Australian Institute of Alpine Studies

Australian Institute of Alpine Studies - Newsletter No. 21, August 2009

The AIAS now exists…..officially!

The Copyright Agency Limited wanted to send us a cheque for $1800 for downloads from the website. Unfortunately, we didn't have an ABN, let alone anywhere to put the cheque. After a lot of fun explaining to the tax office, business registry and bank exactly what kind of organisation the AIAS is we are now registered as a business (unincorporated association) with an ABN, tax file number and bank account. We even have a cheque book! The two signatories on the account are Ken Green and Dave Woods.

AIAS meeting December 2009

The picture below shows the last AIAS meeting, held at Sawpit Creek in the Snowy Mountains in January 2008. The 2009 meeting of the AIAS will be held at the Albury-Wodonga campus of Latrobe University on December 3rd and 4th following the familiar format of a day of talks on the Thursday and a field trip to Falls Creek on the Friday. When the AIAS was established the best we could hope for was a meeting every second year. In fact this has been the longest gap between meetings. NSW and Victorian members are able to host a meeting every third year – this leaves a gap of one year in three. The next meeting will be hosted by NSW in the summer of 2010/11 which leaves a gap in 2011/12 until once again the Victorians take up the challenge. Any takers from Tasmania or ACT? The main problem in organising these meetings is the time involved. The costs can be minimised by use of University or Government facilities and, as an example, the only cost to the AIAS for the last meeting in NSW was morning and afternoon tea (we provided urns plus tea, coffee, biscuits and cake bought from Woolworths) so the major expense was for lunch (mixed wraps and sandwiches and a fruit platter) supplied commercially at less than $10 per head.

Who contributes most to scientific research in mountains?
A paper by Christian Körner just published in Mountain Research and Development (Vol 29: 97-102) examined the number of publications using the words 'alpine' and 'mountain', allocated them to institution and country of origin of the authors and presented the results in a league table. In terms of ISI-listed scientific publications found under the keyword alpine (n=14, 226) Australia made the top 10, just edged out by New Zealand. Under 'mountain' Australia made the top 10 again but surprisingly NZ failed to make the cut. Australia also made the top ten in number of both alpine and mountain publications per million inhabitants (this time New Zealand did much better ranking second after Switzerland on both words).

Australian Itex website launched
The Oztex website has been launched. Log onto www.australianitex.org and check it out. Any comments or feedback would be very welcome. By the way, while you are at it, log onto www.aias.org.au and check out your entry. Does it need an overhaul? Get it into the queue for the next update.

Listing of alpine *Sphagnum* bogs and associated fens as endangered - Jennie Whinam

The Alpine Sphagnum Bogs and Associated Fens ecological community has recently been listed as endangered under the Environment Protection and Biodiversity Conservation Act 1999. Grounds for listing include its restricted geographic distribution and multiple demonstrable threats, and recognize that the community has reduced integrity and function. Components of the Alpine Sphagnum Bogs and Associated Fens ecological community are also listed under a range of state legislation, as follows:
'Alpine Bog Community', 'Fen (Bog Pool) Community' and '*Caltha introloba* Herbland Community' are listed as threatened in Victoria under the Flora and Fauna Guarantee Act 1988 (FFG Act);
'Montane peatlands and swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions' listed as an endangered ecological community in NSW under the Threatened Species Conservation Act 1995 (TSC Act); and
'Sphagnum peatland' listed as 'Rare' in Tasmania under the Nature Conservation Act 2002 (NC Act).
The Alpine Sphagnum Bogs and Associated Fens ecological community also includes the Ginini Flats Wetland and Blue Lake, which are listed under the international Ramsar Convention on Wetlands.
A notesheet describing this important community is being prepared. A map showing the distribution of the listed community is at: www.environment.gov.au/biodiversity/threatened/communities/maps/pubs/29-map.pdf

Weather facts: An automated (BOM) weather station has just been approved for Perisher Valley to complement the one at the top of Thredbo.

