

Economic values



Cultural values



Natural values



Recreational values



Social values



KOSCIUSZKO



INDEPENDENT  
SCIENTIFIC  
COMMITTEE

independent **scientific** committee



an assessment of the...

**values** of  
**Kosciuszko**  
**National Park**

**Availability**

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# Part One

## executive summary

The Independent Scientific Committee (ISC) presents this report as a contribution to the review of the Kosciuszko National Park Plan of Management and to guide ongoing management of the park. The ISC was formed to report on the park's values, their significance and condition, the way in which they should be monitored, the pressures on them and knowledge gaps.

This report states why the park is important. The values assessed were natural and cultural heritage, social, recreational, tourism and economic. The natural ecosystems and landscapes are fundamental to the park's values and, importantly, they provide the setting and the context for the cultural heritage values. The natural and cultural values are the core values on which the social, recreational, tourism and economic attributes depend.

This report includes chapters on the individual values and an integrated statement of its significance. It does not attempt to include all of the vast data on the park, much of which is contained in other documents.

Many of the values identified by the ISC are of international or national significance. The Park has been recognised at international level by listing as a United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve, and by the World Conservation Monitoring Centre as one of the 167 world centres of biodiversity. Blue Lake is a wetland of international importance under the Ramsar Convention.

The ISC found that very few large natural protected areas such as Kosciuszko National Park remain in temperate Australia, where the natural dynamics of ecological processes can still occur without significant human intervention. Kosciuszko National Park forms the central segment of the Australian bioregion that supports all the alpine ecosystems and endemic species found on the Australian mainland. The park forms about half of the area of the Australian Alpine National Parks system and its national significance is enhanced by its connection with other large natural areas in Victoria and the Australian Capital Territory.


The park provides ecosystem services that are nationally valuable: its soils and catchment provide clean water to southeastern Australia, and its large tracts of forest contribute to reduced risk of climate change by sequestering carbon.

There have been significant changes since the 1982 Kosciuszko National Park Plan of Management was developed. These include future climate change, the rate and spread of development within the park, the availability of new technology, socio-economic changes and much greater recognition of cultural values. The ISC found that, while many values were in good and stable condition, various pressures could lead to degradation of significant values if not adequately managed. Such pressures include the expansion of development, imposition of inappropriate fire regimes, increase in summer visitation, possible climate change and introduced plants and animals.

As the ISC undertook its review, a parallel process was underway involving Aboriginal people with connections to the park, to identify the Aboriginal values of the park and their management. Therefore, the ISC has not addressed these values in detail.

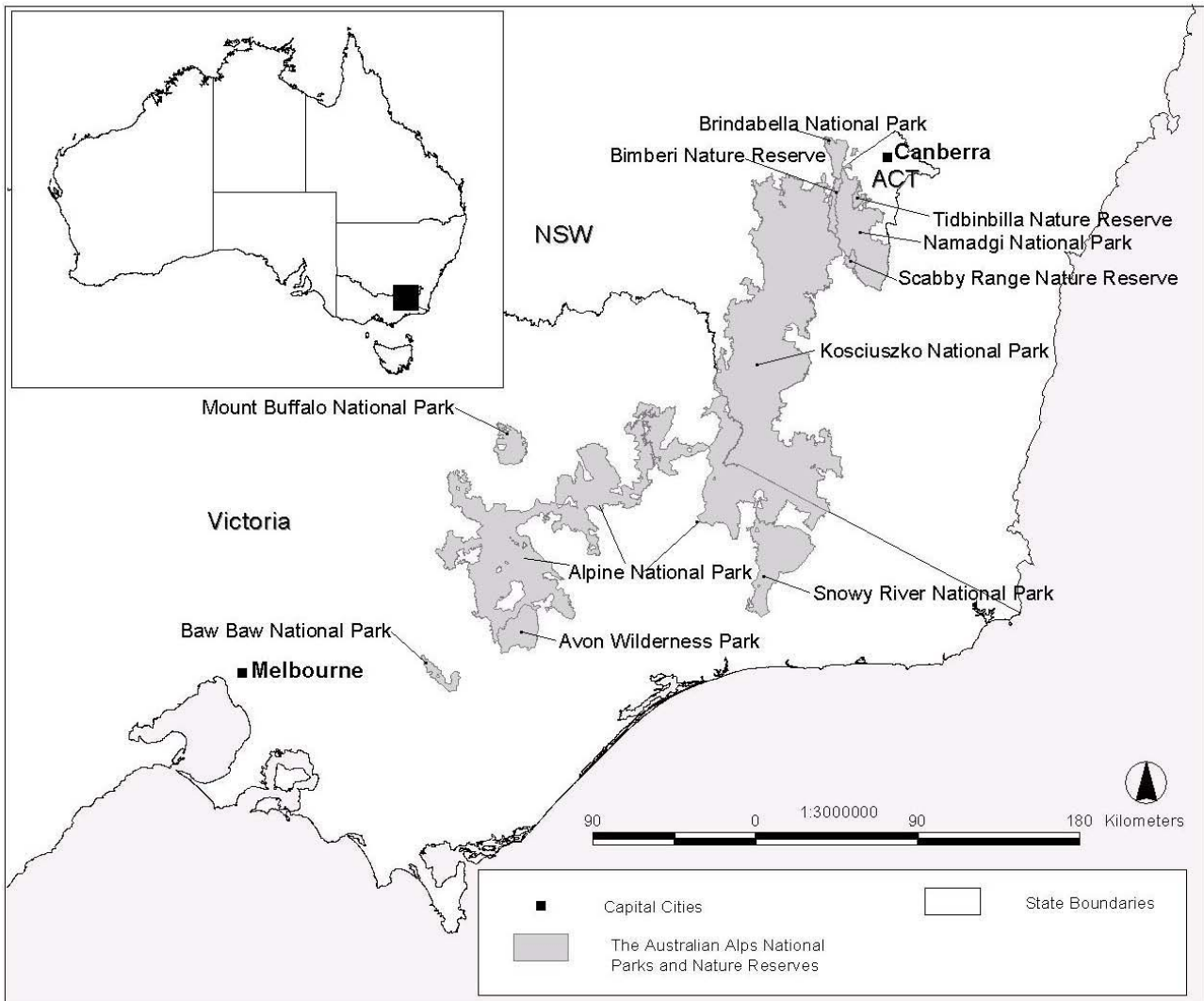
The ISC is aware that the park holds much more information than is yet known. This is illustrated by continued recording of previously undocumented plants and animals, and new perspectives on cultural values and the recent International Year of the Mountains (IYM) conference. A process for continual updating of knowledge is needed to assist conservation management.

The importance of Kosciuszko National Park is the sum of all of the values identified in the ISC report, plus others not explicitly discussed here. All of these values are worthy of being conserved.



*"This report is thus a collective effort that combines the results of individual knowledge and expertise."*

**Map 1.1**      **Location of Kosciuszko National Park**



# Chapter 1

# introduction

## Kosciuszko National Park

Kosciuszko National Park, which encompasses 690,411 hectares, is the largest national park in New South Wales (NSW) and one of the largest conservation reserves in Australia. It is contiguous with other Australian Alps national parks (refer to Map 1.1). Located in the southeastern corner of the state, the park straddles the Great Dividing Range, here known as the Snowy Mountains. It contains a diverse array of montane landscapes, each of which has been shaped by a series of natural and cultural influences, and each of which holds a range of distinctive natural, cultural, social, recreational and economic values.

The park contains the highest mountains in what is the flattest of continents. Although most of these mountains are subdued and rounded features, with few rising above 2000 metres in altitude, they constitute the principal seasonally snow-covered region in Australia. They also exhibit a suite of glacial features and possess an exceptional diversity of alpine plant communities and species that provide habitats for a number of rare and unusual animal species. Elsewhere, the park contains significant karst systems, deep river valleys and frost hollows, and vegetation communities ranging from snowgum woodlands and subalpine grasslands, to extensive eucalypt forests, pockets of cool temperate rainforest and stands of native cypress pines.


All of these environments have been subjected to varying degrees of human modification for thousands of years. Aboriginal people were supplanted by European explorers and surveyors, graziers, prospectors, miners, timber workers, scientists, construction workers, soil conservationists and recreationists. All have left tangible evidence of their passing including stone artefact scatters, campsites and ceremonial grounds, town and mine sites, huts and fence lines, networks of roads and tracks, power stations, dams, tunnels and aqueducts. Their endeavours have also created a rich legacy of stories, experiences and memories, strands of which have been recorded in literature, poetry, paintings and song. In some cases, the mountains, their people and their exploits have become part of Australian folklore and helped shape national identity.

Kosciuszko National Park is centrally located in the most densely populated part of Australia, with some parts of the park within a 500km radius of about 8 million people (Sydney, Canberra, Melbourne and surrounds). Visitor activities include cross-country skiing, car and bus-based sightseeing, bushwalking, fishing, horse riding, canoeing, cycling, caving, and alpine skiing and snowboarding at the various ski resorts located within the park.

The responses of people to this place are many and varied. For visitors, it can evoke a sense of renewal and wellbeing, achievement and satisfaction, exhilaration, connection or wonder. For those with historical connections it may elicit emotions of pride, belonging, loss and lament, or sentimentality. Whatever the attachment, or motivation for visiting the place, many people cherish Kosciuszko National Park as a very special place with significant values worthy of protection.

