Climate Change Adaptation Research Grants Program
- Terrestrial Biodiversity Projects

Project title:
Determining high risk vegetation communities and plant species in relation to climate change in the Australian alpine region..

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Lead organisation: Griffith University

Objectives:
To use plant functional traits in combination with existing long-term data sets to assess the risk associated with different threats to the flora of the Australian Alps, including directly from climate change (reduced snow cover, warmer summers), and indirectly (increased fires, grazing by feral animals, and summer tourism). Managers will be able to use these results to prioritize resilience adaptation strategies to climate change such as fire management, weed and feral animal control and summer tourism. In addition, native and weed species will be classified into high, moderate and low risk/invasive species so key refugia for native species can be identified, and species for rehabilitation programs, weed control and for ex situ conservation in seed banks selected.

Project design and methods:
The initial stage of the project involves completing a functional trait database for alpine, subalpine and invasive plant species (-200 species). Currently we have functional trait data for 80 native species and 7 weed species and will collect data for a fmiher 100 native and 15 weed species. Data will include specific leaf area, dry and fresh leaf weight, phenologic parameters, canopy height and lateral spread, and seed mass. Species with traits suitable for high stress environments are likely to decline with warmer climate, while those species with traits suitable for competition and disturbance are likely to increase. To test how species will respond, we will investigate past responses to these stressors using a series of long term datasets available to the PI's.

Available data:
The authors have access to datasets ranging from 5-50 years in duration covering >80% of the alpine flora and much of the subalpine flora (include 20,000 records of plant species and local environmental data). These consist of data from experimental and observational studies and include:

(i) **Two long-term data sets** looking at **(a)** plant composition vs climatic variables including changes in snow banks and **(b)** a Global Observation Research Initiative in Alpine Environments (5 summits) data set. They will be combined with the functional traits data to determine how snow cover affects the functional trait composition of vegetation and individual species, thereby identifying which species are patiicularly at risk from reduction in stress associated with reduced snow cover.

(ii) **Impacts of grazing and drought - a long term dataset looking at recovery from cattle grazing and impacts of drought.** In combination with the functional trait data these data will be used to assess the vulnerability of species and ecosystems to grazing and drought. Cattle grazing has just recommenced in the Victorian Alps and is a m1\ior factor reducing the resilience of alpine corrnnunities to climate change.

(iii) **Fire data sets from 2003 to 2011 comparing burnt and unburnt alpine and subalpine plant communities.** These datasets will be used to determine how different species respond to fire, i.e. which recover from fire, which do not, and how the relative abundance of various functional traits change with fire. This will help determine which sites are refugia for fire sensitive species and hence be a focus of fire control measures in the future.

(iv) **Impacts of feral hares**. This manipulative experiment compares 20 hare exclosures with control sites over 5 years. It will be used to assess whether the control of hare populations should be an adaption response to increase resilience, or if they, unlike cattle and sheep have little impact.

(v) **Impacts of summer tourism including hiking, mountain biking, camping and different trail types on alpine vegetation**. This dataset when combined with the functional trait analysis will be used to assess the relative impact of different types of tourism activities and different types of tourism infrastructure (walking track types). Managers can then use these data to tailor strategies to minimise impacts from increasing summer tourism in the region, which is itself an adaption strategy from the tourism industry.

Data analysis:

The long-term data sets wiII be analysed using functional traits analyses to generalise the key traits that increase the survival of plant species and plant assemblages, and to assess the relative importance of different resilience adaptation strategies. Although a few of these datasets have been used to identify individual vulnerable species and threats, they have not been analysed using functional traits analyses. Our specific research objectives are:

1) Use functional trait data to assess the relative competitive, stress and ruderal capacity of different plant species found in the Australian Alps.
2) Test how species and plant communities have responded to changes in stress, competition and disturbance using existing long-term data sets.
3) Based on current distribution, functional traits and response to other threats (e.g. fire, grazing, tourism), classify native species and communities into high, moderate and low risk including identifying key refugia.
4) Classify weed species into high, moderate and low risk invasive species as for (3) above.
5) Evaluate different adaptation strategies aimed at increasing ecosystem resilience. This involves examining how climate change interacts with other key stressors in the region e.g. fire, snow duration, grazing, impacts of increased summer tourism to identify which resilience adaptations strategies should be prioritised.