Botanists return to the Snowy Mountains

There have been two boosts to the level of vegetation research in the Snowy Mountains. One has come through an ARC funding grant to the National Botanic Gardens (see below) and the second is in two positions at the National Parks and Wildlife Service office in Jindabyne. Mel Schroder has taken up the position of the late Glenn Sanecki and brings vegetation expertise from her work in the Barrington Tops area, and Susanna Venn has been employed as the Alpine Project Officer until December 2010 on Centenary Fund money. Susanna is working on several projects related to alpine plant ecology and climate change. These include an investigation into recruitment at treeline, high altitude snowgum germination trials in the field and laboratory, frost tolerance among snowgum seedlings above and below the treeline, the role of plant functional traits in determining snowpatch species' responses to climate change and a project investigating the patterns and processes in parallel tree bands in high elevation, sub-alpine snowgum woodlands. Susanna will also be organizing the repeat measurement of the GLORIA plots for January 2011 (following a GLORIA meeting to discuss strategies in Perth, Scotland, in October 2010).

Wot's in flower?

In 2006 Ken Green commenced a (roughly) weekly list of what was in flower on the Main Range of the Snowy Mountains (this just happened to coincide with the earliest thaw on record). This has now continued for three years and in summer 2008/09 Mel Schroder (NPWS Resorts Section Jindabyne) added a collection of data regarding the flowering of sub-alpine plants from November 08- March 09. These two data sets will be used in setting up permanent sites in the coming spring to collect ongoing data on flowering times of selected plants occurring below and above the treeline to relate phenology to altitude and snowmelt date.

ALPINE HONOURS PROJECTS
Below are two abstracts from Honours theses submitted in May 2009 from two students in the Department of Environmental Management and Ecology, La Trobe University. They were supervised by Ewen Silvester, Gavin Reese (Murray Darling Freshwater Research Centre) and Phil Suter (Adrian Clements' thesis only).

AQUATIC FUNGI IN AN ALPINE STREAM OF SOUTH-EASTERN AUSTRALIA.

STEPHANIE SUTER

Aquatic hyphomycetes are dominant decomposers of leaf litter in freshwater streams, contributing significantly to the carbon cycle and in-stream food webs. The presence and activity of aquatic hyphomycetes in Australian streams is not well documented, with no known studies on their contribution to decomposition in alpine headwater streams. This study investigated the fungal community residing in Whiterock Creek, an alpine stream of south-eastern Australia. Heath *(Epacris glacialis)*, Snow gum *(Eucalyptus pauciflora)* and Alpine Ash *(Eucalyptus delegatensis)* leaves were submerged in fine mesh bags in the stream over a thirteen week period during the spring/summer period from November 2008 to February 2009. Experimental and in situ leaves and organic material were removed at predetermined intervals and analysed for fungal biomass, decomposition rates, and fungal diversity. Decomposition rates were derived from the mass loss of leaves while ergosterol content was used to determine the fungal biomass in leaves. A combination of sporulation techniques and DNA analyses were used to examine the fungal communities. Aquatic hyphomycetes were present and actively decomposing organic material in Whiterock Creek. All leaf types showed a decrease in mass and an increase in fungal biomass over time. The fungal communities on the decomposing leaf material showed changes over time but exhibited no significant preference for leaf type or study site. The results show that aquatic hyphomycetes have the ability to function in an alpine stream, utilizing and actively decomposing available organic matter, despite extremely variable and harsh climatic conditions, low levels of litter input, and overall low nutrient status of the stream. These results also show that there is no significant substrate specificity, potentially due to reduced litter availability, with fungi colonizing any available organic matter. Aquatic hyphomycetes clearly are an integral component of decomposition in alpine Australian aquatic environments, contributing to in-stream decomposition.

MACROINVERTEBRATE COMMUNITIES AND THE PHYSICO-CHEMICAL CONDITIONS OF GROUNDWATER-FED BRYOPHYTE POOLS AT WHITEROCKS CREEK, BOGONG HIGH PLAINS, VICTORIA, AUSTRALIA.

ADRIAN CLEMENTS

Aquatic bryophytes are common vegetative characteristics of Australian alpine peatlands. The most dominant species of bryophyte is that of *Sphagnum* but there are pools within the alpine peatlands where *Sphagnum* does not occur. These pools contain distinctive species of bryophytes in the genus *Blinidia*, *Bartramia* and *Brutelia*. While there are a number of studies focused on the *Sphagnum* communities of alpine peatlands there are no studies that have looked at the bryophyte pools in any way shape or form.

