Universität Basel

Research Project

How glacial history, selection and current gene flow affect alpine plants: Population differentiation, local adaptation and demography in a fragmented landscape

Third-party funded project

Project title How glacial history, selection and current gene flow affect alpine plants: Population differentiation, local adaptation and demography in a fragmented landscape
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The alpine landscape is characterized by a pronounced spatial heterogeneity of abiotic conditions and displays high temporal dynamics. To persist in space and time, long-lived alpine plants must be adapted to the geographic isolation of habitats, to natural disturbances caused by climatic oscillation and to topography-induced processes. Glacial history together with the pronounced heterogeneity of the alpine landscape is responsible for a high occurrence of endemic taxa in the Alpine flora. Nevertheless, many alpine plants are widespread and occur from east to west over the entire alpine range. Populations of a species may diverge in morphology and performance through natural selection and/or genetic drift. In widespread plants landscape heterogeneity may lead to genetic differentiation and local adaptation. But adaptation is hindered by gene flow from pollen and seeds and may be confounded by drift. Alternatively, the function of plants over a broad range of environmental conditions can be maintained by phenotypic plasticity. Furthermore, landscape level processes at the regional scale such as colonisation and extinction are linked to genetic patterns and population dynamics at the local scale. Typically, widespread species show high levels of genetic variation and adaptation to particular local conditions. Recently, molecular studies demonstrated the impact of glacial history and migration pattern on the genetic signatures of alpine plants, indicating that population-connectivity and gene flow was not strong enough to mask the effect of isolation in different regions. Molecular break zones are common to most of the alpine species studied so far and strikingly similar to biogeographic boundaries based on floristic evidence. However, it is currently not known to what extend glacial history and corresponding molecular pattern in alpine plants are reflected in phenotypic variation and local adaptation at the scale of the European Alps. Here, we study how glacial history, selection and current gene flow affect population differentiation, local adaptation and population dynamics in widespread alpine plants. We propose experiments in the common garden and reciprocal transplantation with plant material from the entire alpine belt in order to separate effects from historic and current processes on genetic and phenotypic characteristics of the plants. By including experiments on current gene flow, colonisation of suitable habitats, and modeling of metapopulation dynamics in a real landscapes this project links processes operating at different time and spatial scales. As a whole, the project addresses the important question of how plant species are able to survive and perform in fragmented landscapes. The different parts of the project are aimed to integrate population dynamics and genetics with landscape ecology. The results on the effects of glacial history, selection and current gene flow on alpine plant species will provide general ecological informa-

tion on plant responses to climatic and other variability and will thereby contribute to knowledge about the consequences of global change for alpine plant life.

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Published results

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