## The review process

In February 2001, the NSW Government announced that the Kosciuszko National Park Plan of Management would be reviewed. The plan has not been reviewed as a whole since its initial preparation over 20 years ago, and in the intervening period there have been significant changes in knowledge about the park, recreation patterns, the social and economic environment, community values and legislation.



*“Whatever the attachment or motivation for visiting the place, many people cherish Kosciuszko National Park as a very special place with significant values worthy of protection.”*

The revised plan of management, which will build on the existing plan, will contain the vision for the protection of the park for future generations and be the blueprint for management over the next 15–20 years. It will outline the park’s significance, the pressures it faces and the challenges ahead, allow decisions to be based on the best available knowledge and research, and facilitate and encourage interested organisations and individuals to participate in the planning process.

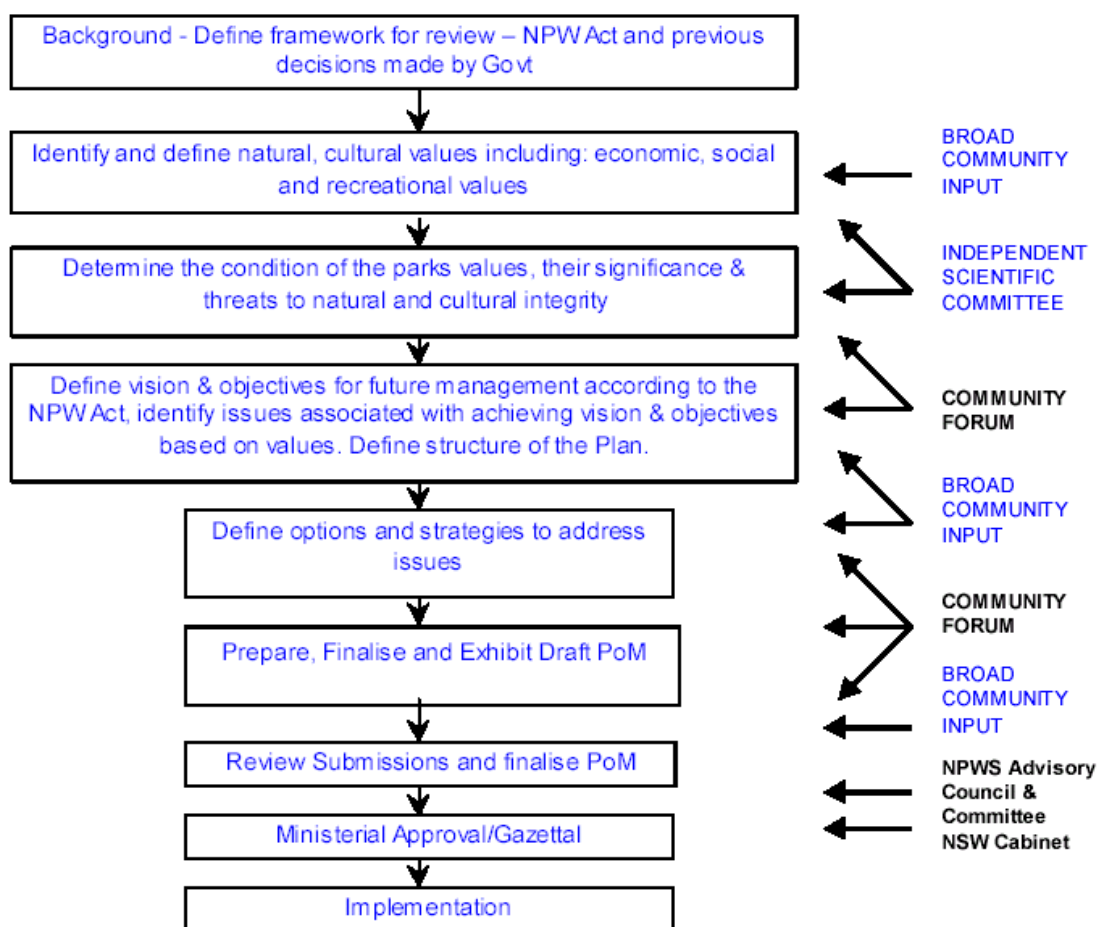
### The Independent Scientific Committee

As part of the review process for the new plan of management for Kosciuszko National Park, an Independent Scientific Committee (ISC) was formed to provide the National Parks and Wildlife Service (NPWS) with independent and objective advice on the values of the park. The committee brought together prominent scientists and experts in disciplines concerning protected areas, who were asked to advise on the natural, cultural, recreational, economic and social values of the park. Expertise from a range of disciplines was needed, given the diverse range of values that Kosciuszko National Park possesses and the new legislative responsibilities for park planning in the *National Parks and Wildlife Amendment Act 2000*. This report, enhanced by comments from the public, is thus a collective effort that combines the results of individual knowledge and expertise.

The report describes the different values of the park, and provides an independent assessment of their significance, condition, trend in condition, pressures, opportunities, knowledge gaps and indicators. This information will assist the review of the plan of management by providing a reference point from which to work, and by providing key findings and recommendations that should be adopted in the revised plan.

The committee has attempted to articulate in a rigorous manner the values of Kosciuszko National Park. It is hoped that by conveying all of the park’s special values in a single document, the community will be encouraged to continue to protect and enjoy this marvellous place.

Figure 1.1 Plan of management review process



## **The Community Forum**

In addition to the ISC, a Community Forum was formed to assist the process of review for the new plan of management for Kosciuszko National Park.

Whereas the role of the ISC was to provide independent expert advice about the park's values, the Community Forum was formed to provide the opportunity for a diverse range of groups with an interest in the management of the park to listen to each other's views and provide direction on the plan.

Specifically, the role of the Community Forum was to:

- assist in defining the vision and objectives for park;
- develop strategies for ongoing protection of the park's values;
- advise on community involvement in the plan's review; and
- provide advice on matters for which the NPWS wishes to gauge community sentiment.

Community Forum meetings were held in local communities around the park. A representative of the ISC attended Community Forum meetings to facilitate information exchange.

Running parallel to the plan of management review was the development of an alpine resorts plan for the ski resort areas and related infrastructure.





# Chapter 2

# independent

# Scientific Committee

## member profiles

### Lorraine Cairnes



Lorraine Cairnes is executive director of Fathom Consulting, which consults in planning, natural resources and heritage management. She has over 30 years experience in management of natural resources, and natural and cultural heritage in Australia. Lorraine has held senior executive positions in both the public and private sectors, including New South Wales (NSW) Fisheries, the National Parks and Wildlife Service (NPWS), Sydney Water, the NSW Department of Planning and the NSW Heritage Council.

Her first employment was at Kosciuszko National Park - Lorraine was Australia's first female ranger. Her extensive practical field experience includes original investigations for new national parks and nature reserves throughout NSW, including the extensive Wollemi National Park. Her longstanding association with Kosciuszko National Park includes studies related to sustainable uses. She has chaired independent high-level reviews and committees, including the Premier's Review of the *Native Vegetation Conservation Act* (NSW), and the NSW Water Conservation Task Force (which produced the NSW Water Conservation Strategy) and the NSW Advisory Panel for the Register of the National Estate (for which she was joint chairperson).

Lorraine is author of the Australian Natural Heritage Charter, Australia's voluntary standard for natural heritage conservation; she is also a member of the Environment Institute of Australia and its NSW Division Committee. Her role in the Independent Scientific Committee (ISC) included coordination and collation of inputs, and overview analysis.

### Dr Alec Costin AM



Alec Costin has more than 40 years experience in research and management of natural resources, especially in high-mountain catchments, through his work with the Commonwealth Scientific and Industrial Organisation (CSIRO), universities and state conservation agencies. Alec was a Senior Research Scientist and Chief Research Scientist at the Division of Plant Industry, CSIRO from 1955 until 1974, and is a fellow of the Australian Academy of Science. He is an international authority on the ecology of high-mountain and high-latitude ecosystems, and is widely acclaimed for his research into alpine vegetation, soils and hydrology.

Alec is a former member of the Kosciuszko National Park Advisory Committee and has published extensively on the flora, soils and ecosystem functions of Kosciuszko National Park, including the definitive *Kosciusko Alpine Flora* (2000) and *A Study of the Ecosystems of the Monaro* (1954).

*“Independent and objective expertise from a range of disciplines was needed, given the diverse range of values that Kosciuszko National Park possesses.”*

## Dr Robert Galloway



Born and educated in Scotland, Robert Galloway researched 'Periglacial phenomena in Scotland' for his doctorate. After graduation he conducted postgraduate studies in France, Germany, Arctic Norway and Greenland. From 1958 until 1987, Robert was a research scientist based in Canberra with CSIRO Division of Land Research, and he conducted extensive regional surveys in Queensland and the Northern Territory. He also worked on the Quaternary, focusing on glaciation in the Kosciuszko area, the United States and Argentina. This led to related studies into snow falls and palaeoclimatics in the Snowy Mountains in relation to climate change.

Robert has produced over 62 scientific publications, as well as more than 20 conference papers, and is considered one of Australia's leading experts in the field of glaciation.

## Prof Elery Hamilton-Smith AM



Elery Hamilton-Smith has been a consultant in social research, policy and planning since 1967, with work experience across some 35 countries and with both the United Nations and the Commonwealth Secretariat. Current academic posts in the social sciences include honorary professorships at the International Centre of Excellence, University of Wageningen, Netherlands; Lincoln Gerontology Centre, Faculty of Health Sciences, La Trobe University, Bundoora; and the School of Information and Environmental Sciences, Charles Sturt University, Albury. Elery is also a visiting professor at some 15 overseas universities with over 1000 books, reports, professional papers and other publications to his name.