Non-destructive method were developed for this study in order to investigate the macroinvertebrate communities and physico-chemical conditions of bryophyte pools found in the Whiterock Creek peatland on the Bogong High Plains, Victoria, Australia. Three sites were used and the macroinvertebrate communities and physico-chemical characteristics at different depths within the pools were investigated over a 14 week sampling period.

This study found that the ground water springs provide a sustained flow of water which had a constant temperature, oxygen concentration, and chemical composition throughout the study. It was also found that between the source water and the exit from the bryophyte pools chemical alteration occurred with a significant change in chemical composition. Changes including decreased nitrogen concentration, increased dissolved oxygen concentration and increased pH values were observed at each of the three sites. Some of theses chemical alterations occurred with depth whilst others may have occurred within the bank of built up vegetation at the bottom end of the bryophyte pool.

It was found that the amphipod *Austrocrangonyx barringtonensis* was the most dominant species at all three sites. Whilst *Paralimnophyes* sp. Oligochaeta sp. and Scirtidae sp. B were characteristic species of different sites. A rare species of Mecopteran was found along with specimens of the equally rare chironomids, *Austrochlus* sp. and *Parochlus* sp.

Vertical zonation was present within in the macroinvertebrate communities. Crustacea, Hydracarina, Trichoptera, Collembola and Coleoptera all showed higher occurrence in the top zone, Dipterans were the characteristic species of the mid zone and the oligochaetes were the characteristic species for the bottom zone.

This study has found valuable results which contribute positively to the existing alpine aquatic macroinvertebrate and water chemistry studies. Additionally this study has highlighted the importance of these niche environments to the health of the rest of the water catchment.

Australian National Botanic Gardens involved in alpine research

Roger Good

Research personnel from the National Botanic Gardens ANU and CSIRO will be undertaking a year research program on alpine plants through an ARGC funding grant of approximately K and additional funding from the Friends of the Botanic Gardens
The project was initiated by Roger Good now working as a Research Associate at the Gardens and ANU An overview of the project follows:

Over the past couple of decades climate change has emerged as a serious threat to high altitude ecosystems in Australia The long term viability of several alpine plant communities and many species in NSW Victoria and the ACT is now in question However very little is known about the tolerance of native Australian alpine plants to climate change the demographic physiological and genetic changes that will occur in alpine plant populations as temperatures rise and snowpack declines or the characteristics of species that are likely to contract most in numbers and distribution
The objective of this project which would be conducted as a postdoctoral fellowship at the Australian National Botanic Gardens (ANBG) in collaboration with the Centre for Biodiversity Research CSIRO Royal Botanic Gardens (Mt Annan), and staff of the Alps National Parks, is to determine the sensitivity of a range of alpine plants and plant communities in the Australian Alps to climate change initially in terms of changes in species phenology seed set viability and seed longevity The seed germination trials will be undertaken at the ANBG with some seed being used to grow potted plants for subsequent ex situ glasshouse trials and trials in the phytotron at CSIRO (replication of predicted temperature precipitation and UV changes) to determine the possible changes in plant phenology morphology and resilience –hybridisation etc)

This work would represent the first major effort to link phenological ecophysiological genetic attributes and demographics of alpine plant species and communities to climate change in Australia, and the first to identify a range of species that would act as at 'climate change indicator species' for Australian alpine plant communities in general Key outcomes of the project will include a much more detailed understanding of the ecology phenology and ecophysiology of alpine plant species and in the longer term provide for the establishment of field experiments in the Alps National Parks, investigating the effects of temperature and UV modification on alpine plants. The project will consist of five components:

Collection of seed from a range of alpine plant species having a wide range of the life history strategies

Seed dormancy germination and viability trials in the seed laboratory at the ANBG

Growing on of plants for study of responses to a range of predicted climate changes (temperature precipitation humidity and UV) - glasshouse, phytotron and field trials. Measurement of ecophysiological attributes such as heat/cold/drought tolerance and UV tolerance would determine traits that are important for the survival of high altitude species

Translocation experiment involving establishment of experimental populations of propagated alpine plants species and determination of the impact of altitude on plant species morphology

5. Establishment of field temperature experiments aimed at determining the impact of increased temperature (deg C) on the phenology of alpine communities

