Australian Institute of Alpine Studies

Australian Institute of Alpine Studies - Newsletter No. 20, August 2007

In this issue

AIAS Meeting, April/May La Trobe University

The ninth meeting of the AIAS was held at La Trobe University Bundoora, on Monday 30 April and Tuesday 1st May 2007. There were three sessions encompassing ten presented papers (see abstracts below) and a short session for all non-presenters to give a sentence or two about their current work. This was followed by a short round-table discussion on future collaborative work within the AIAS followed by a 'round the bar' discussion. The dinner was at the Stuzzi Café at Northcote. On the following day James Shannon led a field trip to Lake Mountain looking at a number of his sites.

Thanks to Susanna Venn and John Morgan for organization.

Left and Above: AIAS participants on the field trip

(Continues Page 3)

Dr Glenn Mark Sanecki

1 March 1968 - 5 July 2007

In an all too short professional career, Dr Glenn Sanecki made a significant contribution to a much-neglected topic of interest to alpine biologists – the ecology of snow. Snow is something that is at best avoided by many biologists who confine their fieldwork to the summer period. To take up studies of snow (especially for a PhD) given its unpredictable nature from one season to the next and within the course of a season requires a level of dedication that Glenn had in abundance.

In his studies in the Snowy Mountains, rather than making generalised statements about snow and its impacts on the animals he was studying or relying on experience from overseas studies Glenn went back to basics in his 2006 paper 'The characteristics and classification of Australian snow cover: an ecological perspective". He measured the physical characteristics of our snowpack and the environmental variables from scratch to come up with a classification of our snow and even came up with the suggestion that in an international snow classification scheme there should almost be an 'Australian' category, so unique was our snow.

Throughout the world, mammals under the snow have been studied using bins etc. placed in a grid system in the summer and allowed to stand until the snow falls so that the subnivean space (that space between the snow and the ground) can be accessed without disturbing the snow cover. This is time consuming, poses certain dangers to the animals and to the researcher because when your traps are open and animals likely to be caught you go out regardless of weather. Glenn took two ideas – the subnivean pitfall trap assemblage that I used for my insect studies and the old Australian standby of hair tubes to come up with a means of looking at distribution of small mammals on a landscape scale. He set tubes up on an altitudinal transect looking at four broad vegetation types on both snow accumulating and ablating aspects. The resulting paper 'A technique for detecting winter active small mammals in the subnivean space using hair tubes' was published in the European Journal of Wildlife Research and drew much attention from overseas including from Bill Pruitt the doyen of snow ecologists. Using this technique, and identifying many hundreds of samples of hairs from the sticky tape used under the snow, Glenn was able to examine the distribution of small mammals across the landscape in his paper 'Winter distribution of small mammals in relation to snow cover in the subalpine zone'.

His other papers looked at influence of snow cover on home range and activity of the bush rat and the dusky antechinus, the implications of snow-based recreation for small mammals in the subnivean space. He also wrote on the control of milfoil and on responses of subalpine birds and mammals to the 2003 fires.

When we first met, Glenn was working at Kosciuszko National Park and also undertaking study for a degree at Charles Sturt University. Glenn went on to take a B.Sc. with Distinction and won a Deans Award in three consecutive semesters. At the time I was considering how to undertake winter fox baiting in the snow and Glenn's interest was awakened by these twin aspects that were to dominate his next few years: snow and fauna. Glenn did the fox baiting for the next three years. He went on to do Honours at Charles Sturt University in 2000, looking at habitat fragmentation of small mammals in his thesis 'The effects of linear disturbances on the movement behaviour of small mammals in Kosciuszko National Park.' Needless to say he got a First Class Honours degree and capped that off with a University Medal.

He came back with a proposal to do a Ph.D. and was accepted at both Charles Sturt University and the Australian National University. He chose the latter and again delved into the question of small mammals and snow. Glenn submitted his thesis, 'The distribution and behaviour of small mammals in relation to natural and modified snow in the Australian Alps' in 2005. His degree conferral was the realisation of a dream that had started as a Field Officer at Kosciuszko National Park.

Basically all that work was an apprenticeship for the research and the glittering prizes that lay ahead. Unfortunately that was not to be. Glenn died at home in early July and we share the sorrow of his family – his wife Karen and daughter Otylia at his untimely death.

Ken Green.

(From Page 1)

ABSTRACTS FROM AIAS

A test of the role of vegetation type on the patterns of burning on the Bogong High Plains

J.W. Morgan, S.E. Venn and J.M. Shannon
Research Centre for Applied Alpine Ecology and Department of Botany, La Trobe University

In 2003, landscape-scale wildfire provided an opportunity to document the patterns of burning in alpine vegetation in Australia. On the Bogong High Plains, Williams et al. (2006) recorded a strong association between vegetation type and probability of burning. Heathlands had a high propensity to burn relative to grasslands and snowpatches leading the authors to state that "fire occurrence was primarily driven by vegetation type". In 2006, areas of the Bogong High Plains previously unburnt in 2003 were subjected to fire. We used this fire as an opportunity to test the hypothesis that vegetation type drives fire in alpine areas. At 52 locations in the vicinity of Mt Jim, we recorded the type of vegetation present, whether the vegetation was burnt, and assessed fire intensity using minimum twig diameters. We found for the 2006 fire that there was not a strong association between frequency of burning and vegetation type. Grasslands, open-heathlands and closed-heathlands all burnt, but in proportions that were different from that seen in 2003. Fire intensity was not significantly different between the two years. Hence, patterns of fire in alpine areas need to be understood in terms of factors other than just vegetation type.

