National Climate Change Adaptation Research Facility:
Terrestrial Biodiversity Network
Application for Funding for a PhD Short Collaborative Visit

The interactive effects of fire and climate change on vegetation in the Australian Alps

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In October 2010, I was given the opportunity to collaborate with my external Dr Dick Williams from CSIRO, Ecosystem Sciences, Darwin. The primary objective of this visit was to be exposed to a specialist fire ecology lab, with emphasis on learning different field and modelling techniques to assess the effect of fires on vegetation. In addition to this, the trip also provided me with the chance to analyse data on the effect of warming, fire and its interaction on the diversity and composition of Australian alpine vegetation I had collected as part of the International Tundra Experiment (ITEX).

Major findings:

This trip exposed me to several different models that can be used to assess the interactive effects of warming and burning on vegetation. In doing so, it has provided me with the confidence and greater understand of how to implement and select the most appropriate models for addressing fire and climate change effects on vegetation. This was put into practice where I explored and produced preliminary results based on 7 years of passive warming data from burnt and unburnt vegetation collected from the Bogong High Plains ITEX sites. Some of the key findings found on the trip included:

- No general decline in species richness or diversity with warming
- Warming enhanced the growth (height) of monocots, forbs and shrubs but there was no clear warming effect on the cover of these life forms.
- There were some evidence of warming and burning interactions but all were idiosyncratic.

Thus, these preliminary results suggest that Australian alpine heathland appears to be resilient to a 1-2^{o}C increase in temperature (albeit in the short-term).

Outcomes of the collaboration:
During this visit I was introduced to the science and scientist associated with the 'Burning for Biodiversity' Project located in the Territory Wildlife Park, Darwin. This project taught me several practical aspects of undertaking fire ecology experiments, including:

- Measuring fuel mass (fine and coarse)
- Measuring rate of spread of the fire front
- Deploying prescribed fire using a drip torch
- Measuring greenhouse gas emissions from bushfire smoke

In addition to learning about the Burning for Biodiversity project, the trip allowed further collaboration with my external supervisor Dr Dick Williams. This collaboration has resulted in writing two papers, one on the interactive effects of warming and fire on alpine vegetation (using ITEX data), and the other on the effects of fire severity on alpine heathland vegetation. Both are to be submitted for peer review later this year.

Significance to adapting and protecting Australia's terrestrial biodiversity:
The significance of this research needs to be put into context. Australia's alpine region faces the twin stressors of a warming, drying climate coupled with altered fire regimes. Higher temperatures are predicted to change fire regimes of the Australian Alps with more severe fire weather and more abundant shrubby fuels expected. However, little is known about how our alpine vegetation will respond to warming and increased fire frequency/severity. The results of this collaboration indicate that alpine open heathland appears to be resilient to warming effects (albeit in the short term), and that there is no clear interaction between warming and burning. Thus, the directions and rates of change in landscape state as a consequence of warming and burning are not within the domains of concern that may trigger management interventions. However, land managers should still be cautious and continue to monitor vegetation. This is because long-term effects to climate change and changing fire regimes are still largely unknown, and many gaps still exist in our knowledge (e.g. effect of fire frequency & warming effects on dominant shrubs not found in the ITEX experiment).

Future research suggestions:
One knowledge gap in the current Australian ITEX design is the lack of data on the effect of warming on dominant alpine shrubs. My PhD aims to fill this gap by determining how such shrubs will respond to warming and whether rates of shrub encroachment are likely to increase in a warmer, drier alpine environment, and if so, will this equate to greater fire frequency?

Beyond the Australian alps, another research direction that warrants further attention is determining 'how effective the communication has been between scientists and land mangers? And 'how can such communication be improved to provide land managers with the knowledge in a timely fashion, to evaluate various scenarios of change, identify fire-climate change interactions that are of potential concern, and identify where intervention to mitigate unwanted change may be most effective?