Australian Institute of Alpine Studies

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Review of 2nd Edition of Kosciuszko Flora

Roger Good

The revised edition of Kosciuszko Flora was launched at the National Botanic Gardens in Canberra on the 7th December. The original edition was basically a 'labour of love' of four very dedicated mountain men, Dr Alec Costin, Dane Wimbush, Max Gray and Colin Totterdell, undertaken while working in the Division of Plant Industry CSIRO, for much of the preparation of the book was undertaken in their own time.

The first edition became 'the reference' for the alpine flora and demand for the book was such that the first edition was out of print within a few years and it became a collectors item. Requests for a second edition were many and in 1998 the Australian Alps Liaison Committee together with the Centre for Sustainable Tourism allocated funds to provide for a total revision and publication of a second edition. The four authors, all being retired again enthusiastically undertook the revision during 1998/99 leading to the publication of the very high quality second edition. A field guide has also been published without the detailed taxonomic key. As with the full volume, the field guide provides a superb photographic coverage of the flora to a level that will provide visitors with the capacity to identify the majority of the alpine species without reference to the taxonomic key. The field guide will no doubt, also be used by many park management and research personnel to avoid taking the full volume in the field, as it also is destined to become a treasured botanical book and collectors item.

The second edition is of very similar content as the first edition, and while the title has been retained the new edition includes descriptions and photographs of the few additional alpine species that occur in Victoria but not in New South Wales. In the first edition the reproduction of Colin Totterdell's outstanding botanical photographs was rather poor and their layout in the book, made for difficult cross-referencing with the taxonomic key. Both the quality of the reproduction of the photographs and their layout in the second edition is excellent and now gives due credit to Colin Totterdell's years of dedication to perfection in botanical photography, particularly that of the alpine plants.

The detailed and informative text has been considerably rewritten and reflects the many years of dedicated mountain research of Alec Costin and Dane Wimbush, who also for many years have given freely of their knowledge to fellow research staff, students, park managers and visitors to the mountains. This high quality book and the field guide will ensure that their knowledge continues to assist and guide people in the appreciation and management of the very significant ecosystems and flora of the alpine area in the Australian Alps Parks in NSW and Victoria.

The taxonomic key prepared by Max Gray also is a reflection of his many years of dedicated study of alpine plants. The descriptions provided by Max Gray in the key are the equal of that of any taxonomic key compiled for any regional flora and will be used by research and management personnel for many years into the future, at least until the next revision. At the launch of the second edition Alec Costin made comment that the authors would not be around to undertake another revision but certainly it will be revised by those to whom they have entrusted their knowledge over the past many years. Certainly they will be around to see a reprint of the second edition as demand for the full volume and field guide has already exceeded expectations.

The full volume of Kosciuszko Flora and the Field Guide should be, and no doubt will be purchased and referenced by all personnel having an interest in the alpine flora. The Field Guide is recommended to the many park visitors who seek to enjoy the alpine flora each summer as it will greatly assist their recognition and appreciation of the very colourful and interesting alpine plants that are the equal of any alpine floral display around the world.

The Australian Alps Liaison Committee, supported by the Centre for Sustainable Tourism, is to be acknowledged for its interest, commitment and enthusiasm to the publication of the Kosciuszko Flora and Field Guide. The benefits accruing from their use by many people over the years ahead will far exceed the 'costs' of publication and will contribute greatly to one of the objectives of the Alps Committee; that of interpretation and understanding of the alpine environments.

AIAS Annual Meeting

The annual get together of the AIAS was set for the day following the launch of the new edition of the Kosciuszko Alpine Flora. Numbers in the AIAS have now reached 75 and the turnout for the meeting held in the theaterette of the Botanic Gardens in Canberra was over 50%. In fact the maximum counted at any one time attending talks was 50 people with the minimum still around the 30 mark. The number of people wishing to present talks was high and so, given the time restraints of the Botanic Gardens, it required constant vigilance to ensure that all sessions ran to time. The range of topics covered was impressive (see abstracts in this newsletter) and equally impressive was the participation by all in the question times. Most people lunched at the gardens and 22 attended dinner that night at Dickson – a short walk for those from interstate who took the night air on the way back to the Pavilion.

AIAS Website finds a permanent home!

The AIAS website has moved to its new permanent home at http://www.aias.org.au/. As part of this move the site is being spring cleaned and all Institute members should contact Jo Hooper via email (jowil@acr.net.au) to update their details.

Mountain Snippets

The AIAS newsletter has made the big time with two references in the new edition of the Kosciuszko Alpine Flora.

The alpine bibliography. We all have somewhere, thesis or on an Endnotexx file, our own alpine bibliography. Remember how long it took to build up that data base? How about sharing it with others? We hope to be able to make an alpine bibliography available on our web page in the near future. To do this we need your help. So, please send an electronic version of your bibliography to Catherine Pickering and she will start to compile the master document.

Even for a zoologist the plant about 20m off the Kosciuszko summit road west of the Snowy River looked unlike the usual alpine plant life form. The plant was Pencil Pine (Cupressus sempervirens stricta) a new weed for the alpine? Spread by cockatoos perhaps? However, on closer inspection the disturbed sod around the plant showed it to be planted, a fact confirmed by the roots being confined within a flowerpot-shaped mass of potting mix. Just two weeks before Christmas was this a piece of decoration ready for a Christmas camp? Suggestions please. Needless to say the tree, and all the potting mix that could be retrieved were removed.

Mini Book Review

Ken Green
Mountain Meteorology: Fundamentals and Applications. By C.D. Whiteman (2000) Oxford University Press. Oxford. 355pp.

This book caught me a bit by surprise, I had expected a tighter mountain focus but a large part of the text was about synoptic weather systems and their passage across America. As such there is much about how the mountains affect the weather in the plains. As an introduction to meteorology it is a useful text and does include much mountain material that we don't really experience in Australia such as Føhn winds (Chinooks) and cold air avalanches. It is well written with good clear colour pictures illustrating various mountain phenomena. One bonus was that I found out that the classic 1950 book by Geiger 'The climate near the ground' went into a fifth edition in 1995 with two further authors R.H. Aron and P. Todhunter. (This book is a must for any serious student of things that grow or creep upon the ground in mountain areas.) One curious line in 'Mountain Meteorology' was that 'frostbite and hypothermia are potential problems even at temperatures above freezing if winds are strong because wind increases the rate of heat loss from exposed skin' yet on the following page 'water will not freeze when the wind chill equivalent temperature drops below 32ºF.' (It is an American book) Water freezes only when the actual air temperature drops to 32ºF or below.' Frost bite occurs when ice crystals form in the body (so the temperature must actually be below freezing). The type of damage inflicted, prognosis and treatment of frostbite and trenchfoot are quite different and this has been known since at least WW I. There has been a formal separation of frost bite and non-freezing cold injury since about the 1950s. The book costs about $90 Australian so a library copy might be a good option for most.