Documented ground control points and a high precision digital Elevation Model for the Bogong High Plains

Michael McBain
School of Geography and Environmental Science, Monash University

The Australian alpine and subalpine zone is generally topographically characterised by gently undulating landscapes surrounded by steeper montane valleys. Publicly-available elevation data, in the form of contour maps and digital data, are typically at intervals of not less than 20 metres, with errors of ± 5 metres, which does not adequately represent the landscapes of most interest to researchers of these higher elevations. This paper describes and documents a series of ground control points covering the Bogong High Plains in Victoria, and subsequent generation of a photogrammetrically-derived digital surface model with a horizontal precision of 0.2 metres and vertical precision of 0.4 metres. Such a model has direct application to precision hydrological modelling, topographic delineation of vegetation boundaries, precise characterisation of elevation differences in geological strata, clear topographic stratification of faunal assemblages, and precise documentation of changes in landscape features over time. Additionally, the public online hosting of these documented ground control points and associated digital surface data has the potential to provide significant benefit to research in the subalpine and alpine zones.

A test of the CSR plant strategy scheme in the Victorian Alps

Megan Good
Research Centre for Applied Alpine Ecology and Department of Botany, La Trobe University

Grime's CSR plant strategy scheme is an attempt to categorise plant species according to the selective pressures that have shaped their ecologies. Grime considers stress (S), disturbance (R) and competition (C) to be the most important selective pressures. The aim of this project is to test this theory using the alpine landscape (supposedly a high stress environment) to determine whether or not the scheme can detect small scale changes in "stress". Grime defines stress as anything that decreases plant productivity, therefore we used snowpatches (which have a substantially shorter growing season than the surrounding landscape) to test the theory in the Mount Hotham area of the Victorian Alps. We found that snowpatch communities are floristically distinct from the surrounding landscape and are also less productive. However, the CSR scheme failed to detect these differences in terms of community stress tolerance (S scores). These findings raised many issues regarding the nature of stress, and the role of disturbance and competition in the alpine landscape.

Litter'in de Alps: Decomposition in subalpine peatlands

Sam Grover
Formerly La Trobe Research Centre for Applied Alpine Ecology

Peat soils in the Australian Alps have long been

recognised as an important component of catchment hydrology. This research described the nature and function of two kinds of peat common in the Australian Alps: bog peat and dried peat. Peat soils form beneath springs and seepage areas, and along valley bottoms, where waterlogged conditions inhibit the breakdown of plant material. This plant material gradually builds up over thousands of years, to form an organic soil: peat.

Carbon dioxide emissions and the mass loss of peat incubated *in situ* were measured in peat soils in the Australian Alps. The carbon chemistry of incubated peats was characterised with ^{13}C NMR. *In situ* decomposition decreased as a function of increasing alkyl carbon content of the initial organic matter, providing direct evidence of the oft-cited link between substrate quality and decomposition rates. More mass loss occurred in the bog peat samples than in the dried peat samples. However, at the peat surface, the amount of CO_2 emitted was not significantly different between bog peat and dried peat. The apparently conflicting results from the two methods of measurement of decomposition could be due to recent carbon inputs from surface vegetation and pressurised and occluded gases at depth. Carbon inputs, and therefore the sink or source status, of these peatlands are yet to be quantified.

Lake studies in the Snowy Mountains

Ken Green
Snowy Mountains Region, NSW National Parks and Wildlife Service

Over the years, there has been intermittent interest in studying the five glacial lakes in the alpine zone of the Snowy Mountains, with the latest interest commencing with measures of maximum ice depth and date of ice breakup as a measure of the impacts of climate change. Three years ago regular three-weekly ice coring of Blue Lake commenced together with hourly recording of the lake water temperature. Last year this was extended to all five lakes fortnightly together with sampling of water nutrients, bacteria and diatoms. The nutrient status will be examined over two years and we will also look at the influences of catchment soils and inputs from snowcover. Bacterial studies will look at the influence of nutrients, season and ice cover. Benthic diatom will be examined with regard to seasonal variation and water quality. This year, studies commenced on density and species composition of plankton on both Lake Cootapatamba and Blue Lake. The movement of the fish *Galaxias olidus* into Lake Cootapatamba, last year (Australia's highest lake and one of the two lakes from which *G. olidus* has never previously been recorded) has raised questions of its impact on the lake fauna and flora. Studies of the fish at this lake and Blue Lake will commence next summer.

Monitoring the rehabilitation process using landscape function analysis: a study of cleared power-line easements in a montane ecosystem, Tumut sub-region, NSW.

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The montane ecosystems of the Tumut sub-region of NSW are a significant part of the Australian continent, linking the largest alpine and sub-alpine ecosystems of Australia with the surrounding lowland areas. As such they provide continuity for the protection of catchments, for landscape diversity and ecological values over a large area. Despite their widespread importance, these landscapes have been threatened by many human disturbances such as grazing, the building of infrastructure, tourism and most recently by over-clearing associated with the construction of high voltage power-line easements.

In April 2001, major over-clearing occurred under the power lines. This caused the ecosystems to suffer from significant degradation, thus, necessitating rehabilitation. In June 2001 rehabilitation action (consisting of dragging fallen trees into log mounds, applying mulches and planting seedling), was implemented. Monitoring using landscape function analysis (LFA) (Tongway and Hindley, 2004) in May 2002 indicated that this rehabilitation had quickly arrested any major potential erosion. However, in January 2003 severe wild-fire badly damaged the rehabilitation at two sites, requiring additional rehabilitation work to be done. Therefore, on-going monitoring to reconfirm the success of rehabilitation and the effect of the fire is critical.

