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# Decode the sentinels' signals: how watersheds influence the functioning of high alpine lakes

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## Abstract

High alpine lakes are remarkable ecosystems, sentinels of global changes providing many environmental services. Changes in algal abundance and composition is a preoccupying trajectory for protected area managers (greening issue) and scientists (bioindication issue). Watersheds (area, groundcover, uses) widely contributes to define the trophic level of lowland alpine lakes. This link is still unclear at high altitude: waterbodies have smaller lawny watersheds and are exposed to stronger environmental constraints. Similarly, phytoplankton structure and dynamics often deviate from conventional PEG (Plankton Ecology Group) models at high altitude. This study aims to assess how watersheds influence the whole trophic functioning of these lakes and impact phytoplankton patterns during the ice free season. In the Ecrins and Mercantour National Parks (France), two groups of shallow lakes with similar characteristics (e.g., morphology, food web) were sampled four times in summer 2015: two with small, mineral watershed, and two with large vegetated catchment area showing pastoral activity. Multiple innovative descriptors were used to highlight interactions between lakes and watersheds, and transfers within food web. Biological compartments were studied in an integrative way, including benthos and plankton. Results show different trophic processes according to the lakes and the sampling periods. The lakes with large watersheds display a phytoplankton biomass increase in august, when functional groups indicate a higher trophic status. This study is the first work allowing a global view of French high alpine lakes dynamics and improves the current knowledge on these ecosystems functioning. It will be helpful to predict phytoplankton responses to environmental changes.

**Keywords:** Shallow lakes, High altitude, Trophic functioning, Phytoplankton, Watersheds

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