Mountain Map

Attached to the definitive work on mountain environments "Mountains of the World - A Global Priority" (1997) was a map "Mountains and Highlands of the World". It provided an area percentage of Earth's land surface by elevation interval. Because it was based on altitude rather than relative relief, in effect it showed high ground that may or may not be mountainous. It was pointed out that a world map based on topographical relief would be more helpful in planning global mountain initiatives Now a map has been published based on topographical relief and slope. For more details contact Mountain Agenda- Swiss Agency for Development and Co-operation (SDC) email: agenda@giub.unibe.ch or see http://www.wcmc.org.uk/habitats/mountains.

Abstract

Small mammal activity on the snow surface. (Published Victorian Naturalist December 2000)

K. Green

Small terrestrial mammals are forced to travel over the snow when the subnivean space is collapsed and the snow too dense for tunnelling. The period spent above the snow is one of high exposure to predators, and small mammals generally keep this time to a minimum. The length of small mammal trails above the snow in subalpine areas is significantly correlated with the mean distance between trees. Small mammal trails are longer in treeless areas (average 73.5 m) than woodland (17.8 m); longer where they cross man-made tracks than in adjacent woodland by a factor of one to three times the width of the track and longer in mid season than early season snow because of the changing availability of routes to the subnivean space.

AIAS Meeting Abstracts

Tourism in the summit area of Mt Kosciuszko: An assessment of tourist interaction and impact.

Peter Arkle

The summit of Mt Kosciuszko represents the most popular tourist destination within the Kosciuszko Alpine Area and is considered to be of international significance. The numbers and patterns of tourists accessing the summit area and the resultant impacts, represent a major threat to the unique natural values of the area. In order to quantify tourism within the summit area, and document the ecological impacts of this use, a detailed program of tourist and impact monitoring was implemented between December 1999 and April 2000. To assess the ecological impacts, measurements of soil and vegetation parameters were undertaken in five different surface condition classes that were established within the study area. The variation in biophysical parameters was assessed both between the surface condition classes (spatial scale), as well as over the study period (temporal scale). The change in biophysical parameters was related to the observed tourist pressure on individual surface condition plots, thus providing an insight into the role of tourism in driving ecosystem change within the summit area.

Tourist monitoring revealed a significant variation in the numbers of tourists accessing the summit according to tourist demand, weather and visibility conditions. These influences also affected tourist movement and congregation patterns, with processes such as tourist displacement observed under peak conditions, and dispersal for protection observed on days of poor weather. The patterns of use documented suggested that the greatest threat to the natural values of the summit area is the distribution of tourist arrivals over a single day, and the resultant tourist dispersal on to vegetated areas. On all observational days, tourist arrivals peaked between 12:00-1:30pm, with 47% of daily tourist arrivals observed during this period. To assess the sustainability of current tourism, a carrying capacity for the summit was developed. The carrying capacity was determined as 174 tourists at a single time under favourable conditions, but under unfavourable weather conditions this value was significantly reduced to 80-90 tourists, due to the influence of wind on tourist congregation (80-90 tourists). The tourist monitoring also suggested that the capacity of the site was exceeded during the middle of the majority of moderate-peak days, and on many unfavourable days.

The surface condition assessment revealed changes in soil and vegetation parameters over the study period. In general, measures of vegetation characteristics such as total cover and total species, and

measures of community structure such as bare ground (%), displayed significant responses, with a degree of correlation between tourist pressure and change within different surface condition classes. Indicator species were shown to be useful in assessing condition and degradation within individual areas, with a range of native and introduced species identified as suitable target species. However, soil based measurements only differed significantly between surface condition classes and displayed minimal change over the timeframes observed. They also displayed limited correlation with observed tourist pressure. The results of the surface condition assessment have allowed the development of a framework of biophysical indicators, allowing the implementation of an impact management program within the summit area. This information enables an informed and proactive approach to tourist and impact management, ensuring more sustainable tourism within the summit area of Mt Kosciuszko.

Developmental plasticity of Crinia signifera populations in the Snowy Mountains

Paul Doughty

Tadpoles occur in many different aquatic situations - from lakes and rivers that never dry, to small temporary pools that last for only short periods. At high elevations in the alpine region, the common eastern toadlet (*Crinia signifera*) breeds in ponds that are formed by melting snow in spring and early summer. Early in the breeding season, snow cover is a physical barrier that prevents choruses from forming. When the snow melts exposing open water, adult frogs breed synchronously within the ponds. Tadpoles can occur at high densities and develop rapidly. Field studies currently underway are monitoring growth and developmental rates in a number of pools near Blue Lake (1900 m elevation), as well as abiotic variables such as pond depth and temperature. Laboratory experiments this year will focus on determining if tadpoles in this population have the capability to accelerate metamorphosis when ponds dry. Further studies will target anti-predator adaptations and involve comparisons with lower elevation populations in the Snowy Mountains.

VAM, ZN and P affects and interactions in Alpine Ecosystems

Markwell Drury

The effects of soil zinc and phosphorous on interactions between alpine plants and soil fungi have been investigated using a combination of a field survey and four separate glasshouse experiments. The field survey was carried out near Mt. Carruthers in the alpine area of Kosciuszko National Park in an area that was previously affected by zinc toxicity due to the use of galvanised wire in past revegetation efforts.

Major Findings.

The results of the field and glasshouse experiments found that:

- Except for zinc, nutrient levels were lower on the zinc affected areas that surrounding unaffected areas.
- High soil zinc concentrations in the field correlated with low AMF colonisation.
- High available zinc concentrations in the field soil correlated with low AMF inoculum potential.
- Additions of 50mg/kg of zinc to the soil reduced mean shoot biomass of *Poa fawcettiae* by over 50%.
- Phosphorous additions had a negative effect on AMF colonisation in *Poa fawcettiae*.
- Additions of zinc decreased shoot phosphorous concentrations in *Poa fawcettiae*.
- Shoot zinc concentrations in *Poa fawcettiae* were higher in AMF inoculated soils.
- Zinc additions increased the zinc concentrations in *Poa fawcettiae* shoots.
- The addition of phosphorous reduced zinc concentrations in *Poa fawcettiae* shoots.
- The addition of zinc affects the health and colour of mature *Poa fawcettiae* tillers.