Northern Corroboree frog

Both the northern and southern species of Corroboree Frogs are small (25–30 mm) distinctively striped yellow and black frogs. They occur in a restricted, high-altitude distribution in waterlogged grasslands, heath, sphagnum moss bogs and adjacent woodlands. In the past two decades, populations of both species have declined to precariously low numbers. In the ACT, there are estimated to be less than 200 Northern Corroboree Frogs left in the wild. The decline of Corroboree Frogs has been attributed mainly to the spread of the introduced pathogen Amphibian Chytrid Fungus.
In 2003, the ACT Government established a captive population of Northern Corroboree Frogs from eggs collected in the wild. The objective of the program is to maintain a captive colony of Northern Corroboree Frogs as an insurance against extinction in the ACT, with the ultimate aim of breeding the species for release to re-establish wild populations. The species was successfully bred in captivity for the first time in 2008

at Tidbinbilla Nature reserve, and has again bred in 2009. Releases to the wild are expected to commence in 2011.(More info: Murray.Evans@act.gov.au).

Sphagnum Bogs

Rehabilitation of key ACT *Sphagnum* bogs burned in the 2003 fires continued through to the completion of NHT funding in June this year. Photo monitoring and some monitoring of peat-wetting was done in association with the water spreading work. This work has been carried out by Namadgi National Park staff with advice and assistance from Roger Good, Jenny Whinam and Geoff Hope.

Experimental work to test some treatments that might facilitate or speed up recovery of *Sphagnum* following fire was also carried out. This project has experimental plots (established 2003) in both Namadgi and Kosciuszko National Parks. Treatments included fertiliser (80g of Osmacote 'native' low PKN pellets), transplanted moss, fertiliser and transplanted moss, and control (no treatment) along with shade (straw mulch, vertical and horizontal shade cloth). Visual evidence appears to indicate horizontal shading offers the best recovery response of *sphagnum* bog species. Analysis of the first five years of monitoring data is underway (Jenny Whinam and Geoff Hope).

Bogs and Climate Change

In May 2008 the ACT government held a one-day Workshop to help identify threatening processes and address long term monitoring options (how we might monitor the condition/ functionality of bogs and how that might be changing with respect to climatic variability) for the bogs in the ACT. The workshop was attended by bog researchers in the Alps and Tasmanian regions, many who are members of the AIAS. Climate change is likely to have a significant impact on the *Sphagnum* bogs and fens, threatening ecosystem resilience through drought, increased temperatures, increased incidence of wildfire and invasive species impacts. These threats may significantly impact the functioning of the bogs and result in loss of ecosystem services.

To manage these ecological communities and their ecosystem services appropriately it is essential to know the extent of the communities. The peatlands (bogs and fens) of the ACT have been mapped by ANU under the direction of Geoff Hope. The mapping is based on orthorectified aerial photography (immediately following the 2003 fires) and satellite imagery, and provides a baseline assessment of the condition of the peatlands against which future changes in their characteristics can be assessed.

Rehabilitation of a number of the *Sphagnum* bogs burnt in 2003 has been carried out to prevent stream entrenchment and subsequent drainage and loss of these bogs. Trials to assess other bog rehabilitation techniques were also carried out. Assessment of this work has been based on vegetation recovery, with little monitoring of bog functional recovery.

The importance of the functional role of groundwater communities as water-regulating ecosystems has long been recognised but not quantified. Long-term management of *Sphagnum* bogs needs to be based on an understanding of how the bogs are functioning and are likely to function under changes in precipitation regimes, increases in temperatures and solar radiation (UV) and changes in surface and subsurface inflow regimes.

Long-term management recommendations: Ensure *Sphagnum* bogs remain ecologically resilient by: 1) Continuing rehabilitation and monitoring of fire - affected bogs to prevent stream entrenchment. 2) Establishing long-term monitoring of representative Sphagnum bogs to assess changes in bog functionality due to climate change and rehabilitation actions and 3) Addressing the threats of invasive species (weeds and feral animals), fire (wildfire and fuel control fires/measures) and recreational impacts.

Maintaining healthy bogs high in the catchments of the ACT is vital to the overall health of downstream aquatic and riparian ecological communities and to those human communities reliant on the water services provided by these bogs. (More info: Trish.Macdonald@act.gov.au)

Feral Pigs

Feral pigs are frequently cited as a threat to *Sphagnum* bog communities. Namadgi National Park has run an effective feral pig control program since 1986. Animal welfare considerations concerning the toxin used in this program (Warfarin) means that within the next few years this toxin will not be able to be used in feral pig control.