Elery is a member of the World Conservation Union (IUCN), a member of the steering committee for the World Commission on Protected Areas, chair of the Task Force on Cave and Karst Protection, and a member of the Working Group on Collaborative Management.

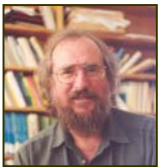
## Dr Marc Hockings



Marc Hockings is a senior lecturer in the School of Natural and Rural Systems Management at the University of Queensland. Following undergraduate and postgraduate degrees in zoology, Marc worked for the Queensland National Parks Service for 15 years, where he gained experience in diverse aspects of conservation and protected area management. His doctorate was on the evaluation of management effectiveness in protected areas and his current research interests focus on issues of monitoring and evaluation in conservation management. Marc is a vice-chair of the IUCN World Commission on Protected Areas, a World Heritage advisor to the IUCN and a member of the Commission's Global and Australian Steering Committees. He is a member of the Fraser Island World Heritage Area Scientific Advisory Committee.

Marc was the principal author of the IUCN's best-practice guidelines on evaluation of management effectiveness in protected areas. He is currently managing a joint United Nations Educational, Scientific and Cultural Organization (UNESCO)/IUCN project that is applying these guidelines in ten World Heritage sites in Africa, South Asia and Latin America.

## Prof Jamie Kirkpatrick AM



Jamie Kirkpatrick is Professor of Geography and Environmental Studies at the Hobart campus of the University of Tasmania. His research is focused on the maintenance of natural values, particularly those relating to vegetation and wilderness, and extends from work on the politics of environment to work on the ecology of natural vegetation. He has had considerable experience in building cases for, and assessing, natural world heritage values in Australia.

Jamie is currently chair of the scientific advisory committee set up under the *Threatened Species Protection Act 1995* (Tasmania), vice-president of the Institute of Australian Geographers, and a member of the Tasmanian Wilderness World Heritage Area Advisory Council and the University of Tasmania Council.



## Bruce Leaver



Bruce Leaver is currently first assistant secretary in charge of the Heritage Division within Environment Australia. As well as filling the role of executive director of the Australian Heritage Commission, Bruce is responsible for the Commonwealth's role in World Heritage Areas, the *Aboriginal and Torres Strait Heritage Protection Act* and the *Historic Shipwrecks Act*. Bruce joined the Commonwealth Government in August 1999. Before that he spent 30 years in heritage management in three states. He was a regional director in the NSW NPWS, director of the South Australia NPWS, and more recently, the Commissioner of Resource Planning and Development in Tasmania.

Bruce's specific contribution to the ISC's report was to co-author the fire management paper. Bruce is a professional forester with extensive experience in bushfire management at all levels of protection and fire suppression, including in Kosciuszko National Park. He has served as a member of the Australian Capital Territory (ACT) Bushfire Council and the South Australia Bushfire Prevention Council, and has developed bushfire protection planning measures for state planning systems.

## Dr Ian Mansergh



Ian Mansergh is currently the manager of the Flora and Fauna Directorate for the Department of Natural Resources and Environment in Victoria. He has published more than 60 scientific publications, has conducted innovative research and is an acknowledged expert in alpine ecology, environmental management, threatened species, wildlife modelling, greenhouse issues and Aboriginal knowledge of fauna. Ian has more than 20 years of experience in scientific investigations in the alps, dealing mainly with fauna. This strong zoological base is complemented by his expertise in broader policy development, land use planning and management, particularly in the context of improved biodiversity conservation - evidenced by Ian's contribution as a major author to *Victoria's Biodiversity*. Ian also has experience in overseas alpine and subarctic environments.

## Dr Richard Marchant



Richard Marchant is a freshwater ecologist and has worked for the past 20 years on the ecology of invertebrate communities in streams and rivers in Victoria. He is currently Senior Curator of Terrestrial Invertebrates at the Museum of Victoria. He has 30 years of research experience, starting with his PhD studies on salt lakes in western Victoria and continuing since on river ecosystems, including tropical rivers in the Northern Territory, temperate rivers in Canada and streams on subantarctic Macquarie Island. His major interests centre on the ecology of the aquatic insects that form the majority of species in these running-water ecosystems. Much of Richard's work has been concerned with the effects of various human-caused disturbances (eg. dam building, and discharge of heated water and various other pollutants) on stream invertebrate communities.

He has conducted surveys of these communities in both disturbed and undisturbed rivers; investigated those that live deep within the gravel of the riverbed (the Hyporheic zone); and carried out quantitative studies on the life histories, growth rates and population dynamics of a range of aquatic insects and freshwater crustaceans. Richard has been involved both as a consultant and as a member of various committees in setting minimum flows for regulated rivers and has been an adviser to the federal government for its Monitoring River Health Initiative.

Richard's recent work has been funded and carried out with colleagues from the Cooperative Research Centre for Freshwater Ecology, of which he is an associate member.

## Prof Trevor Mules



Trevor Mules is currently the Professor of Tourism at the University of Canberra and a coordinator for the Cooperative Research Centre for Sustainable Tourism, having had previous experience as an associate professor at the Graduate School of Management (Adelaide) and as a senior lecturer in economics at Griffith and Adelaide universities. Trevor's research has focused on tourism, particularly special events, the economics of tourism, tourism expenditure, tourism impact, and economic modelling, especially in relation to input-output models. Trevor is also a member of the ACT Heritage Council and is on the board of the Centre for Australian Cultural Studies.

## Dr Alan Newsome



Alan Newsome was educated in zoology, botany and geology at the University of Queensland. He gained early field experience in the Northern Territory, assessing the impacts of pest species on the cattle and sheep industries, describing the distribution and abundance of key species of fauna, and indicating important sites for creating national parks. He was awarded a master's degree from the University of Adelaide for his subsequent studies on the red kangaroo. Alan's study at Adelaide University focused on the causes of mouse plagues, the topic for his doctorate. On joining the CSIRO,

Alan studied dingoes as pests of cattle and sheep in Central Australia and south-east NSW; this included a Fulbright Fellowship for one year at the University of Berkeley, California, where he studied interactions between predators and their prey in the wild. This led to further research in Australia into links between predation by dingoes and the availability of kangaroos, rabbits, foxes and feral cats. Most recently, Alan has worked with the Pest Animal Control Cooperative Research Centre, based within CSIRO Sustainable Ecosystems in Canberra, understanding the likely responses of pest species to immunocontraceptive techniques and diseases such as rabbit calici virus disease and rabbit haemorrhagic disease.

These studies have led to a PhD from the University of Queensland. Alan has been a member of several state, national and international committees: Australian Vertebrate Pest Committee; Cane Toad Advisory Committee; Threat Abatement Plan for Rabbit, Fox, Feral Cat, Feral Goat and Pig; ACT Vertebrate Pest Management Committee; Advisory Committee to Minister, NPWS; Coordinator, Mouse Plague Research, South Australia; Endangered Species Advisory Committee; Marsupial Specialist Group; IUCN Species Survival Commission; IUCN Commission on Ecology; and the Northern Territory Wildlife Advisory Council.

## Dr Catherine Pickering



Catherine Pickering leads the Mountain Tourism Subprogram for the Cooperative Research Centre for Sustainable Tourism. This interdisciplinary research team examines issues in the sustainability of mountain tourism.

Catherine has had a long interest in research in the Australian Alps, from theoretical ecology through to tourism and environmental management. Currently, she is a senior lecturer in the School of Environmental and Applied Sciences at Griffith University. Previously, she was a postgraduate fellow on a National Science Foundation project in the United States. Catherine has a PhD and a BSc (Honours) from the Australian National University.

## Dr David Shorthouse



David Shorthouse has a PhD from the Australian National University, a master's degree in conservation from University College, London and a science degree from the University of Newcastle (UK). He taught ecology and conservation planning at the Canberra College of Advance Education from 1971 to 1980, and has extensive experience in environmental planning and management in the ACT and elsewhere through employment with the (former) National Capital Planning Authority, the Commonwealth Department of Environment (World Heritage Unit), and the ACT Parks and Conservation Service.

David currently manages the Wildlife Research and Monitoring Unit of Environment ACT and is responsible for biodiversity survey and monitoring programs in the ACT, including identification and protection of threatened species, wildlife research and conservation planning. He was closely involved with the establishment of Namadji National Park in 1986 and with the preparation of its first plan of management.

## Andy Spate



Andy Spate was employed for over 20 years by the NPWS as Natural Heritage Officer, Karst and as Senior Project Officer, Water Reforms. His professional career has been largely with the CSIRO Division of Land and Water Research and at NPWS. At CSIRO he was involved in research into dryland salinity, catchment dynamics, groundwater systems, plant-soil-water relationships and landscape rehabilitation.

Andy's appointment to the NPWS was as the first professional karst specialist in Australasia, with responsibilities for cave and karst management, and for research into karstic terrains. He has been involved in many other aspects of land management and land-use planning, representing the service in many forums and community involvement activities. Andy's main interest, when he gets the time, is in hydrologic processes in karst terrains and in the development and management of karst landscapes, including caves. A more recent research interest has been in the field of groundwater-dependent ecosystems - particularly their fauna.

