

Functional diversity of macrophyte communities within and between Pyrenean lakes

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ABSTRACT

Submersed vegetation is a common feature in about 70% Pyrenean high mountain (>1500 m a.s.l.) lakes. Isoetids and soft-water elodeids are common elements of this underwater flora and can form distinct vegetation units (i.e. patches of vegetation dominated by different species) within complex mosaics of vegetation in shallow waters (<7 m). Since isoetids exert a strong influence on sediment biogeochemistry due to high radial oxygen loss, we examined the small scale characteristics of the lake environment (water and sediment) associated to vegetation patches in order to ascertain potential functional differences among them. To do so, we characterised the species composition and biomass of the main vegetation units from 11 lakes, defined plant communities based on biomass data, and then related each community with sediment properties (redox and dissolved nutrient concentration in the pore water) and water nutrient concentration within plant canopy. We also characterised lake water and sediment in areas without vegetation as a reference. A total of twenty-one vegetation units were identified, ranging from one to five per lake. A cluster analysis on biomass species composition suggested seven different macrophyte communities that were named after the most dominant species: Nitella sp., Potamogeton praelongus, Myriophyllum alterniflorum, Sparganium angustifolium, Isoetes echinospora, Isoetes lacustris and Carex rostrata. Coupling between macrophyte communities and their immediate environment (overlying water and sediment) was manifested mainly as variation in sediment redox conditions and the dominant form of inorganic nitrogen in pore-water. These effects depended on the specific composition of the community, and on the allocation between above- and belowground biomass, and could be predicted with a model relating the average and standard deviation of sediment redox potential from 0 down to -20 cm, across macrophyte communities. Differences in pore-water total dissolved phosphorus were related to the trophic state of the lakes. There was no correlation between sediment and water column dissolved nutrients. However, nitrate concentrations tended to be lower in the water overlying isoetid communities, in apparent contradiction to the patterns of dissolved nitrates in the pore-water. These tendencies were robust even when comparing the water overlying communities within the same lake, thus pointing towards a potential effect of isoetids in reducing dissolved nitrogen in the lakes.

Key words: Macrophytes, soft-water lakes, sediment redox, nutrients, Pyrenees