Preferential fox predation on Mastacomys fuscus

Ken Green

Since the publication of a paper examining the diet of foxes *Vulpes vulpes* and the concurrent local food availability (Green and Osborne 1981) there has been intermittent criticism of one of the key suggestions of that paper: selective predation on the Broad-toothed Rat, *Mastacomys fuscus*, relative to predation on the more common Bush Rat *Rattus fuscipes*. The present study set out to examine three areas of the argument. Is the trend of a greater rate of predation on *M. fuscus* than *R. fuscipes* more general than in the study by Green and Osborne (1981)? Is *M. fuscus* trap shy? Within the foraging area of foxes is the occurrence of *M. fuscus* in the diet significantly higher than its occurrence in the habitat? In a study of fox diet over three years at both alpine and subalpine altitudes *M. fuscus* outnumbered *R. fuscipes* in faecal remains in all seasons in all years and at both altitudes. Data from studies of *M. fuscus* and *R. fuscipes* at Smiggin Holes show that the pattern of captures of individuals caught once, twice, etc was not significantly different. Additionally, using mark-recapture data over the same period, estimates of the population of each was made and the proportion of the estimated population of each species captured during trapping sessions was found not to differ significantly. It appears therefore that *M. fuscus* is not trap shy. To determine the habitat parameters of the foraging area of foxes a line was drawn equal to the length of a home range along both sides of the subalpine transect from which fox scats were collected. Aerial photographs were used to delineate woodland and non-wooded habitats. Three sites per square kilometre were located by random sampling and were ground-truthed. The results showed that the area of suitable habitat for *M. fuscus* constituted about 50% of the foraging area. To determine whether foxes were targeting that area, 19 paired transects were skied in winter 2000 and all fox trails encountered were counted. There was no significant difference between the numbers of fox trails encountered in woodland or non-wooded areas indicating no preferential foraging in either habitat. Preferential feeding on the rarer rodent is therefore established but how that choice is exercised is still not determined.

Green K. and Osborne W.S. 1981. The diet of foxes, *Vulpes vulpes* (L.) in relation to abundance of prey above the winter snowline in New South Wales. Australian Wildlife Research. 8, 349-60.

Changing activities in and around Australia's alpine areas.

Andrew Growcock

(See Johnston and Growcock for Andrew's presentation at the meeting.)

This Ph.D. project, which is still being planned out, aims to determine what the ecological footprints of various activities are with consideration to how this can help management decisions. Other key concepts revolve around identifying and reviewing the effects of emergent activities and social responses to the environment in relation to specific activities.

Alien Plants in the Australian Alps

Frances Johnston

The current status of alien plants in the alpine and subalpine regions of mainland Australia is examined. The number of species introduced to the region as a result of human activity has increased following the region's discovery and use by Europeans. One hundred and seventy five alien plant species have been recorded above 1500m in the Australian Alps National Parks. These species are mainly perennials from Europe, Asia and the Americas. They are predominantly associated with disturbance and have either been intentionally or accidentally introduced to the region. The weeds present can be categorised according to the type/s of human disturbance with which they are associated into 'roadside or path weeds' species), 'resort weeds', 'grazing weeds', 'naturalised weeds' and 'rehabilitation weeds'. Examples of some of these weeds are discussed The alien species, their characteristics and the threat to conservation of biodiversity are discussed.

The effects of moth herbivores on the diversity and abundance of tall alpine herbfield species in Kosciuszko National Park.

Andrew Kirkwood

The larvae of two species of native moth (*Lomera caespitosae* and *Oncopera alpina*) graze on the dominant snowgrasses (*Poa spp.*) of tall alpine herbfields in Kosciuszko National Park. The damage is usually severe but localised, resulting in discrete patches of dead grass in a matrix of tall alpine herbfield. In this study, the effects of this disturbance on the diversity and abundance of plants in the tall alpine herbfield community are being examined. Areas recently grazed by moth larvae are being compared to adjacent ungrazed areas for two seasons. Plant species abundance and diversity, soil nutrient levels and soil temperature are being compared in grazed and ungrazed areas, and in areas where the dead grass 'mulch' was removed. The affected areas of the upper Snowy River valley have been mapped, and the relationship between affected areas and topography are being investigated.

Visitor monitoring in the alpine area of Kosciuszko National Park

Stuart Johnston and Andrew Growcock

Counting and surveys of visitors to the alpine area of Kosciuszko National Park were completed over the 1998/1999 and 1999/2000 summer periods with consideration to peak, intermediate and low demand days through each of these summers. As a result of the data collected, it has been estimated that 64 000 visitors have participated in activities in the alpine area. This figure is more than triple what was recorded 22 years ago. Of visitors to the area, approximately 67% were entering the alpine area via the Crackenback chairlift, 31% entering the area through Charlottes Pass and (2%) entering from other areas (i.e. Guthega).

Of those departing on alpine walks from the Crackenback chairlift, 11% were taking the Dead Horse Gap walk, 10.3% walked to the Kosciuszko lookout, 34% returned to the chairlift before reaching the lookout and 44.7% continued on towards the Kosciuszko summit from the lookout. From Charlottes Pass, 43% took the Snow Gums walk, 26.5% departed on the Summit walk, 22.9% departed on the Main Range walk with the remaining 7% taking other walks.

A wide range of activities were observed occurring in the area, however day walking was the greatest of the activities with this representing an average of 81.1% of visitors. Other activities in the area included sight seeing (10.2%), cycling (2.7%) and camping (2.0%) with the remaining 3.9% representing other activities such as running, late season snowpatch skiing, photography, painting, abseiling and fishing.

The data collected from this study should be available as a joint NSW NPWS and CRC for Sustainable Tourism report as of February 2001.

Soil characteristics and processes critical to the sustainability of alpine grasslands.

Stuart Johnston

The focus of this paper is in developing a framework for determining the soil and land properties and processes that are critical to managing alpine grasslands in an ecologically sustainable way. Essential to developing this framework, is the building of concepts describing the stability, resilience and sustainability of the ecosystem as a whole as well as its management.