Andy has published or written more than 150 environmental and consultant reports, environmental impact statements, major in-house reports and peer-reviewed scientific papers in the field of cave and karst management and processes, including groundwater issues, and on land management generally. He has lectured at a number of universities and has presented many courses on karst geomorphology and hydrology. Andy now runs his own environmental consultancy business - Optimal Karst Management - which is undertaking projects in Australia and Asia.

## Prof Sharon Sullivan



Sharon Sullivan has an MA (Hons) and a BA (Hons) in history, with over 30 years experience in heritage place and land management. She is deeply involved in the development of cultural heritage management systems in Australia. Sharon was previously the deputy executive director of NSW NPWS; then executive director, Australian Heritage Commission and first assistant secretary, Australian and World Heritage Group for the Commonwealth Department of Environment and Heritage, and Australian Government Leader of Delegation, World Heritage Committee. She is also a fellow of Australian Academy of the Humanities, a member of the Australian Institute of Aboriginal and Torres Strait Islander Studies, and a member of the National Executive Committee of Australia, International Council on Monuments and Sites.

Sharon is an adjunct professor, School of Anthropology, Archaeology and Sociology at James Cook University of North Queensland, and adjunct professor, School of Natural and Rural Systems Management, at the University of Queensland. She has been a consultant the Getty Conservation Institute, the World Monument Fund, the World Bank, and the World Heritage Committee on various aspects of cultural heritage management. Sharon is the author of a range of publications including, jointly with Michael Pearson, *Looking After Heritage Places* - a university textbook on heritage place conservation and management. She has done extensive planning and teaching work with site managers in Australia, the United States, Cambodia, Africa and China on cultural heritage assessment and management issues. In her spare time, Sharon and her partner run a cattle farm on the Nymboida River in northern NSW.

## Dane Wimbush



Dane Wimbush MSc (Sydney), now retired, worked as an alpine ecologist with CSIRO Division of Plant Industry from 1957 to 1986, based first at Island Bend, then Waste Point, and for the last six years in Canberra.

Together with Alec Costin, he conducted research in a number of fields, including the measurement of vegetation on permanent reference areas over long periods; studies on the hydrology of *Sphagnum* bogs, various aspects of snow accumulation, soil erosion and run-off, and the effects of sheep grazing; and a seven-year study of the effects of feral rabbit populations in a subalpine frost hollow. His interests extend to bird-banding, sailing and flying. He is a co-author of *Kosciuszko Alpine Flora*, recently in its second edition.

Since his retirement, Dane has worked as a consultant with NPWS, carrying out broad-scale vegetation mapping from Landsat Thematic Mapper imagery of southern NSW with his wife, Robyn, for the Murray-Darling Basin Commission, which involved extensive field work. He followed this up by conducting a search for rare and endangered species along the Alpine Way and, more recently, has looked at riparian vegetation for the Snowy River Inquiry.

## Graeme Worboys



Graeme Worboys (M.App.Sci.) is chief executive officer of Green Globe Asia Pacific, and principal consultant to the Cooperative Research Centre for Sustainable Tourism. He is the Deputy Vice Chair, Mountains for the World Conservation Union's World Commission on Protected Areas. He has contributed to environmental management for 30 years and was previously an executive director with the NSW NPWS. Graeme has a long history of involvement in tourism and recreation planning and management, particularly in Kosciuszko National Park. He is the author of the NSW NPWS 1997 Draft Nature Tourism and Recreation Strategy and principal author of *Protected Area Management Principles and Practice*, a university text published by Oxford University Press in 2000.

Graeme's work for the past three years has focused on applications for environmentally sustainable tourism for companies and communities throughout the Asia-Pacific region, including establishing environmentally and socially sustainable performance levels.

## **Doug Young**



Doug Young leads the Natural Resource Economics team in Rural Solutions South Australia (formerly PIRSA Rural Solutions), where he commenced in January 1999. He previously worked for the South Australian Centre for Economic Studies and the Australian Bureau of Agricultural and Resource Economics. Much of his recent research has been directed towards the economic evaluation of projects and policies, particularly those involving interactions between irrigated agriculture and changes to environmental attributes and regional communities.

Doug holds a master's degree in economics from the University of Adelaide and an honours degree in biological sciences from the Flinders University of South Australia. He is also a former president of the South Australia Branch of the Australian Agricultural and Resource Economics Society.

## **Mark Adams**



Mark Adams was executive officer for the Independent Scientific Committee (ISC), a planner in the Kosciuszko Plan of Management Review team and he facilitated and coordinated the ISC's program. His assistance to the ISC was invaluable, with his extensive knowledge and experience of the park's values, management issues and the operations of the Service. His project management skills were important in the successful completion of this report within demanding timeframes.

# Chapter 3

## ISC tasks and Methodology

This chapter looks first at the purpose and management principles of national parks in New South Wales (NSW), then outlines the tasks of the Independent Scientific Committee (ISC), its terms of reference and its approach to assessing the values of Kosciuszko National Park.

### Purpose and management principles of national parks in New South Wales

In evaluating the values of the park, the ISC took into account the purpose of a national park established under New South Wales (NSW) legislation, and the management principles that are the basis for management of NSW national parks.

The National Parks and Wildlife Amendment Act 2000 provides (s.30E(1)) that:

*“The purpose of reserving land as a national park is to identify, protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena that provide opportunities for public appreciation and inspiration and sustainable visitor use and enjoyment so as to enable those areas to be managed in accordance with subsection (2).”*

The Act requires that national parks be managed in accordance with the following principles (s.30E (2)):

- a) the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes;
- b) the conservation of places, objects, features and landscapes of cultural value;
- c) the protection of the ecological integrity of one or more ecosystems for present and future generations;
- d) the promotion of public appreciation and understanding of the national park’s natural and cultural values;
- e) provision for sustainable visitor use and enjoyment that is compatible with the conservation of the national park’s natural and cultural values;
- f) provision for the sustainable use (including adaptive reuse) of any building or structures or modified natural areas having regard to the conservation of the national park’s natural and cultural values; and
- g) provision for appropriate research and monitoring.

The Act also requires that the following matters be taken into consideration in the preparation of a plan of management:

- relevant management principles;
- conservation of biodiversity, including the maintenance of habitat, ecosystems and populations of threatened species;
- protection and appreciation of objects, places and structures of cultural significance, and tracts of land;
- protection of landscape values and scenic features;
- protection of geological and geomorphological features;
- protection of wilderness values and the management of wilderness areas;

*“In evaluating the values of the park, the ISC took into account the purpose of a national park established under NSW legislation, and the management principles that are the basis for management of NSW national parks.”*

- maintenance of natural processes;
- rehabilitation of landscapes and the reinstatement of natural processes;
- fire management; in the case of a plan of management for a national park, nature reserve or karst conservation reserve, the prohibition of the execution of any works adversely affecting the natural condition or special features of the park or reserve;
- potential for the reserved land to be used by Aboriginal people for cultural purposes;
- provision of opportunities for public understanding, enjoyment and appreciation of natural and cultural;
- heritage values, including opportunities for sustainable visitor use;
- adaptive reuse of buildings and structures;
- appropriate (including culturally appropriate) and ecologically sustainable use of the reserved land, including use by lessees, licensees and occupiers of the land;
- preservation of catchment values;
- encouragement of appropriate research into natural and cultural features and processes;
- including threatening processes;
- identification and mitigation of threatening processes;
- statutory natural resource management, land use management plans and land management practices of land surrounding or within a region of the reserved land;
- regional, national and international context of the reserved land, the maintenance of any national;
- and international significance of the reserved land and compliance with relevant national and international;
- agreements, including the protection of world heritage values and the management of world heritage properties;
- benefits to local communities;
- social and economic context of the reserve so as to ensure, for example, that the provision of visitor facilities is appropriate to the surrounding area or that pest species management programs are coordinated across different tenures;
- protection and management of wild rivers; and
- impact of the management and the use of land acquired under Part 11 on the reserved land's management.

## Terms of reference for the ISC

The terms of reference required the ISC to:

- Identify, describe and report on the condition, and trend in the condition, of the park's natural, cultural, recreational, economic and social values;
- Prepare a statement of significance of the values of the park including review of the "Schedule of significant natural features";
- Identify and report on key pressures on the park's values including any works that adversely affect these values;
- Identify and report on key opportunities for the park's values to be protected including the quality and adequacy of NPWS's strategies to foster public appreciation, enjoyment and understanding of the park's natural and cultural values;
- Identify appropriate research, monitoring and key performance indicators required for the management of the park's natural and cultural features;
- Provide advice on the strategies developed by the Community Forum for managing the park.

## Approach to the task

The ISC met during 2002 and 2003, to undertake an objective assessment of the park's values and provide independent advice about those values. The committee developed a methodology that was sufficiently flexible to be applicable to all of the disciplines and areas of expertise involved, and sufficiently consistent to meet the standards of rigour and integrity necessary for scientific and technical studies. In their individual assessment of particular values of the park, each member of the committee addressed the terms of reference. Chapter 4 explains how the terms of reference were addressed in considering each of the individual values. Following exhibition of an interim report, public comments were considered and the final report was produced.

## Criteria for evaluating significance

No single set of criteria could embrace all of the core and derived values that the ISC has identified for Kosciuszko National Park in response to the requirements of the *National Parks and Wildlife Act (NSW)*. In evaluating the nature and level of the values, criteria have been used appropriate to the type of value under consideration. The significance summary and the topic chapters provide advice on the rationale for the identified significance of each of the parameters evaluated.



## **International significance criteria**

Values for international significance were assessed using criteria appropriate to the value under consideration.

