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Which future for Italian high altitude lakes?

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Abstract: High altitude lakes and their fauna are one of the most threatened and less investigated ecosystems in Italy. Alpine lakes are highly influenced by climate harshness and by air pollution, and because of their small dimensions are extremely vulnerable to global climate warming. Italy, in addition to the Alps, hosts another mountain range: the Apennines, reaching in some cases comparable altitudes, and therefore subject to the same risks. Moreover, the gentler slope of the Apennines makes them extremely vulnerable even to direct human impacts. In the present work, for the first time, high altitude lakes belonging to the Alps and to the Apennines are compared to highlight which meteo-climatic or chemical characteristics could be considered key drivers for their macroinvertebrate structure. The study area was explicitly focused on natural lakes placed above 1300 m of altitude and above the 44° parallel, thus in the alpine area and subject to a continental climate. 25 lakes were chosen (19 in the central-western Alps and 6 in the Modenese Apennines) with surface areas lower than 1 km² and with maximum depths lower than 15 m. Physico-chemical parameters and macroinvertebrates were studied and compared. Samples were taken through the use of a hand-net (250 µm mesh size) along the littorals on different substrates following standardised methodologies during the richer-fauna season to allow an easier identification of species. Parallel to that, water samples were collected and analysed. Species richness and the Taxonomic Distinctness Indices were applied to underline the different complexity of the community structure of the two areas. Results showed different macroinvertebrates communities with peculiar characteristics and highlighted a more structured and diverse composition on the Apennines. Predictive models on the future climate scenarios show how the peninsular portion of Italy will be even more affected by the increase in temperatures than the Alpine area. Thus, this work could be highly informative, mainly for central Italy, where proximity to towns encourage tourists to reach these type of lakes, even if placed in protected areas or parks. Therefore, protection and management plans, and conservation efforts of high altitudes cannot overlook a thorough understanding of the biological diversity of these environments, which still appears fragmented and limited to some sector of the Alps. Furthermore, the fundamental role of high altitude lakes as water resource needs a specific management regime, as they are not included under the monitoring programs of the Water Framework Directive legislation.

Keywords: high altitude lakes, Alps, Apennines, macroinvertebrates