The aim of this study was to evaluate the effectiveness of the rehabilitation of the over-cleared easements using the LFA method. Three objectives accompany the aim: (i) to assess changes in the landscape functional status between 2001 and 2005 in rehabilitated areas on four power-line easement sites (ii) to carry out a subsequent evaluation of the effects of wild fire at two of the sites on the rehabilitation process; and (iii) to examine the

efficiency and suitability of LFA as a monitoring procedure in rehabilitation of degraded montane ecosystems.

Rehabilitation work was shown to have achieved its objectives in terms of ecological management and safety requirements for high voltage power-lines. By 2005 at the un-burnt sites the newly restored ecosystem was fully covered by vegetation. Even though the fire had seriously affected the rehabilitated areas at two of the study sites, the LFA indices also showed by 2005 that the burnt sites have achieved a functional state that can be self-sustaining without needing any further help. In terms of safety, the height of vegetative cover was < 1m.

LFA appeared to be the most appropriate monitoring procedure for on-going monitoring. LFA meets the three requirements of land managers of power-line easements, i.e. (i) it provides a rapid assessment procedure for rehabilitation processes and is inexpensive; (ii) it is highly inclusive, not omitting any useful indicators; and (iii) it provides objective information about the current status and longer term, trends of the landscape being monitored, including the response to new disturbances.

Reference
Tongway, D.J & Hindley, N.L., 2004. 'Landscape Function Analysis: Procedure for monitoring and assessment landscapes', CSIRO, Canberra.

Alternative stable states for the Tall Alpine Herbfield Community in the Kosciuszko Alpine Area, Australia

Johnston S.W., Greene R.S.B, and Tongway D.J. Fenner School of Environment and Society, ANU, Canberra, 0200, ACT.

Since the late 1960s there is increasing empirical support by ecologists for the idea that communities can be found in one of several possible alternative stable states. This is particularly the case with Alpine ecosystems. The purpose of this paper is to review the empirical evidence for the existence of alternative stable states derived from disturbance on the tall alpine herbfield community in the Kosciuszko alpine area of S.E Australia. This paper focuses on the effects of environmental stress on the state of communities or ecosystems (the "ecosystem perspective"). As such, the results of this study will be reviewed against a synthesis of different concepts that support the alternate state theory within the trigger-transfer-reserve-pulse conceptual framework developed by Ludwig *et al*. (1997).

Five states of the tall alpine herbfield community were identified and measured across four experimental sites in the alpine area of Kosciuszko National Park. The five states ranged from State 1 (natural, i.e. complete tall alpine herbfield vegetative complex over an intact alpine humus soil profile) to State 5 (pseudo feldmark, i.e. vegetation and soils characteristic of man-induced feldmark community). Large differences in properties were evident among the five identified states found across the four experimental sites including the structural parameters of the vegetation complex, the soil chemical and physical properties, the biomass and the microclimate. Given the scale of these differences, it was found that many of the native plants endemic to the tall alpine herbfield complex found in the Kosciuszko alpine area are restricted to the more natural states (States 1 and 2), where one would expect 'higher fertility'. We attribute the contrast in structure between States 1 and 2, and the more altered States 3, 4 and 5 to differences in functions such as the flux and content of nutrients, decomposition and standing-state of litter, and the subsequent inability of the altered states to buffer against moisture and temperature stress.

This paper will also discuss the concepts of resilience and hysteresis, and the role of stochasticity within the tall alpine herbfield community. By doing so, it is hoped to facilitate the empirical exploration and identification of relationships between the different properties and the critical degradation thresholds identified within this community. Finally, by adapting this data into the Landscape Function Analysis (LFA) framework we have produced a systems approach to assessing and monitoring alpine ecosystem condition, and contributed to effective sustainable management of these areas.

Using historical records to track century-scale changes in the Victorian Alps

Andre Messina and John Morgan
Research Centre for Applied Alpine Ecology & Department of Botany, La Trobe University

Over several centuries, people have been recording what, where, and when organisms have occurred. These natural history records have been made to gain a better understanding of the diversity and behaviours of organisms. These extensive, long-term records may be used to build comprehensive databases from which changes in the distribution and behaviour of organisms, over long timescales, can be elucidated. Despite their potential utility in understanding long-term vegetation changes,

in particular, information on the distribution and phenology (i.e. flowering time) taken from historical records such as herbarium specimens may be combined with other data sources (such as temperature) to show how species are responding (over decadal to century timescales) to biotic and abiotic climate changes. In this presentation, the potential of historical datasets such as archived herbarium specimens in understanding plant responses to change in climate is discussed using an example of flowering time in plants in the Victorian alps.

Australian alpine region and climate change - the things to watch.

Ian Mansergh

Human-induced climate change is now inevitable and predictions suggest that it is the most rapid on record. Mass extinctions are foreshadowed with the Australia Alps one of the three most vulnerable ecosytems on the continent. Australian alpine biodiversity, already atop the low mountains has nowhere to go. Making the environment as healthy as possible to increase biological inertia will be a major management driver. This is consistent with future drivers of management - water production and enhanced carbon sequestration. Important ecological phenomena that need to be actively monitored include: snowline and snow depth, treeline, phenology, and grazing and predator regimes.

In contrast to elsewhere the Australian alps are "soil mountains" with the major grazing organisms being insects rather than mammals. Grazing regimes can determine vegetation communities. Climate change, already happening and the retreat of the snowline will afford a new suite of herbivores (both native (e.g. macropods) and exotic (e.g. Sambar Deer) access to the alpine environment instituting novel grazing regimes. This paper examines potential impacts from changes already in evidence.