Internationally recognised criteria are established for areas listed under various international agreements and conventions. These criteria can apply to the themes and specific areas of the listings without necessarily applying to all values of the park. Examples are the criteria used for listing the park as a United Nations Educational, Scientific and Cultural Organization (UNESCO) biosphere reserve, and those for listing the Blue Lake and its environs as a wetland of international importance under the Ramsar Convention.

Kosciuszko National Park is not part of a World Heritage Property; thus, the World Heritage criteria for natural and cultural heritage are not fully appropriate here, although it can be argued that aspects of the park would meet these criteria if the park were to be nominated.

For most values, this assessment used an adaptation of criteria indicated by the draft national criteria recently adopted for Australia (see below) and criteria put forward by the United Nations Environment Programme (UNEP) World Conservation Monitoring Centre (WCMC)<sup>1</sup> (1996).

### ***Biosphere reserves***

Biosphere reserves are areas of terrestrial and coastal ecosystems promoting solutions to the problem of how to reconcile the conservation of biodiversity with its sustainable use. Collectively, such reserves form a global network within which exchanges of information, experience and personnel are promoted.

Biosphere reserves are internationally recognised and serve in some ways as 'living laboratories' for testing and demonstrating integrated management of land, water and biodiversity. Each biosphere reserve is intended to fulfil three complementary and mutually reinforcing basic functions:

- a conservation function, to conserve landscapes, ecosystems, species and genetic variation;
- a development function, to foster economic and human development that is socio-culturally and ecologically sustainable; and
- a logistic function, to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development.

### ***World Conservation Monitoring Centre criteria***

A useful tool that was used by the ISC is the set of criteria developed by UNEP WCMC (1996) to assist in assessing sites for inclusion in protected areas, which can be adapted to help identify globally and nationally significant sites<sup>1</sup>. The WCMC criteria state that sites containing the following species or ecosystems are likely to be globally significant:

- endemic threatened species;
- globally threatened species for which the country holds a significant part of the world population;
- other globally threatened species;
- ecosystems unique to the country; and
- ecosystems for which the country holds a significant part of the world total.

### ***International application of Australian criteria for national heritage places***

The criteria for national heritage places developed by Environment Australia in 2002 were adopted by the ISC to identify values with international significance where this was appropriate to the values under consideration, as shown below:

- 1 A place that is a component of the natural or cultural environment that is of outstanding international value for future generations and the present community because of any of the following:
  - a) its importance in the course, or pattern, of the Earth's natural or cultural history;
  - b) it possesses uncommon, rare or endangered aspects of Australia's natural or cultural history that are important at an international level;
  - c) it has potential to yield information that will contribute to an understanding of the Earth's natural or cultural history;
  - d) its importance in demonstrating the principal characteristics of: (i) a class of the Earth's natural or cultural places; or (ii) a class of the Earth's natural or cultural environments;
  - e) its importance in exhibiting particular aesthetic characteristics valued internationally;

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<sup>1</sup> In 1988, the independent, non-profit World WCMC Conservation Monitoring Centre was founded jointly by IUCN, WWF the World Wildlife Fund and UNEP. The UNEP World Conservation Monitoring Centre (WCMC) was established in 2000 as the world biodiversity information and assessment centre of the United Nations Environment Programme UNEP.

- f) its importance in demonstrating a high degree of creative or technical achievement at an international level at a particular period;
- g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- h) its importance as part of the developing traditions and customary law of Indigenous peoples;
- i) its special association with the life or works of a person, or group of persons, of importance in the Earth's natural or cultural history.

### **National significance criteria**

The criteria that have been used to establish national significance include the WCMC criteria, and the criteria for national heritage values developed in 2002 by Environment Australia and the Australian Heritage Commission.

#### **World Conservation Monitoring Centre national criteria**

The WCMC (1996) criteria state that, as a general guide, protected area sites that are large (by national standards) can be regarded as being at least of national significance. Nationally significant sites are likely to contain:

- nationally threatened populations of globally non-threatened species;
- endemic non-threatened species; or
- species-rich ecosystems.

#### **Criteria for national heritage values**

The most recent criteria developed by Environment Australia and the Australian Heritage Commission were adopted as a consequence of legislation passed in 2003. This legislation provides for a special list of national heritage places to be developed comprising natural, historic and indigenous places that are of outstanding national heritage value to the Australian nation.

The criteria for the national heritage values are:

- 1 A place that is a component of the natural or cultural environment of Australia is eligible for entry to the National Heritage List if it is of outstanding national value for future generations and the present community because of any of the following:
  - a) its importance in the course, or pattern, of Australia's natural or cultural history;
  - b) it possesses uncommon, rare or endangered aspects of Australia's natural or cultural history;
  - c) it has potential to yield information that will contribute to an understanding of Australia's natural or cultural history;
  - d) its importance in demonstrating the principal characteristics of: (i) a class of Australia's natural or cultural places, or; (ii) a class of Australia's natural or cultural environment;
  - e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
  - f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
  - g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
  - h) its importance as part of the developing traditions and customary law of Indigenous peoples; and
  - i) its special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

#### **Additional national criterion for non-heritage values**

The values of Kosciuszko National Park include some 'non-heritage' values, including the recreational and economic values. The criterion adopted by the ISC for identifying the national significance of these non-heritage values is: 'Other nationally important values that contribute to the social and economic well-being of Australia.'

#### **State or regional significance criteria**

The criteria used to define significance at state or regional level are primarily derived from the *National Parks and Wildlife Act* (NSW) and the *Heritage Act* (NSW).

The definition of 'state' is clear, but the concept of 'regional' is more abstract and has been used as appropriate in the sense of the park in its landscape setting, as a bioregion, the ecosystem service delivery area immediately around the park, or the local government areas surrounding the park.

The key to the significance levels is the context of the values; for example, regional movement of Aboriginal people or regional consideration of pastoral history imply different regional boundaries to each other and to the bioregion boundary.



### **State criteria from the National Parks and Wildlife Act**

The NSW state criteria are derived from the *National Parks and Wildlife Act*, Division 2 Management principles, which are set out elsewhere in this report. They are broad criteria and principles that extend beyond the traditional natural and cultural heritage values.

### **State criteria from the NSW Heritage Act**

'State significance' has been defined in the *Heritage Act* (NSW) as the basis for listing places on the State Heritage Register. The criteria in the Act have been used to assist in assessing the type and level of significance of 'items' (the term used in the Act) in the Kosciuszko National Park.

State heritage significance, in relation to a place, building, work, relic, moveable object or precinct, means significance to the State in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of the item (S.4A(1), *Heritage Act 1977*).

To be assessed for listing on the State Heritage Register an item, in the opinion of the Heritage Council, is required to meet one or more of the following criteria:

- an item is important in the course, or pattern, of NSW's cultural or natural history;
- an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history;
- an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW;
- an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons;
- an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history;
- an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history; or
- an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments.

### **Additional state or regional criterion for non-heritage values**

The values of Kosciuszko National Park include some 'non-heritage' values. The criterion adopted by the ISC for identifying the state or regional significance of these non-heritage values is:

'Other important values that contribute to the social and economic well-being of NSW or the region.'

### **Local or park significance criteria**

The criteria used by the ISC were derived from local dependencies, expert opinion or other knowledge. Sites and values of essentially local or park significance are likely to:

- be relatively small;
- relate to core values that are well represented or better protected in other larger protected areas within the country; or
- other attributes that contribute to the social and economic well-being of the park and its local communities.

### **Interaction with the Community Forum**

The interaction between the ISC and Community Forum was recognised by the committee as critical in the success of the plan of management review process. A series of 'envoys' and a joint meeting facilitated information transfers between the two groups. A member of the ISC has attended each Community Forum meeting in order to facilitate this information transfer. The chair of the Community Forum and representatives preparing the Alpine Resorts Plan were also invited to ISC workshops and meetings. The ISC made itself available to receive and respond to referrals for information from the Community Forum. In addition, the ISC requested data sources and information on the values of the park from the Community Forum in order to consolidate the collective knowledge of the two groups.

## The Submission Process

The Independent Scientific Committee (ISC) produced an 'Interim Report' in December 2002 and public comment was invited. 79 submissions were received by the ISC from a range of geographic locations and sectors, with the majority being from Sydney.

Submissions were discussed in detail at an ISC meeting in March 2003 with individual authors responsible for incorporating relevant changes into their chapter. The majority of submissions and comments supported the information present on the values assessed by the ISC and the knowledge gaps, findings and recommendations. The ISC's approach of evaluating all values within the Park, ie: natural, cultural, social, recreational and economic, was also strongly supported. Critical comments related to:

- the perception that the ISC believed summer activities were more popular than winter or snow sport activities,
- the assessment of values associated with snowfields; or
- additional references, minor corrections and additions.

These issues have been addressed in this final report. It is also important to note that some comments referred to matters outside the ISC's Terms of Reference and were referred back to the National Parks and Wildlife Service for consideration within the Plan of Management review process.

The Independent Scientific Committee would like to extend thanks all those who took the time to read and comment on the 'Interim Report'.

# Part Two

## Chapter 4

# introduction to values

### Identification of values

The values assessed by the Independent Scientific Committee (ISC) related to the natural and cultural heritage phenomena of the park and its social, recreational and economic aspects. These values are: earth sciences, soils, karst, aquatic, flora, fauna, landscape, fire, cultural and social heritage, tourism and recreation, economic valuation and the economic value of tourism.