The park received funding through the Natural Heritage Trust and Caring for Our Country to test other toxins and baits for effective control of pig populations in Namadgi.

This work has been carried out with the CRC for Invasive Animals. Testing a new toxin in an environment where the pig population is already controlled brings particular challenges. Pig dung and rooting on pre-established plots have been used as indices for pig density and damage (Dr Jim Hone UCan). Using this technique to test whether a particular toxic bait could reduce the damage and pig density at a landscape scale meant establishing 2000+ monitoring plots in 2 montane valleys in Namadgi NP. Given plots of 20m x 1m, with 5m gaps along transect lines meant that monitoring of the plots required walking 50km! Plots were monitored six times.

PigOut baiting successfully reduced pig density and damage levels in the experimental areas. Use of this toxin has been extended to the whole of the park (an area of 106,000 ha) in 2009 and 2010. In May 2009 HogGone bait was tested in the Cotter valley, and further development of the bait is likely to lead to an effective bait that will minimise bait aversion, as well as avoiding non-target and secondary poisoning problems that can occur with PigOut baits. (More info: Trish.Macdonald@act.gov.au or Nicola.Webb@act.gov.au)

ALPINE TALKS AT THE 10TH INTERNATIONAL CONGRESS OF ECOLOGY IN BRISBANE.

Climate influences on the upper range limit of a common herbivore in subalpine Australia (also to be presented at the10th International Mammalogical Congress in Mendoza, Argentina)

Alison Matthews, Peter Spooner, Dan Lunney, Ken Green and Nick Klomp

Alpine ecosystems are particularly susceptible to climate change. Climate models in Australia predict a substantial reduction in the snow cover, and this could result in range shifts of species to higher altitudes. Of particular concern is the movement of herbivores to higher altitudes and their potential impact on grazing-sensitive alpine ecosystems. However, the distribution of key habitat resources may constrain the range of herbivores and prevent any upward migration. This study examined the local resource constraints on the distribution of a large herbivore in Australia, the common wombat *Vombatus ursinus*, along an altitudinal gradient above the winter snowline in the Snowy Mountains. Logistic regression analyses of environmental and habitat predictors were conducted on the presence/absence of animal signs recorded during winter and summer. Wombats responded strongly to the altitudinal gradient and shifted to higher altitudes during the snow-free period. Maximum snow depth was the most influential variable in wombat occupancy in both seasons, but other habitat covariates were also important predictors. Rugged, high-relief terrain was important to wombats in winter, allowing individuals access to a wider range of altitudes and snow depths. During summer, high soil bulk density was an important predictor of occupancy, and in both seasons, occupancy declined in response to a higher cover of burnt grass. These models demonstrate that, for some animal populations, local habitat factors are important even where there are strong regulating environmental factors. For wombats, this may limit future range expansion into the alpine zone despite the potential for an increase in abundance at their present range limit. These findings highlight the importance of conducting local ecological studies in parallel with broad-scale climate modeling, to understand and manage shifts in species distributions as the climate rapidly changes.

Can plant traits be used to predict functional shifts within snowpatch communities with global warming?

Susanna Venn, John Morgan, Catherine Pickering

Plant functional types are non-phylogenetic groupings of species which show close similarities in their resource use and responses to environmental and biotic factors. Species within groupings of plant functional types therefore share similar morphological, physiological or life-history traits. These plant functional traits among species and communities can explain past environmental filtering processes and can be used to predict species assemblages in given environments. Here, we use plant trait analysis, as an alternative to traditional taxonomic, species-based approaches to plant community description, to examine potential functional shifts within Australian snowpatch communities. Snowpatch plant communities are restricted to the lee side of mountain ridges, where snow lies late into the summer months, long after snow in the surrounding landscape has melted. We measured response traits (dispersal mode, clonality, Raunkier life form, leaf area, seed mass, pollinator type) and effect traits (plant height, seed mass, specific leaf area) of species within several snowpatches from high mountain ridges within the Kosciuszko National Park, Australia. We then used multivariate techniques and simple regression to show how different suites and frequencies of traits, and therefore plant functional types, match the frequencies of species recorded from already defined within-snowpatch community zones, which correlate strongly with snowmelt date and soil temperature. By using plant functional traits in this manner, we can explore possible consequences of global warming, such as reduced snowfall and snowpatch longevity for these communities, and predict which suites of traits and therefore groups of species, are most at risk of expansion or extinction in marginal snowpatch areas.

