9 \text{ m}^3$), deep (350 m) lake located south of the Alps. The relationship between the winter climate and the North Atlantic Oscillation (NAO) was unclear, probably because of the location of the lake, which was on the border between different centers of action of the NAO (the Mediterranean region and central and northern Europe). Soon after the major enrichment episodes, conjugatophytes and large diatoms developed with higher biovolumes during April, whereas from midsummer to midautumn, the cyanobacteria and, more irregularly, the conjugatophytes were more important. In two other deep southern subalpine lakes (Iseo and Lugano), the interannual variations in the extent of spring vertical mixing, nutrient replenishment, and phytoplankton development were closely related because of the common effects of winter climate on the subalpine region. The effect was proportionally more evident in the two meromictic and more eutrophic lakes, Iseo and Lugano, because of the higher nutrient content in their hypolimnia.

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