The information for identifying values was drawn from existing documents and data sources; given the time and resources available, the ISC did not attempt an exhaustive compilation of all of the knowledge about the park's values, and for the same reason no new research was conducted.

### Criteria used for assessing values

#### Condition

The criteria used for assessing condition were derived from existing recognised reporting frameworks or structures. The assessments include concepts of dependency, fragility, isolation and dispersion. In describing condition, some reference point or desired outcome is typically ascribed; for example, in vegetation assessments, pre-1750 extant is commonly used. However, it was considered inappropriate and outside the scope of the ISC to use such an approach for economic and social values; thus, in the chapters concerning these values, assessments of condition are not validated by describing reference conditions.

#### Trend in condition

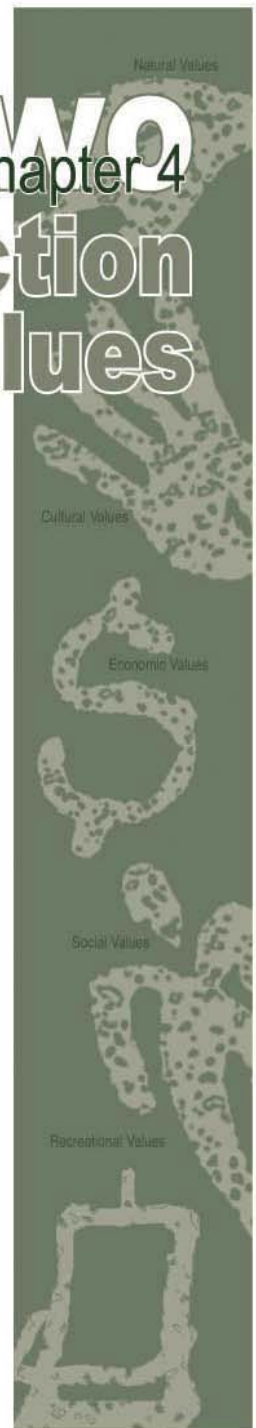
Description of trend in condition is appropriate for some values but not others; where possible it has been measured within known timescales and referenced to the initial condition statement. The following measures were used as a guide:

- improving generally;
- improvement slight or patchy;
- no net change;
- declining in some places; and
- widespread or large declines.

#### Significance

Statements of significance have traditionally been used in natural and cultural heritage assessment. For this report, the concept has been extended to the recreational, social and economic values of the park to provide a comprehensive platform for analysis. Statements of significance were completed for each attribute of Kosciuszko National Park's values. The legal status (if any) formed part of this evaluation. The significance of the individual values has been described in ways that are appropriate to each of the categories of values. Generally, a range of criteria was used to decide if the values were significant at the levels of

- international;
- national;
- state;
- regional; and
- local or park.



*“The values assessed by the Independent Scientific Committee related to the natural and cultural heritage phenomena of the park and its social, recreational and economic aspects.”*

These criteria were further developed and refined as the ISC's work proceeded, and the assessment appears in detail in the individual "topic" chapters.

### **Pressures**

Pressures may arise from indirect or underlying societal and economic processes, or from activities that act directly on values, sometimes called proximate causes. A pressure on a value indicates that the value may be degraded unless the pressure is removed, reduced, or appropriately managed and its effects mitigated. Identification of pressures and their impacts is a valuable means of identifying where management strategies need to be developed.

### **Opportunities**

The ISC identified positive management opportunities for some values, particularly those related to the legislative duties on National Parks and Wildlife Service (NPWS) to provide educational enjoyment and understanding of the park's natural and cultural values. These opportunities can be considered in the review of the plan of management.

### **Knowledge gaps**

Knowledge gaps that require further research or data to elucidate significant or potentially significant values were evaluated for each of the value areas. These will assist in the future understanding, conservation and management of Kosciuszko National Park's significant values.

### **Indicators**

The ISC was asked to identify key performance indicators required for the management of the park's values, to provide managers with the data and capacity to make informed decisions. These are of a strategic nature and focus on practical, achievable and repeatable monitoring.

### **Peer review**

All papers in this report were peer-reviewed by other professionals in the appropriate fields or by other ISC members. The peer review process was considered important in order to meet academic standards and maintain an objective assessment.

# Chapter 5

# earth sciences values

Dr Robert W Galloway

## Introduction

The relevant sections of the National Parks and Wildlife Act 1974 (NSW) stipulate that a primary object of the Kosciuszko National park is conservation of significant landforms, geological features and earth processes. Also, management should seek to foster public appreciation and understanding of the earth science aspects of the park and sites of scientific significance. The following discussion has been written with these management aims in mind.

Geology and geomorphology are the basis of the entire Kosciuszko National Park. The geology is well displayed by a geological map at the scale of 1:250,000 (Wyborn et al. 1990). Copies of this map may be obtained from the Australian Geological Survey Organisation (AGSO) in Canberra. There is quite an extensive scientific literature bearing particularly on the solid geology, the effects of glacial and periglacial processes and the soils.

Earth science features of the park can be conveniently divided into four time-based groups. Each is discussed here with comments on significance at national, state and park levels.

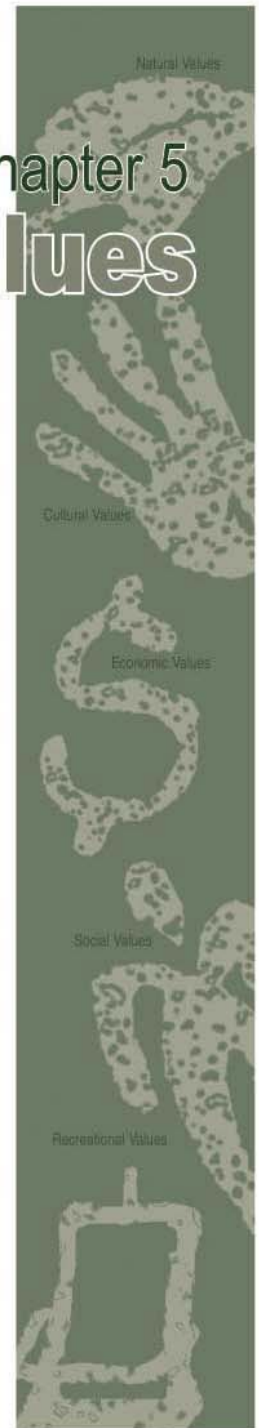
- Ordovician to Lower Devonian (approximately 430-370 million years old). These rocks form the bedrock of the entire area. The formation of these rocks was followed by a prolonged period of erosion that lasted into the Tertiary.
- Tertiary (about 50 –2 million years ago). Uplift and continued erosion were features and basalt and stream sediments formed in the Miocene (about 20 million years ago).
- Pleistocene (the last 2 million years). Great climatic changes occurred, particularly over the period 70-10,000 years ago, that produced glacial and periglacial features.
- Holocene (approximately the last 10,000 years). The climate and earth processes have been roughly similar to those of today.

## Ordovician to Lower Devonian

### Description

The Ordovician to Lower Devonian sedimentary rocks are mainly sandstone, siltstone and shale forming greywackes deposited in deep marine environments, but including shallow-water limestones found at Cooleman in the northeast, Yarrangobilly in the centre and Indi in the extreme southwest. Some volcanic rocks occur, chiefly in the northern third of the area, including the Mount Jagungal Basalt which is the oldest rock in the park. These volcanics were extruded mainly under marine conditions but include some sub aerial occurrences. Granitic rocks were intruded at depth in Silurian and Devonian times, and now underlie most of the southern half of the park and the Bogong Peaks wilderness area in the northwest, plus scattered occurrences elsewhere. These rocks have been extensively affected by folding and faulting. LAI Wyborn (Table 3 in Good 1992) lists the following particularly significant geological features of this age.

- Geehi Valley: metamorphic rocks with abundant garnet, staurolite and amphibolite;
- Ravine Basin: Devonian shallow water sediments;
- Mount Talbingo: Devonian lava flows forming cliffs;
- Cabramurra serpentine along major faults with nickel and chromium;
- Cooleman Plain: Silurian limestone and chert;
- widespread Ordovician marine sediments forming hard quartzites and softer phyllites and schists;
- Tumut Ponds, Tantangara, Kiandra and Byadbo areas: graptolite fossils;
- The Pilot and Byadbo: Ordovician hard, green, platy quartzite;



*Geology and geomorphology are the basis of the entire Kosciuszko National Park.”*

- Yarrangobilly: Silurian limestones, fossils, shales and tuffs;
- Cowombat Flat, Marble Creek and Pilot Creek: limestones and tuffs;
- Pilot Ridge and Cowombat Flat: Devonian rhyolites and breccias;
- Main Range: three types of granitoid rocks;
- Nungar: folding of Bowning tectonic episode;
- Cooleman: slump bed folding; and
- Black Perry: skarn rock with garnets.

Knowledge of the solid rocks has been enhanced by the extensive and intensive studies required for the Snowy Mountains Hydro Electric Scheme and the ski tunnel between Bullocks Flat and Blue Cow Mountain. Economic minerals, including gold, copper, tin and lead accumulated at many places but mostly as minor occurrences.

After the Mid Devonian, the area was subject to prolonged erosion for some 250-300 million years which exposed the granites and reduced the area to a lowland with ridges on more resistant rocks. Some features of this lowland have been partially preserved by the Miocene basalt: notably, a north-flowing valley near Kiandra. Part of the Great Divide that separates west and east-flowing drainage in New South Wales now occurs in the park.

