

Accelerating climate change exerts strong pressure on Europe's mountain flora

April 19 2012



Alpine flowers which only grow on a few mountain peaks are highly endangered through climate warming and increasing summer drought. For example, plants restricted to the high zone of Sierra Nevada, such as *Linaria glacialis*. Credit: Harald Pauli, GLORIA

A pan-European study published in *Science* shows that mountain plants across the continent are moving to higher altitudes. This often results in raised species numbers on mountain tops, when colonizers from lower down start to dwell on the summits. This study, however, also shows that upward shifts can lead to a reduction in species richness. The paper is based on detailed surveys of 66 mountain summits distributed between the north of Europe and the southern Mediterranean Sea. An international research group, led by the Austrian Academy of Sciences and the University of Vienna, mapped all plant species at each site in 2001 and 2008 using the same standardized procedures. The study was

coordinated by Harald Pauli, Michael Gottfried, Stefan Dullinger and Georg Grabherr.

Increasing [species numbers](#) were only found on summits of northern and [central Europe](#). By contrast, species numbers were stagnating or declining at nearly all sites in the Mediterranean region.



Anchusa caespitosa in Crete are expected to lose their habitats through accelerating climate change. Credit: Harald Pauli, GLORIA

Harald Pauli from the Global Observation Research Initiative in Alpine Environments (GLORIA) programme, which coordinated the study, said, "Our results showing a decline at the Mediterranean sites is worrying because these are the mountains with a very unique flora and a large proportion of their species occur only there and nowhere else on Earth".

On summits further north in Europe, more [plant species](#) are prospering. This could be taken to indicate that these are much safer sites for alpine flowers. Michael Gottfried from GLORIA's coordination team said, "I'm afraid that this is not necessarily the case because the newly appearing plants are predominantly more widespread species from lower elevations

and will pose increasing competition pressure on the rarer cold-loving alpine flowers".

The uppermost tips of Mediterranean mountains are rather small patches of cold habitats, spread like islands over a sea of much warmer lowlands. Lowland areas and the mountains are exposed to a characteristic dry season in summer. In the higher altitudes, precipitation mainly falls as snow during winter and spring and snowmelt is crucial for water supply of mountain plants during the arid growing season.

Harald Pauli added, "The observed species losses were most pronounced on the lower summits, where plants are expected to suffer earlier from water deficiency than on the snowier high peaks. Climate warming and decreasing precipitation in the Mediterranean during the past decades fit well to the pattern of shrinking species occurrences. Additionally, much of the [Mediterranean region](#) is projected to become even dryer during the upcoming decades".

Georg Grabherr, chair of GLORIA, said, "Impacts of climate change, either through warming or combined with increased drought stress, are likely to threaten alpine plants not only on the continent, but even on the world-wide level. A number of mountain plants may resist or find colder substitute habitats somewhere in a rugged mountain terrain. Continued species monitoring will be vital for tracing ongoing ecological impacts on the diversity of alpine plant life".

More information: *Science*, April 20, 2012. DOI: [doi/10.1126/science.1219033](https://doi.org/10.1126/science.1219033)

Provided by University of Vienna

Citation: Accelerating climate change exerts strong pressure on Europe's mountain flora (2012, April 19) retrieved 25 April 2024 from <https://phys.org/news/2012-04-climate-exerts-strong-pressure-europe.html>

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