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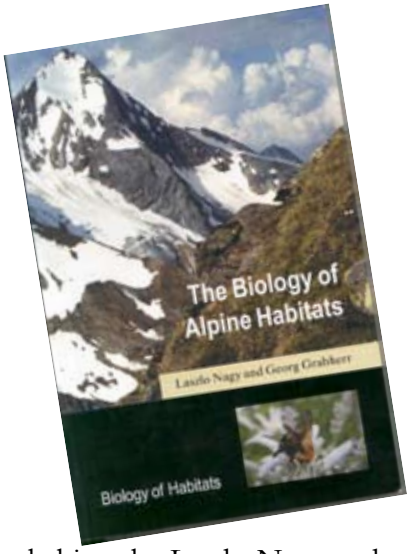
New alpine text



The biology of alpine habitats by Laszlo Nagy and Georg Grabherr Oxford University Press 376pp. This is a brief note rather than a review just to let people know that this book is available in the 'Biology of Habitats' series. The book is divided into 11 chapters with the first the definition of what is alpine – this seems to have to be defined time and again as people still use the term loosely even in ecological contexts. This is followed by an excellent review of mountains in different latitude life zones that revealed some mountain ranges that I have never heard of. The book continues through elevational gradients, alpine energy and climate, landforms geology and soils. Chapter 6 is particularly interesting as it deals with the variety of 'alpine' assemblages ranging from arctic alpine through boreal, temperate, subtropical to both seasonal and aseasonal tropical alpine environments. Chapter 7 looks at biogeography and 8 with succession. The next two chapters deal with human impacts; climate change and land use while the final is in the form of concluding remarks. This is a valuable text for those just starting out in alpine research or for those wanting to broaden their alpine horizons. It is, for the most part, extremely well researched and the cited literature is extensive. I have one quibble with it in that it does fall down on the fauna side a bit. Although in the concluding remarks the authors comment that there is only one comprehensive account of the animal life of alpine ranges they do acknowledge the large body of published zoological literature. However they do fail to use this and instead Table 7.9 is 'Adaptation of insects to arctic conditions' rather than alpine. Hence melanism is mentioned but not physiological colour change (because an alpine insect has to deal with high solar irradience whereas arctic do not). All in all though it is en excellent text and I highly recommend it. It costs about US$110 in hard cover and half that in paperback.

New Journal online

June 1 saw the publication of eco.mont, a new Journal on Protected Mountain Areas Research. eco.mont is published twice a year and available online from http://epub.oeaw.ac.at/eco.mont Issue 2 of eco.mont will be published in December 2009.

Global Change and the World's Mountains 27 September – 1 October 2010 (www.perth.uhi.ac.uk/mountainstudies/2010)

conferences

State of the alps catchments project
Graeme Worboys, Roger Good and Andy Spate.

The aim of the project is to prepare a submission for long-term funding for management and research in the Australian Alps. The project will be completed over the next 12 months. A number of issues will be addressed:

1.What is the current status/condition of the catchments across the Alps with particular reference to soil stability/catchment stability and what are the current water yield trends?
2.What are the predicted impacts on the catchments with particular reference to: 1) vegetative cover and stability, 2) soil stability, 3) catchment stability, and 4) water yield e.g. rain v snow, storm v steady precipitation.
3.What actions should be taken to maximise water yield for the long-term?
4.What actions can be taken (adaptive management) to maximise the water yield.

What is required to address the above questions? 1) Assessing the current baseline condition of the Alps catchments e.g. soil conditions, vegetation conditions, significant habitats, ecosystem functions/functioning and key threatening processes currently existing and predicted to occur in the future. 2) Developing and implementing a program to assess the change in condition trends of the above. 3) Assessing/predicting future changes in condition under forecast climate change scenarios. (This would include predicting changes to the extensive areas of catchment rehabilitated over the past 45 –50 years, particularly in the Snowy Mountains of NSW). 4) Modelling a number of scenarios of temperature change e.g. 1.5°C, 3.5°C, 5.0°C and precipitation changes in terms of vegetation impacts, catchment stability and water yield. 5) Assessing the water yield impacts with and without intervention. (cost – benefit analysis). e.g forecast $ benefits of management intervention and maximisation of catchment resilience v $ cost of intervention. 6) Assessing the social benefits of management intervention. – national, regional and local benefits. (financial, psychological and well-being). 7) Assessing the impacts of no intervention works and adaptive management.

