Global change threatens high-mountain plants able to adapt to new environmental conditions

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Studying plant species like S. longifolia can improve the understanding of key

mechanisms in high-mountain lives. Credit: Universidad de Barcelona

High-mountain plant communities are one of the most vulnerable groups to global change. This phenomenon could threaten species living in the highest areas, such as Saxifraga longifolia, a plant in the Pyrenees with sophisticated mechanisms to adapt to environmental changes.

This is one of the conclusions of a study published in the scientific journal *Plant Physiology* by the experts Sergi Munné-Bosch, Alba Cotado, Melanie Morales and Eva Fleta-Soriano, from the Department of Evolutionary Biology, Ecology and Environmental Sciences of the University of Barcelona, and Maria B. Garcia and Jesús Villellas from the Pyrenean Institute of Ecology (IPE-CSIC).

How can this plant act towards global change?

Saxifraga longifolia is an herbaceous and perennial plant, with populations with lots of reefs and scarps of the Pyrenees, and sporadic in the Cantabrian mountains, the Iberian System and mountain chains in the south and east of the Peninsula. This scientific work analysed for the first time the physiological response and cell protection mechanisms that Saxifraga longifolia uses to adapt to the changes in the mountain ecosystems.

According to professor Sergi Munné-Bosc, first author of the work and head of the Research Group ANTIOX of the UB, current global change can affect these species' physiology and death rate: "If global change continues and increases with time, it will probably endanger some plant species –with possible biodiversity losses- and will make other species to move and live in higher altitudes."

According to the published study and to Melanie Morales, postdoctoral researcher of the group, "levels of α-tocoferol, a compound from vitamin E, increase in populations of S. longifolia that are at a higher altitude (2.100 meters)." α-tocoferol protects leaves from high solar radiation –usual in high-mountain climate- and "helps the plant to protect from oxidative damage by lowering lipid oxidation levels in high-mountain populations."

In the highest areas of these ecosystems, populations show a clonal growth, "a characteristic only seen in high altitude populations" says Morales. "In addition, alpine populations have a lower rate of recruitment and higher death rate of young plants, therefore bigger plants predominate. In this plant, mortality is not linked to the size of plants, like it has been said for other species."

An uncertain future for high-mountain plants

With the rise of global temperature, drought episodes are more and more frequent; there is more risk of forest fires and therefore, extinction of species (especially the endemic ones). The biome moves to higher altitudes, competition between plants is clearer and microhabitats that allow the presence of lots of adapted species to high-mountains start to disappear.

"A priori, S. longifolia will not be successful to adapt to future changes in natural ecosystems regarding global change," says Alba Cotado. "In its current natural habitat, S. longifolia doesn't have competition problems with other species. But transformation of plan communities in these ecosystems involves an increase in competition, and this affects slow-growth plants, that need high light radiation and are used to cold weather, such as S. longifolia." Moreover, the lack of genetic diversity, caused by the space isolation of different populations, adds another obstacle for that species to face new environmental situations.

Preserving, protecting and restoring

Studying plant species like S. longifolia can improve the understanding of key mechanisms in high-mountain lives, not only at an individual level (activation of different biochemical mechanisms), but also in population (new reproductive strategies, for example). "Knowing about these mechanisms will enable facing future challenges in the field of plant improvement, ecosystem preservation and the mitigation of global change effects" says Alba Cotado.

Melanie Morales says that "the melting of ice caps is another big problem, since it could have a great impact on hydric underground resources." The European Union Strategy for the Alpine Region (EUSALP) is the framework that recognizes the alpine regions as environmental heritage with great importance for preservation and protection of unique ecosystems in mountain regions (Natura 2000, national parks, etc.). According to the expert, "preservation, protection and restoration are the three key points to ease the impacts: avoiding situations of risk of fire, reforest, improve management of hydric balances, among other actions."

More information: Sergi Munné-Bosch et al. Adaptation of the Long-Lived Monocarpic Perennial, Saxifraga longifolia to High Altitude, *Plant Physiology* (2016). DOI: 10.1104/pp.16.00877

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