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Holocene plant community changes in the Western Alps, as inferred from sedaDNA

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Climate change has already started to rapidly transform ecosystems. Predicted scenarios of future ecosystem changes inferred from contemporary ecological data may be uncertain, as these records do not provide the temporal depth needed to understand how ecosystems have responded to past periods of climatic changes and human pressure. However, palaeoecological approaches allow for the reconstruction of past ecosystem changes, including the composition of plant communities, thereby enabling researchers to improve models of future climatic change impacts.

Lakes located in high-mountain ranges, such as the Alps, are suitable ecosystems for studying long-term species turnover and environmental shifts driven by past climate changes, as they preserve a wealth of palaeoecological information in its sediment archives. The Alpine ecosystems are expected to be affected by ongoing climate warming, prompting an upward displacement of vegetation, elevated replacement rates and species losses, with projected increased intensity of impacts in the future.

Previous studies of the Alps have used pollen and macrofossil evidence to infer past vegetation dynamics. However, microscopic morphological determinations are time-consuming and some inferences have been limited by low taxonomic resolution and the biased preservation of identifiable remains. Ancient DNA from organisms is also often preserved in the sediment (sedaDNA), which can rapidly be detected and analysed using metabarcoding approaches.

Together with a novel, region-specific barcode reference database for the flora of the Alps (PhyloAlps; 4500 taxa), we can bypass the morphological limitations of previous palaeobotanical studies and refine taxonomic resolution, often to the species level.

To investigate the origin and impact of past environmental changes in alpine ecosystems throughout the Holocene, we performed a multi-proxy reconstruction of 9 lake sediment cores from the Western Alps (France, Italy and Switzerland). Using metabarcoding, we reconstructed the plant community composition and used XRF, magnetic susceptibility, and loss-on-ignition data to understand lacustrine dynamics during the Holocene for each lake. We will present the major findings from these analysed records, the general ecosystem shifts inferred, and the impacts of perturbations caused by human pressure and climatic changes.