ALPINE PHD PROJECTS

Phillipa Griffin PhD candidate, University of Melbourne: Genetics and adaptation in alpine Poa grasses

Australia's alpine region is particularly threatened by climate change (CSIRO 2007). We currently have little knowledge about how resilient our unique alpine ecosystems will be to climate change, or what form any ecosystem changes will take. This study aims to predict how Australian alpine *Poa* species will respond to climate change. *Poa* grasses are keystone species of our alpine ecosystems, being the dominant tussock grasses in alpine grassland, herbfield and heath. Survival of alpine ecosystems as we know them today relies upon the persistence and adaptive potential of these grasses under climate change.

First, I aim to discover whether the Australian alpine *Poa* species are truly separate species, using nuclear and chloroplast DNA sequence data and microsatellite markers. My results indicate that ongoing hybridisation between 'species' is a real possibility; this would bode well for the grasses' adaptive potential under climate change, as well as prompting a re-examination of their current classification. Alternatively, this may be a case of incomplete lineage sorting, in which ancient ancestral genetic variants are maintained across present-day species boundaries. Recently-developed phylogenetic and coalescent methods will be used to distinguish between these two explanations.

Precipitation is predicted to decrease in the Victorian Alps (Hennessy et al. 2003) in coming years, meaning that droughts will be more frequent and severe. For species currently adapted to relatively high levels of rain- and snowfall, drought may be a major selection pressure. I have used a combination of techniques to investigate drought response in the two dominant alpine grasses of the Bogong High Plains, *Poa hiemata* and *Poa hothamensis*. Plant community composition, soil moisture, depth and water potential have been tested for their effects on grass death during the 2006-2007 drought, both along altitudinal gradients and on a smaller spatial scale. Quantitative genetic experiments in a common environment allow me to calculate the genetic basis of drought tolerance and morphology in these species. By combining the results of the field and common-garden experiments, I will discover how field populations are likely to evolve in response to more frequent and severe drought conditions under climate change.

Results will be of direct application in long-term management plans for the Alpine National Park, including revegetation efforts. They will also shed light on larger-scale questions about alpine ecosystems and climate change around the world.

CSIRO. 2007. Climate change in Australia.
CSIRO. Hennessy, K., P. Whetton, I. Smith, J. Bathols, M. Hutchinson, and J. Sharples. 2003. The impact of climate change on snow conditions in mainland Australia. CSIRO Atmospheric Research, Aspendale, Victoria.

Jessica M'Baya, PhD candidate at CESAR, University of Melbourne: An Integrated Assessment of the Impacts of Climate Change on Victorian Alpine ecosystems: Adaptation of Carex species to Climate Change

60% of the plant species in the Victorian Alps are endemic, which makes the alpine region of prime conservation value. These plants are adapted to survive very cold climate and are particularly threatened by climate change. However persistence of these species is possible if adaptation to changing environment occurs. The Bogong High Plains hosts one site of the International Tundra Experiment (ITEX). This experiment aims to evaluate the effect of climate change on cold climate ecosystems in Arctic and Alpine regions by using open top chambers (OTCs), which simulate the future warming expected under current climate change scenarios.

My research project aims to incorporate genetics studies into ITEX experiments. In fact the ability of threatened alpine species to adapt to climate change depends upon their population genetic structure and upon whether genotypes from low altitude are better adapted to higher temperatures and can migrate to high altitudes. I want to estimate the population structure of two *Carex* species commonly found in the Bogong High Plains (*Carex breviculmis* and *Carex hebes*) using microsatellites and AFLP markers. Besides, sometimes individuals with the same genotype give rise to different phenotypes in different environment. This is called phenotypic plasticity and it can also favour local adaptation. To check if there is phenotypic plasticity in *Carex hebes* and *Carex breviculmis* populations, I will do measures of altitudinal variation in plant morphology along two different transects (Mount Nelse and New Country Spur), as well as reciprocal transplant experiment and measures of heritability to assess the environmental and genetics effect on survival and plant morphology.

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Your comments on the content or contributions for future issues are most welcome.

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