

>> SYNTHESIZE MOUNTAINS OF KNOWLEDGE <<

## Submitted Abstract

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## Abstract

How does plant performance change over time, along with changes in elevational distribution? Analysing intraspecific trait variation along an abiotic gradient extracted from herbarium records offers a way to observe such changes in plant performance over time.

We selected four species -- *Poa alpina* and *Polygonum viviparum* typically found in subalpine meadows, and *Cardamine resedifolia* and *Ranunculus glacialis*, typically found in higher-alpine scree habitats -- differing in how successfully they have shifted upwards and colonized new summits.

We measured growth and reproductive performance traits from herbarium records collected between 1880 and 1950, and from individuals re-sampled in 2014 along >1500 m elevation within the same region in the Swiss Alps, to analyse shifts in the distribution of traits along the studied elevation gradient over time.

Reproductive traits and vegetative height largely decreased with elevation. *P. viviparum* and *P. alpina* trait values generally increased over time; those of *C. resedifolia* (all traits) and *R. glacialis* (reproductive traits) decreased. Changes over time varied along the elevation gradient: *P. viviparum* traits and *P. alpina* reproductive height increased at lower, but not higher elevations. Conversely, *R. glacialis* reproductive traits and most *C. resedifolia* traits decreased over time at lower, and increased or converged at higher elevations. In 2014, at lower elevations, species mainly occurred on their typical substrate types of organic soil and scree, respectively, but occurrence on other substrates increased with elevation for all species.

The contrasting trends in trait values of meadow and scree species at the lower elevation over time exemplify how climate warming is favouring generalist species from lower elevations at the expense of more specialised alpine species. At higher elevations, for one of the meadow species this process was limited by a lack of suitable substrate (organic soil). Further warming may confine the distribution of high-alpine plant species to even higher elevations, or to microclimates and substrates on scree and rock that are currently difficult to colonise by lower-alpine species.