Climate Change and Alpine Research in Australia

Henrik Wahren
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La Trobe University, Bundoora, Victoria 3089.

Climate change is possibly the greatest threat to alpine ecosystems world wide. Australia's alpine and sub-alpine landscapes are particularly vulnerable because they occupy less than 0.2% of the continent and, compared with most other high mountain areas of the world, this treeless vegetation zone is narrow, with limited high altitude refugia; alpine and sub-alpine biota have nowhere else to go. Thus, the most recent media and political interest in climate change (and the alps) is encouraging because climate change studies can make a valuable contribution to research in the Australian Alps by taking advantage of the social interest to attract funds and provide a useful conceptual framework for future research. A minor concern is that the perennial problems of fashion and political influence lead to an emphasis on climate change research at the expense of other, equally valuable, projects.

Nevertheless, climate change studies have shown the power of multidisciplinary, multi-scale, cooperative research. This is not new or untried, but research in the Australian Alps has generally been state-based, focused on one or two levels of biological organisation, and often run by one or two individuals. Although useful, such an approach is less suitable for understanding ecosystems across scales, interactions among ecosystem components, and identifying causes of ecosystem responses to changes in, for example, climate and fire regimes. We therefore need to develop closer links among researchers, institutions and projects; foster multidisciplinary research to improve predictive power and avoid the 'black box' approach; encourage a systems approach; share data; extend temporal scales by including long-term projects and their datasets; use syntheses to explore existing data from different sites; and, above all, develop an Australian Alps database.

OTHER NEWS

Post-fire sediment transfer in a sub-alpine environment

Deirdre Dragovich and Hugh G. Smith
University of Sydney

From: Regional responses to global changes: A view from the antipodes. International Geographical Union 2006 Brisbane Conference Abstracts

Bushfires in eastern Australia in 2003 burnt across 1.73 million hectares, including much of Kosciuszko National

Park (KNP) where fire frequency tends to be relatively low and where grazing is no longer permitted. Previous extensive fires in KNP were reported in summer 1972-73, when about 12,000 ha were burnt at elevations above 1360 m. Following these earlier fires, heavy rainfall led to sheet erosion, with severe erosion along fire trails. Hydrological patterns in a catchment following high intensity fire in the Snowy Mountains were reported to have returned to pre-fire conditions within 4-5 years. Following the 2003 fires, erosion pin arrays were installed to record sediment movement in upper, mid and lower slope positions on burnt and unburnt slopes for a period of 12 months. 216 pins were set up in arrays of 36 pins for each of the 6 slope conditions. Both net and total surface change were considered. Net surface change combines surface gain and loss to approximate the actual surface change over the study period. Total surface change sums changes in pin measurements without sign, identifying those sites experiencing the most active sediment movement regime. Although mean total surface change was higher for burnt than unburnt sites the differences were not significant. Between-pin variability within each of the 6 pin arrays was high. Average sediment transfer rates were relatively low, possibly because of surface characteristics and vegetation factors. Regeneration of ground cover since the fires has been slow and patchy. Pre-fire, snow gums provided most canopy cover at higher altitudes and little or no regeneration of these has yet occurred.

New Alpine Rehabilitation Guidelines and Manual

Two new documents are been prepared, which would be of interest to anyone involved in rehabilitation, restoration or landscaping in alpine areas. They are:

- *Alpine Rehabilitation Manual*, prepared by Roger Good for the Australian Alps Liaison Committee; and
- *Rehabilitation Guidelines for the Resort Areas*, prepared by NGHenvironmental for the NSW National Parks and Wildlife Service.

Although the two documents may appear to overlap in scope, they will actually fill two different areas of need. Drawing from Roger Good's vast experience with rehabilitation in the Snowy Mountains, the *Alpine Rehabilitation Manual* will provide detailed information about the history of rehabilitation in the Australian Alps, including case studies of post grazing and burning era rehabilitation in Kosciuszko National Park and post 2003 mire community rehabilitation. It will also provide an overview of the Australian Alps environment and its ecological communities, and will make explicit observations about the implications of these factors for rehabilitation. The main body of the *Alpine Rehabilitation Manual* will provide details of a range of considerations for planning and carrying out rehabilitation, from site assessment and preparation of a rehabilitation plan, through to detailed steps and practices for a range of typical activities and rehabilitation objectives. These will include a useful section on fauna habitat restoration and guidelines for rehabilitation of existing disturbed sites such as borrow pits, creeks and gullies, stream crossings and linear developments such as closed roads and fire control lines. The *Alpine Rehabilitation Manual* is likely to be of particular interest to people involved in remediation of existing impacts and natural resource management.

Rehabilitation Guidelines for the Resort Areas, on the other hand, is being prepared specifically to address the needs of the alpine ski resorts, for whom the emphasis is on minimising impact during development activities and successfully rehabilitating any disturbance. It will provide detailed information with photographs and diagrams of many aspects of rehabilitation, including: step-by-step guides and proformas for preparing a site assessment and rehabilitation plan; information about timing considerations; and technical information on site preparation, plant selection and acquisition, planting, maintenance and weed control. The appendices contain lists of recommended species for each of the NSW resorts, useful case studies from NSW and Victoria and a comprehensive resource list.

Rehabilitation Guidelines for the Resort Areas is being prepared in collaboration with a steering committee from the NSW alpine resorts and is currently being amended so that it incorporates further comments and requests for content from the resorts. It has been designed for use as an adaptive management tool, and it is hoped that it will be periodically revised in the future, to keep up with increasing knowledge in this field. Although the *Guidelines* were prepared for the resorts, they would be equally relevant to anybody involved in construction or similar activities in the alpine and sub-alpine areas.