Natural Australian alpine ecosystems are a self-sustaining mosaic of vegetation types. A sustainable alpine ecosystem is one that, over the normal cycle of disturbance events, maintains its characteristic

diversity of major functional groups, productivity and rates of biochemical and geochemical cycling. These rates are determined by a set of four interactive controls (climate, the soil resource, the major functional groups of organisms, and disturbance regimes) that both govern and respond to alpine ecosystem processes and oscillate between stable bounds. However, these ecosystems cannot be sustained if the interactive controls move outside stable bounds.

Anthropogenic modification of the Australian alpine environment has occurred over the last 180 years, initially with the advent of European pastoralism and more recently with the increase pressure by tourism. This modification can best be described as the cessation or perturbation of the ecological processes that initiate and maintain these systems. The ecological consequences of disturbance to these systems are the threat to ecosystem functioning through the loss of soil and biodiversity. Therefore, sustainable management of Australian alpine herbfields should aim to establish the levels of disturbance, which do not threaten the processes, which establish and maintain landscape heterogeneity (i.e. disturbance thresholds). Secondly, where the landscapes have already become badly degraded through disturbance, if the climax state cannot be restored, management must aim to restore landscape equilibrium.

Fire, Fodder, Feet and Faeces

J.B. Kirkpatrick, K. Bridle, P. Mcquillan and A. Wild

This paper provides an overview of the ecological research in alpine areas being undertaken within the School of Geography and Environmental Studies at the University of Tasmania. There are three main research areas: vegetation dynamics, particularly in relation to fire and stock grazing; landscape ecology of Australian alpine ecosystems; mitigation of human impacts, particularly trampling and human waste disposal.

The vegetation dynamics work has involved resampling of plots established 25 to 11 years ago in a variety of vegetation types on a variety of mountains in Tasmania. Many of these plots were established in areas that had been burned 17-40 y before initial recording. Others were in areas that had been burned and also grazed by stock. Twenty-five to five year old exclosures provided data on the impacts of various mixtures of vertebrate grazers on the vegetation. We have found that the incremental rate of cover increase after fire, or exclusion of stock, approximates 1% per annum, while in the presence of stock grazing recovery can be slower on more sheltered sites, while loss of cover prevails on more exposed sites. Lifeform does not seem to be a good predictor of behaviour in the successional process, which is exceedingly slow, with areas burned more than 40 years ago still not evidencing any substantial recovery of the fire-susceptible gymnosperms and deciduous beech (*Nothofagus gunnii*).

The landscape ecological work has involved the assembling of a data set on soils, climate, geology, vascular plants, vegetation structure and invertebrate faunal assemblages for sites distributed through the full range of alpine vegetation in Australia. Soil characters were shown to have the strongest relationships with structural variation in vegetation, while climate most strongly influenced floristic variation. Geology, climate and topography most strongly influenced the nature of soils.

Our work in the trampling area involves determining the rate of recovery of alpine vegetation in different environments after removal of foot traffic decades to years ago, with the aim of developing guidelines for the selection of areas for rehabilitation. We have experimental plots in place that are designed to determine the single and interactive impacts of digging for human waste disposal and urination on vegetation and the rate of breakdown of toilet paper and tampons in the soil. We will be determining the extent of human faecal contamination around camp sites and huts in a project commencing in 2001. The aim of the faecal/urinal work is to develop guidelines for ecologically responsible human waste disposal in the wild.

The demography of small Southern Corroboree Frog Populations

Dave Hunter (Not available when the newsletter went to press)

Changes in Maisie Carr's Bogong High Plains bog between 1979 and 1999 (a paper in prep.)

Keith McDougall

A small catchment on the Bogong High Plains near Falls Creek was fenced by Maisie Carr (then Maisie Fawcett) and John Turner (University of Melbourne) in 1946 to exclude cattle. The purpose of the exclosure was to monitor the effects of cattle and the 1939 fire. A similar, unfenced catchment adjoining the exclosure acted as control. Although measurements were made in a range of vegetation types over the next 10 years by Carr and Turner (and have been continued since then by Warwick Papst), no measurements were made in the bog communities. Maisie regarded the bog vegetation as too complex (and probably too fragile) to measure repeatedly. Her observations of the two bogs in 1977 indicate though, that substantial change occurred, particularly after the mid 1960s. Before that "most of the (*fenced*) mossbed was firm underfoot and there were numerous patches of bare peat. The surface had a dense cover of Big Horny Grass (*Poa costiniana*). On the downhill side of each hillock was a steep concave eroded face with, in front of it, a flat apron of bare peaty soil … There is no doubt that the (*fenced*) mossbed has increased in size… One lunch place which we used in the early days of our work (and incidentally were tormented by small black ants) is now so wet that neither we nor the ants would find it comfortable. The comparable mossbed to the east of the plot has shown little, if any, change" (Carr 1977).

Cattle grazing is still permitted around Maisie's bog exclosure between December and April. Although cattle rarely enter the unfenced bog, they do so regularly at some locations to obtain water and have been observed grazing and trampling in the bog, especially in autumn, when the water level in some *Carex* dominated pools is low.

A monitoring program was finally set up in 1979 by the Soil Conservation Authority of Victoria and the University of Melbourne. A grid of 39, 20 x 20 m quadrats was established using a theodolite in the fenced bog. Twenty nine quadrats were established in the unfenced bog. Corners were marked with red gum pegs; some of which were later replaced by star pickets. The unit of measurement was a 4 x 4 m sub-quadrat, there being 25 of these in each 20 x 20 quadrat (and in total, 725 sub-quadrats in the unfenced bog and 960 in the fenced bog). The following measurements were made in each sub-quadrat: *Sphagnum* cover and the position of pools and drainage features were plotted onto scaled graph paper; all species with a cover of > 5% were recorded using the Braun-Blanquet cover scale. Composite maps of the bogs were produced (McDougall 1989). A portion of the bog was resurveyed in January 1999. At that time an additional technique for assessing the cover of *Sphagnum* was trialled.

In 1979, there were notable differences in the structure of the two bogs. *Sphagnum* cover in the fenced bog was ± continuous and drainage was diffuse (with drainage lines difficult to detect in places). In the unfenced bog, water drained freely along a well-defined, entrenched channel and *Sphagnum* cover was disjointed. In areas where *Sphagnum* occurred, *Baeckea gunniana* and *Richea continentis* were more abundant in the unfenced bog than in the fenced bog.