### **Condition**

These rocks are obviously robust and in their natural condition.

### **Trend in condition**

These rocks are a permanent feature of the landscape and, assuming quarrying and mining continue to be banned, no change in condition is expected. Possibly there may be some reduction in their scenic value if additional buildings and roads are created. No special management is required to maintain their condition other than retention of the existing ban on prospecting, mining or unlicensed collection of samples.

### **Significance**

These rocks form part of the Lachlan Fold Belt that occupies much of eastern Australia (Wyborn LAI 1977). They are of national and state significance. Areas of particular significance at state and park levels are the limestones with associated karst features (discussed by A Spate in Chapter 7). The landforms surviving from the later part of this period and on into the Tertiary are likewise of significance in understanding the evolution of much of southeastern Australia, including the history of the Great Divide.

Gold around Kiandra and the Grey Mare Range, copper and gold at Ravine-Lobs Hole and in the southwest were economically significant and formed the basis of former mining activities. The surviving associated cultural features (discussed in Chapter 13) are now of state and park significance.

### **Pressures**

While the major rocks and landforms are immune to any conceivable pressure, large numbers of visitors can affect their scenic attractiveness by damaging the overlying soil and vegetation. This is occurring around Mount Kosciuszko. It is conceivable that pressure will arise from fossickers seeking fossils in the limestones and interesting minerals such as the garnets at Black Perry Mountain. Construction of roads and building can reduce the scenic attraction of the area.

### **Opportunities**

There is some scope for educational signing at conveniently situated outcrops, notably the quarry on the road between Dead Horse Gap and Tom Groggin. Provision of leaflets setting out the geological story would assist leaders of educational excursions.

### **Knowledge gaps**

There is much scope for more detailed geological mapping in most parts of the park. Research by university and state geologists will gradually meet this requirement (e.g. Wyborn, LAI 1977, Wyborn D 1983). Such future research should continue to be controlled through licensing by the New South Wales (NSW) National Parks and Wildlife Service.

### **Indicators**

In accord with the permanency of the rocks in terms of human lifespan, indicators of changing condition are not apparent in the values themselves but there may be changes in their accessibility and visibility. A good cover of soil and native vegetation indicates good condition while bare rock surfaces, slumps and gullies indicate poor and probably deteriorating condition.

## **Tertiary**

### **Description**

Earth movements in the Tertiary uplifted the area, especially in the south and west, enabling stream erosion to cut deep linear valleys along lines of rock weakness, such as the Thredbo Valley aligned along the Crackenback fault. The dissection resulting from the Tertiary uplift has produced spectacular scenery – notably the mile-high drop from the summits of the Main Range to the Geehi Valley. Miocene basalt extruded over the central part of the park covered stream valley deposits of lignite, silt and clay containing alluvial gold and fossils of rainforest trees. Later erosion has reduced the basalt to scattered remnants.

Notable areas and features of the Tertiary geology as listed by LAI Wyborn (in Good 1992) include:

- Round Mountain: Tertiary basalt flows;
- Kiandra, Cabramurra and Yarrangobilly: columnar basalt pinnacles; and
- New Chum Hill, Golden Crown and Round Mountain: Tertiary sediments.

The wet and warm climate of the Tertiary favoured deep weathering. The effects are still visible in road cuttings throughout the park where granite has lost its cohesion but is still in place. Over much of the park, later erosion has removed some of this unconsolidated material to leave resistant core stones exposed as tors. Some insights into the landform history can be found – for example, the sub-basalt valley at Kiandra and the mature gentle slopes of upper valleys (e.g. Long Plain) perched above deep lower valleys cut by later erosion.

### **Condition**

The major landforms resulting from the geomorphic history of the Tertiary are generally robust, as is the Tertiary basalt. The surviving remnants of the Tertiary stream deposits are liable to loss by erosion. The evidence of deep weathering was clear in fresh road cuts made when the Snowy Scheme was under construction, but in many places it is now obscured by rain wash, slumping and vegetation.

### **Trend in Condition**

While the scenery will survive unchanged in terms of human lifetimes, there will probably be a gradual deterioration in accessibility and visibility of the mining evidence. However, reasonable maintenance should maintain the surviving features indefinitely. Ironically, further loss of evidence of deep weathering in road cuts will be caused by soil conservation measures.

### **Significance**

The spectacular scenery of parts of the park, notably the Geehi Valley, is certainly of Australia-wide significance. The gentler relief typical of most of the park has state-wide significance. The rainforest fossils found in stream sediments under basalt at Kiandra are rare testimony of a time when Australia's climate and vegetation were very different and contribute to understanding the climatic evolution of the entire continent. The alluvial gold was the focus of an important gold rush around 1850, followed by half a century of placer mining. The relics of the mining are significant at state and park levels. The deep weathering of granitic rocks seen in road cuttings is a common feature in Australia and most mid- to low-latitude countries; it is of park significance only.

### **Pressures**

Some increase in tourist pressure on the more accessible mining sites can be expected. However, because these sites are well away from the main attractions of the ski areas and the highest country, such pressures should not be unsustainable. Any attempt to resume mining would greatly increase pressure but is most unlikely to happen.

### **Opportunities**

If major faults are exposed in road cuttings, information notices would be helpful. Public knowledge of deep weathering effects could be furthered by suitable notices. Deeply weathered granite in place is well exposed in road cuts near Island Bend and is regularly demonstrated to geology students on field trips.

### **Knowledge gaps**

There is always scope for more research and knowledge about these rocks and the geomorphic history. Such research is best carried out by academic researchers under park licensing.

### **Indicators**

As was the case for the older rocks, no visible change is to be expected in the rocks themselves but access and visibility may be affected. A good cover of soil and native vegetation indicates good conditions, while bare rock surfaces, slumps and gullies indicate poor, and probably deteriorating, condition of the sites

## **Pleistocene**

### ***Description***

During the Pleistocene, comprising about the last two million years, the world experienced remarkable climatic events, including the repeated growth and decay of immense ice sheets in North America and Europe, while glaciers developed on mountain ranges through the world. In Tasmania there were several extensive glacial events but, on present evidence, in mainland Australia only the very highest land in the Kosciuszko National Park had small glaciers during the last part of the Pleistocene. Cold-climate periglacial processes beyond the ice were more extensive and produced distinctive landforms and deposits.

Glacial features of the park include cirques, moraines, lakes, erratics and ice-scratched surfaces. The cirques formed mainly in the lee of the Main Range where accumulation of snow was maximal and melting minimal. Some 13 cirques have been identified (Galloway 1963, Barrows et al. 2001).

Both terminal and lateral moraines occur. They usually form bouldery ridges but one case of hummocky moraine exists in Mawson's cirque. Radiometric dating of boulders in the moraines has shown that there were several successive ice advances and retreats during the last glaciation (*sens lat*) (Barrows et al. 2002).

There are five glacial lakes. Only Blue Lake is at least partly formed by glacial erosion of the bedrock; the others are shallower features formed by morainic dams. Pollen in lake sediments has provided valuable evidence of vegetation and climate changes since the ice disappeared about 15,000 years ago (Martin 1986).

Glacial erratics are rocks ranging in size from pebbles to boulders which differ from the underlying bedrock. They are believed to have been transported to their present position by former glaciers. Erratics near the cirques provide incontrovertible evidence for glacial transport but elsewhere their significance is problematic because of imperfectly known variations in the underlying bedrock and because rocks on the surface can creep downhill from one lithology to another. Further confusion can be caused by anomalous material imported to make roads and tracks.

Ice-striated surfaces that occur on lower slopes overlooking Lake Albina demonstrate the former direction of ice movement. Ice-smoothed rock surfaces are well developed in Blue Lake cirque.

The periglacial evidence is less striking but more widespread and can be found in most areas above the 1000 m contour and possibly as far down as 600 m. Features include frost-shattered bedrock, boulder fields, solifluction deposits, stone streams, stone-banked lobes, non-sorted steps and nivation features.

Frost-shattered Ordovician sedimentary rock – evidence of former permanently frozen ground (permafrost) - is exposed in a roadside quarry one kilometre east of Mount Kosciuszko. This is almost the only evidence for past permafrost known in mainland Australia. Angular rock debris around tors at high altitude is a product of former frost-wedging.

In many parts of the park, solifluction (the downslope movement of unconsolidated rock debris by freeze-thaw processes, interstitial ice and snow melt) has produced smooth slopes. The northwest-facing slope of the Kangaroo Range is a good example. Where the debris included boulders, the fine fraction may be subsequently washed out to leave boulder fields and stone streams (Caine and Jennings 1968) which are now a favoured habitat for the Mountain Pygmy-possum. Striking block streams, dated to about 20,000 years ago occur at about 1100 m altitude near Ravine. In detail, solifluction can result in irregular low steps formed by the fronts of solifluction lobes and terraces. Sometimes these fronts are barely discernable through soil and vegetation (e.g. on the Kerrie's Range). In road cuttings, solifluction deposits can be seen to fill valleys and gullies cut in the weathered granite.

Nivation is a complex of land-forming processes found in and around long-lasting snow patches, particularly where the ground surface is bare. It includes splitting of rocks by freeze-thaw and mass movement of wet soil and rock debris. In the long term it produces shallow hollows that form incipient cirques; there are many such nivation hollows in the higher parts of the park (e.g. the Rolling Grounds).