Spring 2006 no exception for the birds

Ken Green
Snowy Mountains Region, NSW National Parks and Wildlife Service

2006 in the Snowy Mountains had the lowest recorded

winter maximum snow depth at Spencers Creek over the whole 53 year period that it has been measured from 1954. At lower altitudes the snow story was even more dire and many areas above the 'snowline' had virtually no snow all winter except for brief periods after a snowfall. The Whites River aqueduct bird transect was again variable and was variously 100% snow covered, 0% snow covered, with live *Grevillea* flowers, later killed by frosts – so the whole gamut of what appears in Green (2006) apart from fire occurred in this one year. The weekly monitoring of bird species along the Whites River aqueduct to look at bird migration basically confirmed what is in Green (2006). Once again it seems that it is the presence or absence of snow (not its depth) that determines whether or not the bird species are present. Most of the spring migrants had arrived by late August- early September, a month or more earlier than normal. Even in late July when work on the transect normally commences with just 2-3 species and up to a maximum of 5 recorded, there were 10 in spring 2006. However, there was no late season dump of snow, the expected 'dump' in the second week of September had no lasting impact on bird species.

On the Disappointment Spur aqueduct transect that was burnt in 2003 things are not anywhere back to normal. I chose the date of expected maximum number of bird species when I got 18-19 species on the unburnt Western side of the valley and in identical weather the next morning walked the burnt area – there were just 5 species. To add insult to injury, even in the short unburnt end of the aqueduct there were 7 species. The long time requirement for regrowth of *Grevillea victoriae* before it can flower and the longer time period before there is a decent canopy for birds means it may be some time before things are back to normal.

On that note, this coming winter will be the fifth since the fire so there will be a flurry of activity to remeasure the subnivean space in burnt and unburnt, some effort to get veg data in the following spring on the transects and small mammal grids and perhaps even some wombat work.

References both available from me as reprints or emailed as pdf: Green (2006) and Green & Sanecki (2006) (see; 'Other recent publications' section).

International Mire Conservation Group Field symposium: 13th to 23rd July 2006, Finland.

Jennie Whinam
Chairperson (IMCG)

The field symposium commenced at Teuravuoma, north of the Arctic Circle and visited mires (peatlands) down to the south coast over an 11 day period. A wide range of different peatland types, with various research and conservation issues were addressed. The main themes for the field symposium were:

- Mire conservation, utilization and restoration
- Mire development history, vegetation, flora and ecohydrology
- Aapamires
- Land uplift phenomena, IMCG past and future,
- Ramsar sites and the Global Actions on Peatlands Plan
- Assessment of mire conservation situation in Finland.

Meetings were held with non-government organisations and government officials. There was a lot of media coverage of the event with IMCG press releases expressing concern about the state of conservation of mires in Finland. We visited a large power station that is currently being powered entirely by pulverised peat. Further such power stations are planned. There is also the possibility that peat will be processed into a liquid fuel – with huge ramifications for peatland conservation.

A two day IMCG conference followed at Tammela (near Helsinki) where papers were presented by some of the 53 delegates present from 21 countries. Then the General Assembly of IMCG was convened. The Executive and other members of IMCG met with the International Peat Society to further several issues, including the issue of 'eco-labelling'. There is considerable concern amongst IMCG members that peat is being promoted as a 'slowly renewable resource'. There was also a meeting of the Consultative Committee of the Global Actions on Peatlands, to look at ways of further peatland conservation through the RAMSAR process.

Throughout these symposium, meetings and conferences it was clear that the sustainability of peatland utilisation is still a major issue, with restoration receiving much attention. In addition, the impacts of climate change on peatlands were discussed – with the importance of peatlands in the carbon budget highlighted. The issue of funding research into peatland carbon sequestration was thought to be a high priority, with the implications for climate

change as large as those for forest carbon sequestration.

For full details of the field symposium, press releases and other peaty news, check the website: www.imcg.net

International Tundra Experiment comes to the Victorian Alps

Recently, La Trobe University scientists from the Research Centre of Applied Alpine Ecology, along with collaborators at the University of Melbourne and the Victorian Department of Sustainability and Environment, joined an international research effort to quantify impacts of climate warming in alpine areas. The International Tundra Experiment (ITEX) has investigated the potential effects of climate change on the northern hemisphere's tundra since 1990, with study sites in Sweden, Norway, Finland, Russia, Canada and the USA. Using small open-top chambers to warm vegetation passively by 2-3 ℃, scientists have been observing the flowering and growth responses of plants to a warmer environment in the hope of understanding what impacts global warming will have on alpine ecosystems.

In 2002, the first ITEX open-top chambers in Australia were established on the Bogong High Plains in the Victorian Alps near Falls Creek. These occur in alpine grassland where the first evidence of climate change might be observed. Using third year undergraduates from the Biological Science degrees to assist them, scientists record the timing of key events such as bud burst, flowering and seeding inside the chambers, and compare this to what happens outside the chambers.

Financed by an Australian Research Council Linkage Grant, these experiments follow the same methods as at other ITEX sites but are breaking new ground with studies of how alpine plant species can adapt to global warming. The research will add to the understanding of the global effects of climate change on cold climate ecosystems and make a significant contribution to the knowledge of the genetic adaptability of plants to changes in climate.