The changes between 1979 and 1999 were not great. *Sphagnum* cover has increased in both bogs, both as a result of in-filling of gaps in the body of the bog and outward expansion. There were also areas of both bogs where *Sphagnum* cover decreased. In the fenced bog, these were at the edges of the bog and appear to be due to changes in water movement. In the unfenced bog, many of the decreases were within the main body of *Sphagnum*. The cause of such decline is unknown. There appears to have been a decrease in the cover of pools and other open water in the fenced bog since 1979. Although the area of pools and open water fluctuates during the snow-free season and between years because of variation in catchment flow, it is curious that a similar decrease in water area did not occur in the unfenced bog, in which there were more increases in the cover of pools than decreases. Between 1979 and 1999 there was little change in associated species. However, *Baeckea gunniana*

was less abundant in the grazed bog (consistent with the large number of senescing plants observed in 1979) and more abundant in the ungrazed bog (mostly, apparently young plants).

At a small scale, there have been substantial changes in the cover of *Sphagnum* and pools in both bogs over the past 20 years. Bogs, as the literature suggests, are dynamic communities. Overall, however, the changes in the two bogs are similar. Both bogs are expanding. Both bogs may be displaying continued recovery from past disturbances, such as the fire of 1939 and the extreme grazing pressure in the early 1900s. Fencing one bog in 1946 may have simply hastened recovery. It is a pity that measurements of the vegetation in the two bogs were not possible at that time. An alternative approach to determining the current impact of cattle grazing and trampling on bogs may be to remove the fence from the lower half of the exclosure. It would be nice to know what Maisie thought of such an idea.

References

Carr, S. G. M. (1977) Report on inspection of the Bogong High Plains 1977. Unpublished report to Land Conservation Council, Victoria.

McDougall, K. L. (1989) The effect of excluding cattle from a mossbed on the Bogong High Plains, Victoria. *Arthur Rylah Institute for Environmental Research. Technical Report Series No. 95.* Department of Conservation, Forests and Lands, East Melbourne.

Environmental Education, Interpretation and Visitor Information in the Alpine Region of Kosciuszko National Park

Kirsty McMaster

The primary management objective of any National Park is to preserve and protect the natural and cultural features of the park. While conservation is the foremost priority of National Park agencies, they also have to encourage and regulate the recreational use of the Park. These two activities often seem incompatible, as tourism and recreational activities frequently have negative impacts on the natural and cultural values of protected areas. Tools such as environmental education, interpretation and visitor information can be utilised by National Park agencies to directly address the causes of the damage inflicted by tourism and recreation. Interpretation, information and education can aid National Park managers in their dual responsibilities of managing Parks for conservation and recreation, while also providing more enjoyable recreational and educational experiences for Park visitors.

The effective utilisation of environmental education, interpretation and visitor information is particularly critical in the alpine region (above 1850m) of Kosciuszko National Park. This is due to several factors:

1. The pressure of summer tourism and recreation in the alpine area is growing – as many as 4500 people have been known to visit the alpine area on a peak summer day. An effective interpretation strategy can be used to manage the large numbers of visitors entering the area, to ensure that they have an educational and enjoyable experience, while also encouraging them to reduce their impact on the area.

2. The alpine environment is a fragile environment, thus visitors to the region need to be informed of the actions that they can take and the behaviour that they should practise in order to lessen their impact on the area.

3. The educational value of the alpine area is high, as it is one of the few places in Australia that visitors can experience the alpine environment, with its unique flora and fauna.

4. It is also critically important that visitors to the alpine region are aware of the appropriate clothing and equipment that they will require whilst undertaking activities in the alpine region. It is essential

that safety information be disseminated to alpine visitors, as entering the area ill prepared can result in sickness, injury or death.

The predominant source of information and interpretation in the alpine area is the signage that accompanies the main alpine walks. Visitors can also access information at the Snowy Region Visitor Centre in Jindabyne, through the displays, personal contact with the Visitor Centre staff, touch screens, books, brochures and maps. For school groups and families another important source of interpretation and educational material is the Education Centre at Sawpit Creek.

Over the summer 1999/2000 and Easter 2000 visitor interviews and observations were carried out in the alpine area to determine if the interpretation/information strategy in the alpine region is working effectively and if visitors are receiving the information that they want and need. Over 540 interviews were conducted over this time.

The results indicate that:

- Alpine visitors rely on their prior knowledge, advice from family and friends, books, brochures and maps when planning a trip to the alpine region.
- That less than twenty five percent of people visiting the alpine region use the Snowy Region Visitor Centre.
- A majority of visitors (especially those that are returning to the region) rely on their previous experiences and prior knowledge of the area.
- Approximately ninety percent of the people interviewed stated that they had read the signs along their walk, however, observations indicated that only 50% of visitors utilised the signage.
- The success of signs is partially related to their placement and their ability or lack in ability to hold people's attention.

Safety Information

The level of preparedness (for the changeable alpine weather conditions) of visitors undertaking activities in the alpine area of Kosciuszko National Park is a further indication of the effectiveness of the current interpretation and information strategy in the Park.

The results indicate that:

- Over thirty percent of visitors interviewed were ill prepared.
- Many of those that were ill prepared considered themselves adequately prepared, suggesting that a significant proportion of visitors are not receiving safety information and education before they enter the alpine area.

Summary

Preliminary results from visitor surveys carried out in the alpine are of Kosciuszko National Park in the summer of 1999/2000 and Easter 2000 suggest that the education, interpretation and information regime in this region is in need of some improvements. This research will be beneficial in helping produce an effective education, interpretation and information strategy in the alpine area of Kosciuszko National Park in order to promote enjoyable and educational visitor experiences and to promote sustainable tourism in the Park.

Issues in mountain tourism: the Mt Kenya experience

Catherine Pickering

Mountain tourism is increasingly popular among adventure travellers in Africa. For the second highest peak in Africa, Mt Kenya (5,199 m), tourism is concentrated around three well-defined routes, a series of huts and the main peaks. Impacts in these areas include tramping damage along tracks, untreated human waste, litter and increased risk of fire. Away from these areas, the park remains relatively pristine and rarely used.

Long sections of the tracks are highly eroded with complete loss of vegetation in the main path, soil compaction or loss, exposure of bed rock in some areas, formation of trenches, and ribboning of the track in the subalpine and alpine zones. In the nival zone erosion appears less severe with paths often traversing harder natural surface such as scree and boulder fields.

