
Lyallia kerguelensis, a Kerguelen endemic cushion plant from extreme environments in the face of climate change

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Abstract

Rapid climate change is occurring in sub-Antarctic islands, mostly with temperature increase and loss of precipitations. The native sub-Antarctic flora is poor and composed of perennial and often long-lived plants, potentially more vulnerable to rapid environmental changes. Endemic species should be even more at risk. *Lyallia kerguelensis* (Montiaceae), an endemic cushion plant in sub-Antarctic Iles Kerguelen is particularly infrequent on the archipelago and specialized in certain habitats. Many cushions show more or less important necrosis. Our research aims at understanding the ecological and physiological limits of *L. kerguelensis* in its current range and predict the plant potential to respond to climate change. We aim to determine which environmental factors (abiotic, biotic) are most limiting for plant performance. Field studies covered wide distribution and ecological ranges of the species in Kerguelen. Plant performance was described by the extent of necrosis within cushions. In each studied population, we quantified topographic and geomorphological features, climate (meteorological and local climatic recorders), edaphic parameters (soil profile, water content, conductivity, pH, texture, elemental composition and nutrients), epiphytes in cushions and composition of the neighbouring community. To characterize the performance and morphology of cushions we developed a photointerpretation method using ArcGis. We made calibrated pictures on a sample of individuals from each population. Several views by individual were used to extract phenotypic traits. Morphological traits such as shape and compactness were calculated. Trait variability at intra- and inter-population levels and correlations to environmental factors were investigated. Finally, morphology and flowering phenology were monitored across 10 years in one population. The results are interpreted in the light of climatic data and provide a hint for the temporal scale of morphological changes in the cushions. As a whole, we found correlations between the proportion of plant necrosis in the populations and several abiotic factors all resulting in water stress.

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