One tangible benefit of the ITEX project was realised in February (3rd -6th) 2007. Hosted by the Research Centre for Applied Alpine Ecology and DSE, researchers from all over the world attended an ITEX conference at Falls Creek to showcase the Australian research. The conference examined recent results from ITEX sites in Australia and the northern hemisphere and attracted researchers from New Zealand, Sweden, Norway and the USA. Dr Henrik Wahren, Principal Investigator of the ITEX project. concluded that "We really are at the forefront of climate change research in Australia, and are now also important contributors to the international effort to understand potential changes in alpine and arctic areas. Fundamental long-term ecological research like this will be vital to understand just how the natural world will respond to global warming."

News from the Queensland Alps

Dr Catherine Pickering
Griffith University

Both Andrew Growcock and Frances Johnston were awarded their PhD on the 5th of August 2006. Congratulations to them as they both did well. Papers are continuing to come out of their work (and Pascal's) so watch this spot for more… Frances Johnston (2005). Doctor of Philosophy, School of Environmental and Applied Sciences, Griffith University. Research topic: *Exotic plants in the Australian Alps Including a Case Study of the Ecology of* Achillea millefolium *in Kosciuszko National Park.* (8 papers published, 1 under review, 1 in draft). Andrew Growcock (2005). Doctor of Philosophy, School of Environmental and Applied Sciences, Griffith University. Research topic: *Impacts of Camping and Trampling on Australian Alpine and Subalpine Vegetation and Soils.* (1 paper published, 1 Research Report, 5 papers in draft). Graeme Worboys submitted his mammoth opus (523 pages with appendices) which is titled '*Evaluation subjects and methods required for managing protected areas*". It contains a chapter describing the results of a survey of protected area agency staff and other interested parties into the way in which the management of Kosciszko National Park is evaluated. While doing his PhD Graeme has also published several books and reports, so he has been busy.

Ken, CP and Wendy are currently working on papers examining the latest lying snowbanks in the Australian Alps, and vegetation, soil and climate of the five GLORIA sites in the Snowy Mountains. In addition, we (the Griffith group) are also looking at issues to do with the distribution of weeds in the Australian Alps, do tourists collect weed seed when they go walking?, changes in species richness of tall alpine herbfields with increasing altitude, recovery of snowgums from the 2003 bushfire, and recovery of tall alpine herbfields, subalpine grassland, feldmark and alpine heaths from the 2003 fires – the first 5 years…, as well as lots of reports/work etc. on monitoring the terrestrial ecological impacts of visitors in protected areas. So watch this space for more…

PUBLISHED ABSTRACTS

Scherrer P. and Growcock A.J. (2006) Managing Visitor Impacts in the Australian Alps: A Case Study in Informal Track Development and Track Recovery. In *'Sustainable Tourism II'*. (Eds CA Brebbia and FD Pineda) pp. 107-116. (WIT Press: Southampton).

Visitation to protected areas is increasing worldwide, causing increasing pressures on areas that are often principally conserved for their natural and cultural heritage values. The Australian Alps have been no exception with a continuing increase occurring over the last 25 years. Visitation to the Kosciuszko Summit Area (Australia's highest mountain) in Kosciuszko National Park, for example, has increased from an estimated 20 000 visits per annum in the late 1970s to over 100 000 per annum by the year 2000. The most common activity of these visitors is walking from one of two main park entrance points to key landmarks within the area. While hardened areas can contain some of the impacts of these visitors, damage from off-track walking can rapidly occur and is slow to recover in this alpine environment. This paper presents a case study from the Kosciuszko Summit Area on track development and recovery in tall alpine herbfields, the area's dominant vegetation community. Results from experimental off-track walking studies demonstrate that longer-term damage can occur after only moderate usage levels (as little as 200 passes). Results from a study on a closed walking track in the area further provide examples of the slow recovery of the vegetation and soils once damage has occurred, with significant differences from undisturbed conditions remaining evident for vegetation cover, soil nutrients and species composition 20 years after track closure. Locally appropriate solutions are required to ensure that a sustainable level of tourism and visitor use can continue to occur in the area. The use of proactive management tools is discussed with regard to a damage prevention/ minimisation approach.

Scherrer, P. and Pickering, C.M. (2006) Recovery of alpine herbfield on a closed walking track in the Kosciuszko Alpine Zone, Australia. *Arctic, Antarctic and Alpine Research.* 38: 239-248.

Human use of arctic and alpine environments can result in damage to the natural vegetation and soils. Restoration of the damage can have limited success due to the severity of the environment, which restricts plant germination and growth and increases the potential for soil erosion. In this study, we evaluated the success of restoration of a closed track in the alpine area around continental Australia's highest mountain, Mount Kosciuszko. Vegetation and soils along a 4 km walking track (that was closed and rehabilitated more than 15 years ago) were compared with the adjacent undisturbed vegetation and soils. There was limited success in restoration with clear differences in soil nutrients, extent of vegetation cover, plant species composition, and height of vegetation between the track and adjacent natural vegetation sampled using 1 m^2 quadrats. The study highlights the need for limiting disturbance in such environments, and for ongoing rehabilitation in areas that have been disturbed. It also indicates that when non-native species are used in rehabilitation, they may not be succeeded by natives, particularly if soil conditions do not return to a state similar to undisturbed areas.

Johnston, F.M. and Pickering, C.M. (2006). Phenology of the environmental weed *Achillea millefolium* (Asteraceae) along altitudinal and disturbance gradients in the Snowy Mountains, Australia. *Nordic Journal of Botany.* 24: 148-160.