The untreated human waste on Mt Kenya has important environmental and health impacts. Although there are pit toilets at most huts and associated camping sites, there is still considerable deposition of faecal material and urine outside the toilets. Along the tracks prominent rocks and other screens become informal toilet areas. The cold conditions result in very little breakdown of the material, and resulting in contamination of many of the water bodies, with faecal material running into tarns and creeks during the intense storms of the rain seasons. It is therefore recommended within the park that all drinking water be sterilised.

Rubbish is an issue, with plastic drink bottles and other litter seen along paths and around the huts. The dumping of rubbish is prohibited within the park and clean up days are organised by some guiding associations.

The increased risk of fires from tourism has resulted in a complete ban on open fires, with fuel stoves used for cooking and heating. However, tourism still results in an increased fire risk with fires staring from cigarette butts, and either deliberate or accidental illegal fires in and around huts.

The Kenyan Wildlife Service has introduced a series of regulations to limit impacts, with parks staff regular patrolling the areas and manned gates at the start of the main routes.

Foraging and Breeding Ecology of the Australian Pipit

Chris Norment

Objectives of this study are to determine the basic foraging and breeding ecology of Australian Pipits in alpine habitat of the Snowy Mountains. In 2000, flocks of pipits arrived in the high country in late September, coinciding with appearance of the first snow-free ground. Pairing and territory establishment occurred in late October – early November, while clutch initiation dates ranged from early November to early December. Pipits are the only abundant breeding bird in the alpine between elevations of 2100 and 1820 m, with a density of approximately 1 pair/ha in my study area. Most pipit nests are placed beneath low shrubs, with a nest orientation directed away from prevailing winds. Mean clutch size for Australian Pipits (2.8) at my site is much lower than for American Pipits breeding in alpine habitats at an equivalent latitude in the Northern Hemisphere (4.7). Although nest survival data are only preliminary, it appears that the main nest predator may be ants (*Iridomyrmex*). Pipits apparently use habitats for foraging roughly in proportion to their availability, and show no strong preference for snow. However, snow has much higher numbers of arthropods early in the breeding season than herbfield or heath habitats and may be an important foraging site at this time. Results described here should be considered preliminary, as the study is ongoing.

Landscape ecology and population genetic structure of the Northern Corroboree Frog (Pseudophryne pengilleyi) PhD proposal

Rod Pietsch

The Northern Corroboree Frog is a threatened species which has suffered significant population declines in recent years. The species has a restricted distribution in the Brindabella and Bimberi Range in NSW and the ACT and in the Fiery Range and Bogong Mountains in NSW. Suitable breeding habitats for the Northern Corroboree Frog are discontinuously distributed throughout the species' range. These breeding habitats form patches in the surrounding landscape matrix. Therefore, Northern Corroboree Frogs are likely to be spatially subdivided into a number of local populations focused around suitable breeding habitat patches. The context and connectivity of breeding habitat patches are likely to influence the abundance of calling adult males at breeding sites and the degree of movement or interchange between patches. In addition, chytrid fungus has been detected in Corroboree Frogs, however the role that chytrid plays in declines and local extinctions is unknown and may also be influenced by landscape scale factors. The aims of the project are to: (i) undertake a comprehensive survey of the current distribution and abundance of the species; (ii) determine habitat associations and patterns of population decline; (iii) to undertake genetic studies to measure the extent of genetic differentiation between populations, identify patterns of gene flow between populations, determine metapopulation structure, assess population viability and identify significant population units for conservation; and, (iv) examine the relationship between the incidence of chytrid and local population persistence and the pattern of incidence (or distribution of chytrid) in relation to landscape factors and metapopulation processes. Knowledge of these factors will help determine the cause/s of decline and to develop appropriate management actions for the recovery of the species.

Population Ecology of Feral Horses in the Australian Alps

Michelle Walter

Feral horses have occupied what are now the Australian Alps national parks for about 150 years. There is a spectrum of opinions in the community about how they should be managed. Research into the biology of a species not only improves management but also helps abate conflict between interest groups. The study has several components. (1) Mapping current distribution, and comparing it with the historic distribution. (2) Estimating abundance and density using aerial survey, a repeatable technique allowing long-term monitoring of population trends. (3) Assessing feral horse use of the alpine zone. Feral horses re-colonised the alpine area near Mount Kosciuszko about six years ago. An area of ~20km2 was surveyed every three weeks for a year. I found that they migrate up to the alpine area after the spring snowmelt, and graze predominantly in valley floors. Between 0 and 22 horses were observed using the area on any one day. The number of horses observed was positively correlated with maximum daily temperature. (4) Demographic parameters are being measured at three sites every spring and autumn for three years during ground surveys. This information will be used to determine survival rates, rate of increase, fecundity and other key population statistics. These will be compared with wild horse populations in other parts of the world. The maximum rate of increase for wild horses is estimated at 20 percent per year, however much lower rates have been observed at some locations. Preliminary analysis of results suggests a foaling rate of 0.31 foals/adult female in the Australian Alps. Similar rates have been observed in populations in central Australia and New Zealand, but higher rates are evident from five states of the USA. Finally, models will be fitted to the data to assess trends in the population under a variety of future management scenarios. (5) Assess factors limiting population growth. The relationship between feral horses and their food supply will be established as a functional response to predict biomass levels that limit population growth. The effect of snow on survival will be assessed by comparing over-winter survival rates between years.

Small mammals, snow and fragmented habitats

Glenn Sanecki

The presence of snow for a significant part of the year is one of the defining characteristics of the Australian Alps, and has made it a popular destination for visitors throughout the year, particularly winter. It is seldom considered however, that the human modification of snowpack could serve to fragment the habitat of small mammals active in the subnivean space. This study will investigate the effects of human modified snowpack on small mammals. Before we can achieve this however, we need to better understand how small mammals respond to natural snowpack in Australia. Most of our understanding has been derived from overseas research, and the few studies undertaken in Australia have used indirect measures or have been constrained by resource or logistical factors. This study is building upon the work undertaken by previous workers, and is commencing by modelling the factors that affect the occurrence of small mammal species in alpine and subalpine areas, and then extending these models into the winter to include the important variables related to the presence of snow. The study is being undertaken at two resolutions: At a landscape level, we are investigating the distribution of small mammals during the snow-free months, in the presence of snow and then in response to modified snow conditions. This general pattern of investigation will also be undertaken at a finer resolution with the ultimate goal of understanding how individual animals might be affected when snowpack is modified within their home range. It is expected that this research will contribute to our knowledge of small mammals in the Australian alps and facilitate future management decisions.

