Phenotypic differentiation in a common garden reflects the phylogeography of a widespread Alpine plant

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1. Glacialhistoryhasaffectedthephylogeographicstructureofnumerous Alpineplantspecies,but its impact on phenotypic differentiation has been little studied. Therefore, we asked whether pheno- typic differentiation in a common garden reflects the phylogeographic structure of the widespread Alpine plant Geum reptans L.2. Wecombinedamolecularinvestigationwithacommongardenexperimentandinvestigatedgen- ets from 16 populations of G. reptans sampled from the European Alps. Using neutral molecular markers (RAPDs) and Bayesian cluster analysis, we analysed the species' genetic differentiation and phylogeographic structure. In the common garden, we measured the differentiation of pheno- typic traits related to growth, reproduction and leaf morphology.3. Molecularanalysispartitionedthepopulationsintothreegenetic groups,indicatingpronounced phylogeographic structure. Regional molecular variation was correlated with regional phenotypic differentiation. 4. Quantitative trait differentiation (QST) differed from neutral molecular differentiation (GST) in 10 of 11 traits, indicating that selection has contributed to phenotypic differentiation. Significant negative correlations between biomass and precipitation records for site of origin are a further indi- cation of adaptation.5. Synthesis. The current study compared regional molecular variation and phenotypic differentia- tion among populations of a widespread species in the context of extreme range changes during gla- ciations in the Alps. Because the common garden phenotypic differentiation of G. reptans reflects its phylogeographic structure, we conclude that glacial history affected both genotypes and pheno- types. The results suggest that the present-day phenotypic differentiation was caused by genetic drift and limited gene flow between populations in glacial refugia and during postglacial recolonization, as well as by adaptation to current climatic conditions. Our findings are relevant for understanding the adaptive potential of Alpine plants and predicting potential range shifts in response to future climate change.
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