This study examined the phenology of the weed *Achillea millefolium* L. (Yarrow) over a growing season in the Snowy Mountains. Vegetative and reproductive characteristics of plants in 1 m^2 quadrats were compared among sites at four different altitudes (medium and high montane, low and high subalpine) and three types of infrastructure (primary road, secondary road and building, total 12 sites). Altitude, infrastructure and time of year did not affect percentage cover of vegetation. Flowering started earlier and lasted longer in the low montane sites compared to high subalpine sites. The type of infrastructure only affected the number of reproductive structures at the peak of flowering, with *A. millefolium* growing next to buildings having two to three times more inflorescences per m^2 than along primary and secondary road verges. At the peak for each reproductive stage, there was an average of 1.47 developing inflorescences, 21 inflorescences in bud, 24 inflorescences in flower, 4 inflorescences setting seed, and 3 releasing seed. Based on the maximum number of inflorescences present at any time at each site, there was an average of 36 inflorescences, giving an estimate potential seed production of 51,400 seed per one m^2 for *A. millefolium* in the Snowy Mountains. If the climate changes in the Snowy Mountains as predicted, then it is likely that yarrow will produce more inflorescences and seed in the higher altitude sites.

Bear, R. and Pickering, C.M. (2006). Recovery of subalpine grassland from bushfire. *Australian Journal of Botany.* 54: 451-458.

In January-February 2003 bushfires burnt 1.75 million hectares of the Australian Alps including >70% of the subalpine zone of Kosciuszko National Park. The recovery of subalpine grasslands one year after these fires was examined by comparing vegetation between paired unburnt and burnt plots at six subalpine grassland sites. Although the cover of vegetation at these sites had largely recovered, there were still differences between unburnt and burnt plots. For example there were large areas of bare ground (19% vs <1%) in the burnt plots and less vegetative cover (56% vs 87%). The above-ground biomass of the recovering vegetation was much lower, 10% of that in unburnt plots, well below levels required for adequate soil protection. Weeds did not appear to have spread post-fire, although this may not be the case in burnt areas adjacent to weed seed sources. Both cover and biomass of burnt areas will continue to increase provided there is limited disturbance in the future. Recovery will be uneven due to the inherent variability of subalpine grasslands, patchiness in the severity of the fire and differences in post-fire conditions.

Bear, R., Hill, W. and Pickering, C.M. (2006). Distribution and diversity of exotic plant species in montane to alpine areas of Kosciuszko National Park. *Cunninghamia*. 9: 559-570.

Diversity and distribution of exotic plant taxa in Kosciuszko National Park was reviewed based on 1103 records of exotics from 18 vegetation surveys conducted between 1986 and 2004. 154 taxa from 23 families were recorded in the alpine to montane zones, with eleven taxa in the alpine, 128 taxa in the subalpine and 69 taxa in the montane zone. Nearly all taxa were associated with anthropogenic disturbance with only four taxa exclusively recorded in natural areas. 62 taxa were recorded from subalpine ski resort gardens, and although not recorded as naturalised in the vegetation surveys, their presence in the Park is a concern.

Road verges provided habitat for numerous exotics (65 taxa). 44 taxa were recorded in both disturbed and natural locations but most were uncommon (33 taxa < 2% frequency). Nine common taxa *Acetosella vulgaris, Achillea millefolium, Agrostis capillaris, Anthoxanthum odoratum, Cerastium* spp., *Dactylis glomerata, Hypochaeris radicata, Taraxacum officinale* and *Trifolium repens* comprised 68% of records. These species are common to disturbed areas in other areas of Kosciuszko National Park, NSW and worldwide. The forb *Acetosella vulgaris* was the most ubiquitous species particularly in natural areas where it was recorded at 36% frequency. Based on the data presented here and a recent review of other data sets, there are at least 231 exotic taxa in the Park (including exotics in gardens). The increasing diversity and abundance of exotics is a threat to the natural values of this Park.

Johnston, F., Hill, W. and Pickering C.M. (2007). Distribution, frequency and density of the weed *Achillea millefolium* (Yarrow) in the Snowy Mountains, Australia. *Victorian Naturalist.* 123: 52-63.

This paper examines the distribution of *Achillea millefolium* L. (Yarrow, Asteraceae), in the Snowy Mountains. Location data from species specific surveys, field experiments and 18 general vegetation surveys were mapped in relation to altitude/floristic zone, climatic parameters (rainfall and temperature) and location of roads and tracks. *Achillea millefolium* is less common with increasing altitude and benefits from human disturbance. Using all location data, Yarrow was found at 376 sites; nearly all associated with human disturbance (91% of sites) mostly road or trail verges (72%) and around buildings and other ski tourism infrastructure. It occurred along ~100 km of public access roads, management trails and walking tracks, from the tableland to the alpine zone (800 m to 2100 m altitude). The general vegetation surveys, however, indicate that although it can be found in 15% of disturbed sites, it is uncommon in undisturbed vegetation (4%). Yarrow occurred at high density around buildings and low density along walking tracks in the species specific surveys.

The distribution of *A. millefolium* demonstrates that human disturbance provides favourable habitats for weeds even in mountains. Although its distribution was affected by altitude, *A. millefolium* was able to establish and grow on some of the highest mountains in Australia, along tracks. Increased disturbances as well as climate change are likely to facilitate its spread.

Other recent publications

Green, K. and Osborne, W.S. (2006) Diet of the mountain log skink *Pseudemoia entrecasteuxi* at high elevations in the Snowy Mountains *Herpetofauna* **36:** 6-10

Green, K. (2006) The effect of variation in snowpack on timing of bird migration in the Snowy Mountains. *Emu* 106:187-192

Green, K. and Sanecki G (2006) Immediate and short term responses of bird and mammal assemblages to a subalpine wildfire in the Snowy Mountains, Australia. *Austral Ecology* **31:** 673-681

Green, K. (2006) Impacts on fauna from late winter variability in weather in the Snowy Mountains of Australia; implications for monitoring. Pp162-165 in: Global change in mountain regions. Ed. By M. Price Sapiens Publishing, Duncow, Scotland.