Evaluation of long-term vegetation transects in the alpine zone of Kosciuszko National Park.

Pascal Scherrer

Vegetation changes over a period of 40 years were assessed at two locations in the alpine zone of Kosciuszko National Park, New South Wales, Australia. The data from long-term transects established by Dane Wimbush and Alec Costin were analysed in relation to climatic variations and human disturbance. The transects were established at two sites considered representative of the type of vegetation assessed. The Summit transects had experienced less disturbance with a longer recovery time from grazing, while the Gungartan sites were more disturbed. Cover of bare areas, litter, specific species and functional groups were assessed. After an initially strong decrease in bare areas at the Gungartan sites and an increase in species abundance, the rate of change gradually declined. The Summit sites displayed little variation. Percentage cover of bare areas at the Gungartan sites was significantly higher even after forty years without grazing. Percentage overlapping cover for most palatable species increased and decreased for some of the opportunistic species, possibly due to increasing competition. Drought had strong effects on the vegetation at both locations.

Your comments on the content or contributions for future issues are welcome. Please contact Dr Ken Green, PO Box 2228 Jindabyne NSW 2627, tel: 02 64505538, fax: 02 64562240, email: ken.green @npws.nsw.gov.au.

Editor Ken Green Layout Jo Hooper

Global Mountain Biodiversity Assessment Conference

The first Global Mountain Biodiversity Assessment (GMBA) conference was held at Rigi-Kaltbad, Switzerland from 7-10 September 2000. There were two attendees from Australia, Jamie Kirkpatrick and Ken Green. A steering committee for the GMBA was established and Ken Green was 'elected' as continental representative for Australia/New Zealand. A number of GMBA workshops on specific topics for around 30 people were flagged, the next being on alpine grassland in 2001.

Some of the outcomes of the conference were:

• The compression of climate zones causes mountain biota to be hotspots of biological richness. At very high elevation biodiversity diminishes gradually and so does land area, causing very high biodiversity / land area ratios often exceeding those of lower elevations.

• There are strong indications that diversity within one group of organisms (e.g. plants) is linked with diversity in another group of organisms (e.g. butterflies). Since we have neither the resources nor the time for a complete biological inventory of all mountain biota across the globe, keystone organisms groups and taxonomic ratios (between groups) are promising tools in biodiversity assessments. At the same time our biodiversity data bases needs to be improved rapidly, an area of prime engagement of GMBA.

• Mountain biota are rich in endemic species found only at one location worldwide. There are characteristic patterns of distribution of endemism reflecting geological history, etc.

• Why should we care for mountain biodiversity?

1. Ethical argument (conservation *per se*)
2. Aesthetical value (beauty)
3. Economical value (fodder, food)
4. Cultural heritage
5. Ecological value (e.g. ecosystem integrity)

• Ecosystem integrity on steep mountain slopes and high elevation landscapes in general is a question of soil stability, which in turn depends on plant cover and rooting patterns. The more morpho-types of plants co-occur the less likely will extreme events lead to vegetation failure and soil erosion (insurance hypothesis). Although intuitively plausible this is a field poorly supported by data, a prime topic in the GMBA agenda.

• Human land use has shaped mountain biota worldwide and will continue to do so. The ways mountain biota are managed and should be managed for sustainable use need to be understood.

• Inventories of organismic taxa do not require the visitation of every square km of mountain landscape. 90% of the taxa and measures of overall biotic richness can be retrieved in sample areas of 10-20km2 within a given biogeographic zone.

• Life form and functional diversity have a value by their own and provide a most useful way of ecological interpretation of taxonomic diversity.

• Remote sensing (satellite data) offers new avenues of documenting community diversity over large areas.

• Certain trends for species richness emerged

1. Mountains that bridge between phytogeographic zones are richer than isolated ones.
2. Biodiversity is greater on calcareous rock.
3. Moderate (vs. short or long) snow cover enhances diversity.
4. Species area curves are extremely variable.

• Keystone species and the evenness of species contribution are key elements of a functional interpretation of diversity data (abundance, facilitation, and competitive exclusion).

• Environmental changes often affect evenness much more than absolute presence-absence of taxa.

• Intraspecific diversity drives evolution and secures long-term presence of taxa. Genetic diversity strongly depends on the breeding system and life strategy of organisms. An open question is the degree to which variance reflects functionally significant traits.

• Old databases have enormous value for detecting long-term trends, but need to be used with great care.

• Global warming will reduce available land area for cold adapted organisms (trap phenomenon) unless horizontal allocation (exposure) is feasible; many are likely to become extinct.

• In some areas of the globe the change of social climate is likely to affect mountain biota more and faster than will the physical climate. Mountain economies must create added value beyond raw materials, if they are to survive.

• When poverty drives human life, sustainable use rather than 'set aside' scenarios are realistic. Adequate traditional land use may even increase biodiversity. The presence of people may improve ecosystem values. We cannot separate people and nature anymore.

• Biodiversity matters for mountain agrosystems: high altitude agro-ecosystems become more reliable with spatially diverse rotational cycles.

United States National Mountain Conference 2000

Abstracts from the National Mountain Conference 2000: Stewardship and Human Powered Recreation for the New Century held in Golden, Colorado from 14-16, September 2000. Are available at: http://www.mtnforum.org/resources/library/nmcon00a.htm

Areas covered in sessions were:

Concurrent Sessions #1: Development Pressure on Mountain Environments.

A. Ski Area and Four Season Development, Reduce, Reuse, Restore - Responsible Development. Ski Area Development in the West. Water Withdrawals.

B. Suburbanization of Mountain Regions. Balancing Nature and Commerce in Gateway Communities. Grand Canyon General Management Plan. Development In and Around Greater Yellowstone Ecosystem.

C. Human Infrastructure. Controlling the Aesthetic Impacts of Telecommunication Towers. Impacts of Backcountry Roads and Protecting Roadless Areas. Human Infrastructure on Public Lands.

Concurrent Sessions #2: Human Threats to Mountain Ecosystems

A. Air, Water, and Noise Pollution. Mountain Air Quality and Visibility Trends. Water Quality. Aircraft Overflights and Noise Pollution.

