Adaptation to a stress gradient of elevation in the alpine plant Arabis alpina

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Abstract

- When populations in contact through a mild gene flow experience contrasted environment, local adaptation, i.e. adaptation to the local environmental conditions, is a possible evolutionary output. Alpine ecosystems are likely to be prone to such phenomenon, as they are characterised by highly contrasted environmental conditions within a very short distance range. Among alpine plant species, Arabis alpina is characterised by a very wide elevation amplitude, ranging from 800m to 3000m of elevation.
- Using a common garden experience replicated in two different sites, combined with in situ environmental data collection and high-throughput genotyping (double-digest RAD sequencing), we show that key phenotypic traits (total fruit length, growth, height) display significant signs of local adaptation according to the average temperature of original populations. This significance is tested against neutral drift, using molecular markers and a rigorous model of phenotypic differentiation under a neutrality hypothesis. Using the two different experimental sites, we show that these adaptive traits are also characterised by the presence of considerable phenotypic plasticity.
- We perform genome scans to detect signal of selection and association studies with our measured phenotypic traits. Consequently, we propose a short list of 13 genes in A. alpina that show significant signal of selection and are associated with an adaptive phenotypic trait.
- Overall, our results testify of a selection, along the elevation gradient, for smaller, more compact plants, that are growing slower and producing less fruits. These intraspecific results mirror a well-known inter-specific pattern of stress response to resource limitation in alpine ecology.

Keywords: local adaptation, Arabis alpina, alpine ecology, stress response, ddRADseq, elevation gradient

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