Green K. (2006) Winter arousal of a high mountain skink *Pseudemoia rawlinsoni* following hibernation beneath the snow. *Herpetofauna* **35(2):** 95-97.

Green K. (2006) The return migration of Bogong Moths, *Agrotis Infusa* (Boisduval) (Lepidoptera : Noctuidae) from the Snowy Mountains, New South Wales. *Australian Entomologist* **33(1):** 27-30.

Sanecki G. M., Green K., Wood, H., Lindenmayer D. B. & Sanecki K.L. (2006) The influence of snow cover on home range and activity of the bush rat (*Rattus fuscipes*) and the dusky antechinus (*Antechinus swainsonii*) Wildlife Research 33, 489-496.

Sanecki G. M., Green K., Wood, H, & Lindenmayer D. B. (2006) The characteristics and classification of Australian snow cover: an ecological perspective. *Arctic, Antarctic and Alpine Research* **38:** 429-435

Sanecki G. M., Cowling A., Green K., Wood H. & Lindenmayer D. B. (2006) Winter distribution of small mammals in relation to snow cover in the subalpine zone, Australia. *Journal of Zoology*. 269: 99-110.

Sanecki G. M., Green K., Wood, H, & Lindenmayer D. B. (2006) The implications of snow-based recreation for small mammals in the subnivean space in south-east Australia *Biological Conservation* 129: 511-518.

Thesis

Carbon and water dynamics of peat soils in the Australian Alps

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PhD thesis summary

This research investigated carbon dynamics, water dynamics and peat formation at Wellington Plain peatland in the Victorian Alps. The properties of bog peat and dried peat were measured, and the ensuing results are outlined below.

The carbon chemistries of both bog peat and dried peat displayed changes with depth consistent with an increase in the extent of decomposition of the organic material. Representative changes in the alkyl:O-alkyl ratio down the profile were 0.14 to 0.96 for bog peat and 0.28 to 1.07 for dried peat. Laboratory incubations on the influence of chemistry, particle size, water content and sample preparation indicated that, in the absence of confounding factors, peat chemistry was the most important factor in determining the size of the mineralisable carbon pool.

Water content was the most important factor in determining the rate of carbon mineralisation. In the field, both bog peat and dried peat emitted an average of 2 g $CO_2/m^2/d$ from the surface. Carbon mineralisation was related to both soil temperature and soil water content, and this relationship was used to model peat mineralisation under a range of possible future climate scenarios. Below the surface, however, I measured lower rates of decomposition in the dried peat than in the bog peat.

The water-holding capacity of peat was measured in the laboratory, as was the rate of water movement through peat. Specific yield decreased down the profile in both bog peat (0.88 to 0.45 cm^3/cm^3) and dried peat (0.36 to 0.11 cm^3/cm^3). Hydraulic conductivity also decreased down the profile in both peats: $5.1x10^{-4}$ to $3.0x10^{-6}$ m/s in bog peat, and $1.0x10^{-4}$ to $7.0x10^{-6}$ m/s in dried peat.

Relationships between the hydrologic properties of peat and its physical and chemical properties were identified. In the field, fluctuations in the watertable were monitored in concert with rainfall. These laboratory and field measurements enabled me to develop models of the hydrology of bog peat and dried peat.

Radioisotope dating indicated that both bog peat and dried peat began forming around 3300 years ago. The bog peat appeared to have drained to form dried peat between 131 and 139 years ago. Since that time, erosion appeared to have contributed more to the loss of organic material from dried peat than carbon mineralisation had.

Ongoing research in Australian alpine regions

Characterising Climate Change Vulnerabilities and Implications for Adaptation Strategies in Alpine Regions - a case study of the Tourism Industry in Alpine Shire, Victoria.

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Tourism is one of the most significant drivers of economic activity and viability in the Alpine Shire region of north-east Victoria. However, the tourism industry is sensitive to the specific characteristics of the regional climate, which under climate change, is likely to experience increasing temperatures, aridity, variability and extremes weather events. With already observable changes in weather patterns in recent years, it is becoming increasingly important to acknowledge that some degree of climate change impact will be inevitable and climate adaptation will be fundamental for the industry's long-term viability in the region.

This PhD thesis project is part of an interdisciplinary research initiative undertaken by Monash University for the development of a conceptual and analytical framework for conducting regional climate impact assessments, which includes effective climate adaptation strategies. This project will focus on characterising climate change vulnerabilities for the tourism industry in the Alpine Shire, which will form the basis for an evaluation of climate adaptation strategies. Through this, the project aims to make a concrete contribution to the strategic planning and implementation of tourism policies in Alpine Shire for its long-term viability. To reach this goal, the project collaborates with Alpine Shire Council and tourism stakeholders to identify key vulnerabilities and reporting regularly to stakeholders for feedback and re-direction.

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Upcoming events and activities

- This coming **February 2008** will see the 10th anniversary of the launching of the AIAS. We hope to be holding a meeting in Jindabyne to coincide with that birthday (more later).
- On another note we will be making a big effort to get the website AIAS.org.au up to date. I will also be sending an email around as a reminder but can each member please update your details on the website (particularly needed are updates of publications!) Please send an update to:
  Jo Hooper at jowil@homemail.com.au

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

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