B. Challenges from Mining, Logging, and Grazing. The Challenges from Logging. The Threat of Past, Present, and Proposed Mines. Livestock Grazing on Public Lands.

C. Montane Ecosystems and Species Protection. Habitat Fragmentation and Unique Species. Introduction of Alien Species and the Effects on Native Biota. Large Scale Wildland Network Design in the Southern Rockies.

Plenary Session #1: Banff National Park: A Mountain Ecosystem Under Stress.

Plenary Session #2: A Campaign for the World's Mountains.

Plenary Session #3: Comparing Regional Recreation Demands, Impacts, and Stewardship Activities.

Concurrent Sessions #3: Human Powered Recreation

A. Identifying and Solving Problems Between User Groups. Trail Conflicts - Bikers, Hikers, Horses. Climbing Management Plan Process - Joshua Tree National Park. Motorized Recreation in the Southern Rockies.

B. Human Powered User Impacts. Hikers and Trail Network Impacts. Human Waste and Trash Disposal on Mt. McKinley. Impacts On Historical and Spiritual Treasures.

C. Challenges of Evolving Technology, New User Groups, and Legislation. Cellular Phones and GPS in the Backcountry. Emerging Regulations Affecting Access for Persons with Disabilities. New Recreation Technologies: Impacts on National Parks.

Concurrent Sessions #4: Mountain Recreation Stewardship

A. Trails and Backcountry Facilities. Protecting Trailhead Access. "The Unfinished Trail" - Protecting the Pacific Crest. Trail Huts and Shelters as Management Tools.

B. Allocating Use and Managing an Increasing Number of Users. Leave No Trace: A Unified Minimum Impact Recreation Message. Wilderness Management in the Adirondacks. Challenges of Managing Winter Recreationists. Carrying Capacity for Outdoor Recreation: Theory and Practice.

C. The Role of Mountain Clubs and Governmental Agencies to Meet the Challenges of the Future. Land Conservation Efforts. Research Needs. Legislative Action and Advocacy. Education. The Federal Interagency Team on Volunteerism.

Plenary Session #4: Rewilding - The Importance of Ecological Integrity in Mountain Ecosystems

Himalayan Ice reveals Climate Warming, Catastrophic drought

National Science Foundation Press Release September 14, 2000

Program Contact: Herman Zimmerman, NSF (703) 292-8550/hzimmerm@nsf.gov

Ice cores drilled through a glacier more than four miles up in the Himalayan Mountains have yielded a highly detailed record of the last 1,000 years of earth's climate in the high Tibetan Plateau. Based on an analysis of the ice, both the last decade and the last 50 years were the warmest in 1,000 years.

The findings, published in September in the journal Science, outlined data recovered from three cores drilled through the Dasuopu Glacier, a two- kilometre-wide ice field that straddles a flat area on the flank of Xixabangma, an 8,014-metre peak on the southern rim of the Tibetan Plateau. The international team, including American, Chinese, Peruvian, Russian and Nepalese members, retrieved the cores during a 10-week, 1997 expedition to the region

"This is the highest climate record ever retrieved," explained Lonnie Thompson, professor of geological sciences at Ohio State University and leader of the expedition, "and it clearly shows a serious warming during the late 20th Century, one that was caused, at least in part, by human activity. This is a very compelling story." For the last 25 years, he and his colleagues have drilled cores from glaciers and ice caps in some of the most remote parts of the planet in an effort to recover records of ancient climate. Most current predictions of global climate change suggest that early signs of warming will be seen at high elevations where these ice caps exist. So far, Thompson's work has borne this out. "This work is a great achievement accomplished under extremely adverse and hazardous conditions," says Herman Zimmerman, director of NSF's earth sciences division. "These investigations of the earth's past climate leave little doubt that the earth is warming and that all characteristics of our climate can change rapidly. This is something that needs to be taken quite seriously by all the peoples of the world."

Researchers at Ohio State's Byrd Polar Research Center and the Chinese Lanzhou Institute of Glaciology and Geocryology divided the three cores and were able to identify annual layers for the last 557 years. Samples from these layers were analyzed for dust concentrations, chemical composition and oxygen- and hydrogen- isotope ratios. The isotope ratios let researchers extrapolate the air Temperatures present when the ice was formed. Dust concentrations give an indication of dryness or wetness in the region, and the analysis of chlorides, sulfates and nitrates provide clues about volcanic activity, fossil fuel burning and desertification.

"We now have a record from 23,500 feet in the atmosphere (about as high as instruments are carried in a weather balloon), one that has been preserved naturally, that shows the last 50 years were warmer than any other equivalent period in the last 1,000 years," Thompson said. The data seem to point to the impact human activities have had on changing climate in the region. Core samples covering the last century reveal a four-fold increase in dust trapped in the ice and a doubling of chloride concentrations, suggesting an increase in both drying and desertification in the region. "There is no question in my mind," he said, "that the warming is in part, if not totally, driven by human activity. I think the evidence for that is so clear - not only from this site but also from Kilimanjaro in Africa." Thompson led an expedition to the ice fields atop the highest mountain in Africa earlier this year. At least 75 percent of the ice there has disappeared since 1912, caused in part, he said, by global warming.

Application Form
Australian Institute of Alpine Studies

Dr Ken Green
PO Box 2228
Jindabyne NSW 2627
tel: 02 6450 5538
fax: 02 6456 2240
email: ken.green@npws.nsw.gov.au

Name _____

Affiliation _____

Address _____

Telephone _____

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Email address _____

Please select the research fields which best describe your areas of interest:

☐ Cultural heritage	☐ Meteorology	☐ Soil science	☐ Snowy ecology
☐ Recreation & tourism	☐ Geology	☐ Glaciology	☐ Plant ecology
☐ Animal ecology	☐ Hydrology	☐ Global warming	☐ Enhanced UV impacts
☐ Long-term monitorin	☐ Management of alpine areas		
☐ Other _____			

Relevant publications (these will be included on a list for inclusion on the web site and newsletter and will be updated regularly). Write below or send as an email attachment to Dr Ken Green.

☐ Yes, I would like to become a member.

☐ Yes, please include my details in the Australian Institute of Alpine Studies Directory.

Current research or projects. Please provide a title and brief description of your research or project.

Australian Institute of Alpine Studies (AIAS) web site, http://www.aias.org.au/