### ***Condition***

The glacial features are generally clearly visible, although the older ones have lost much of their pristine form through natural erosion. Glacial erratics have become more difficult to find since the termination of grazing has encouraged vegetation to recolonise bare areas. The periglacial deposits are best exposed in road cuttings and quarries where they gradually become less identifiable because of rain wash, growth of vegetation and soil conservation measures. A road has cut through the block stream at Ravine.

### ***Trend in condition***

Continued obscuring of relevant exposures through vegetation growth and soil conservation measures is to be expected. The quarry showing permafrost evidence near Mount Kosciuszko mentioned above will be concealed for reasons of conservation.



## ***Significance***

The glacial features are of high scientific and educational significance for Australia. They are an outstanding example of a glaciation that developed under extremely marginal conditions (Galloway 1989) and are the only occurrences on the Australian mainland. They also help our understanding of ice age climates. The Helms moraine near Blue Lake is a particularly clear example of glacial transport of one kind of rock onto another. The so-called 'Railway Embankment' moraine near Mueller's Pass is another example. It is also the site of an early estimate for the date of glaciation (David et al. 1901) and is consequently significant for the history of geology in Australia. The periglacial phenomena are amongst the most striking in Australia and demonstrate that the effects of cold climate in the Quaternary spread far beyond the limited glaciers.

## ***Pressures***

The glacial features are well outside the ski resort concessions and consequently should not experience greatly increased pressure although there will be some increase in foot traffic along and near access tracks. The more widespread periglacial features may suffer some loss through building and road construction. On the other hand, such work may expose new examples of solifluction deposits. A more immediate possible pressure is the smoothing of ski runs. In the past there has been some bulldozing on ski runs but such extreme measures are not now employed.

During early stages of constructing the Snowy Mountains Hydro Electric Scheme it was proposed to dam Spencers Creek. This would have seriously affected the integrity of the landforms, especially the ridge known as the David Moraine (whose morainic origin is very dubious). However, the proposal was abandoned and is no longer a problem although traces of disturbance by exploratory excavations still exist.

## ***Opportunities***

There is considerable public interest in the glacial history of the park but the periglacial story is less well known. Opportunities exist for informing the public with signs at appropriate locations. Existing signs may need to be updated in the light of recent research. There is a case for recording features temporarily exposed during construction of roads and buildings. It may be possible to illustrate the development of a small glacier by means of a kaolin model that could be an item in an educational video on the park.

## ***Knowledge gaps***

There is scope for further radiometric dating (Barrows et al. 2002) to increase understanding of both glacial and periglacial history. Current work in progress is successfully dating block streams. More detailed mapping of the granites and inclusions of other rocks therein should assist in resolving the question of exactly how far the ice extended and whether earlier glacial events occurred. There are probably many evidences of past vegetation such as described by Caine and Jennings (1968) still to be discovered under solifluction layers and many more periglacial features remain to be identified. All such research will need to be done carefully in view of the need to avoid damaging the environment.

Knowledge gaps more relevant for conservation include the distribution of periglacial features in relation to proposed development. Also of potential importance is the location of old gullies cut in the soft weathered granite and then later infilled by soliflucted material. The presence of one such gully may have contributed to the Thredbo landslide disaster.

## ***Indicators***

Indicators of changing condition include fresh rock surfaces stripped of their usual lichen cover, soil erosion and damaged vegetation.

## ***Holocene***

### ***Description***

By 15,000 years ago the last glaciers had melted as the climate warmed with the close of the ice age. The tree line, which had been lowered by as much as 1000 m at the glacial maximum, gradually rose to near its present level at around 1850 m. By 10,000 years ago the climate was broadly similar to that of today. Earth science phenomena in the Holocene are intimately interlinked with the development of soils and vegetation.

Holocene land-forming processes in the park include solifluction (less intense than during the Pleistocene), erosion, nivation, frost heaving of soil (Costin and Wimbush 1973), stone movement by snow pressure (Costin et al. 1973) and the formation of string bogs (narrow turf contour ridges separating elongated ponds).

At high altitudes, solifluction of frost-shattered debris and soil on the Ordovician sedimentary rocks has created non-sorted steps, lobes and terraces on slopes. These features are now largely inactive but a slight decrease in mean temperature could reactivate them (Costin et al. 1967).

Erosion of soils and other fine-textured surface materials has been significant in the Holocene. At least 7 m of sediment has been washed into Blue Lake since the ice disappeared 15,000 years ago. This process is still active today and substantial soil erosion control works have been necessary as discussed in Chapter 6 of this report.

Nivation is most active today on the upper slopes overlooking glacial cirques and in other south- and east-facing hollows where thick snow drifts accumulate in winter and survive through spring into summer. Effects of nivation include mass movement of wet unconsolidated material, movement of boulders by snow pressure, frost heaving of soils and accelerated surface wash.

### **Condition**

Over most of the park, Holocene processes and deposits are generally in reasonably good condition but there are limited areas of concern such as the heavily impacted summit of Mount Kosciuszko and parts of ski concessions. It has been feared that 'snow farming' in ski concessions could lead to unwanted surface changes. While this may be true for vegetation and soil (Pickering and Hill in press) the depths of snow involved are substantially less than would be required for full nivation to occur (Galloway et al. 1998). Active stream bank erosion around Blue Lake is cutting away sediments with potential value for dating.

### **Trend in condition**

In the last century and a half stock grazing, road construction, mining and engineering works have had major impacts on the area of the park. The completion of the Snowy Mountains Hydro Electric Scheme, soil conservation efforts and walkway construction have now helped to re-establish more natural, gradual Holocene processes. On the other hand, the increasing tourism in the park and the growth of skiing have inevitably added new pressures. The effects of the 2003 fires and the associated fire-fighting measures such as bulldozing access tracks will also adversely affect the condition for years to come. In future, nivation may be reduced if snowfall decreases as a result of climatic warming. However, no significant change in snow fall is yet apparent even though there has been some warming (Osborne et al. 1998).

### **Significance**

In the park surface processes such as soil erosion, frost heaving and solifluction can be observed under the present climate in a great variety of situations. The park can thus serve as a benchmark for processes in more heavily impacted regions elsewhere giving it state level significance. In particular, it offers comparison with alpine areas in Victoria that are subject to more stock grazing although the advent of horses in the Kosciuszko alpine zone is now tending to reduce this contrast. The pollen evidence for past vegetation and climate is of state and even national significance.

### **Pressures**

Pressures on Holocene phenomena are inevitably linked to changes in park usage with some pressures concentrated in heavily used areas such as Perisher and the Kosciuszko summit. Pressures from bushfires, on the other hand, can occur almost anywhere. These pressures will be apparent through their effect on vegetation and soils.

### **Opportunities**

Study of the depositional history of alluvial fans might throw light on the possibility of flood damage after exceptionally heavy rain. This is a problem in Swiss ski areas and may arise here if more intense rain results from the greenhouse effect. The evolution of alluvial flats over the last six decades could be studied using successive generations of air photographs. This air photo record could also provide a useful picture of the park not long after the great 1939 fires for comparison with what is happening after the 2003 fires.

Climate studies and observations are relevant to Holocene earth sciences. Re-establishment of the Spencers Creek climate station at the same site as in the 1950s and 1960s might be possible using solar-powered, unmanned equipment. This would enable climate change in the mountains to be tracked more effectively. It is important that the existing snow courses are maintained; their value as records of snow history increases year by year.

### **Knowledge gaps**

Topics worth investigating include what effect will the use of artificial snow have on stream processes? How much erosion and other effects might occur in a 100 year flood? Will significant climatic change occur and, if so, what will be its effects on earth processes?

### **Indicators**

A good cover of native vegetation and soil indicates good condition while bare earth and soil erosion indicate bad, and probably deteriorating condition. Monitoring at 10 year intervals of sediment accumulation in lakes and dams throughout the park could provide useful indication of current soil loss rates for comparison with the high rates recorded for parts of the Main Range (see Chapter 6) and with the long record of sediment accumulation in Blue Lake.

### **Acknowledgments**

Useful discussions were held with Dr Tim Barrows and Dr Jim Peterson before these notes were written. Dr Peter Whetton supplied information on climate studies.

# Chapter 6

## soil values

Dr Alec Costin AM

### Introduction

Soils are very complex physical, chemical and biological systems. They provide the life-sustaining pathways of air and water from the atmosphere, through the vegetation, into and through the ground below. In the reverse direction, soils transmit some of the air and water back into the atmosphere. Because soils are mostly out of sight beneath plants, their values tend to be overlooked among other natural values. Kosciuszko National Park differs greatly from other alpine areas in that deep organic soils dominate, whereas in most other alpine areas around the world soil formation is limited. This characteristic has led to the Australian Alps being described as 'mountains of soil' (Costin 1989). It also points to the area's sensitivity to disturbance.

The soils of Kosciuszko National Park are of great scientific interest in themselves. They have attracted international attention as outstanding examples of some of the great soil groups, both individually (the alpine humus soils) and in association with each other (e.g. the alpine sequence of lithosols, snow patch soils, alpine humus soils, bog and fen peats and silty bog soils), and for the associated studies of the pedogenic factors and processes controlling their formation and maintenance (Costin 1989, Good 1992). The scientific value is enhanced further by the large degree of 'naturalness' of the soils, which are relatively unaffected by the centuries of human occupation and associated uses of most mountains elsewhere in the world. Hence they are important natural 'standards', like above-ground reference areas of vegetation (Costin 1954, Costin et al. 2000).

In addition to their scientific interest, soils have vital 'service functions' such as the supply of clean water for domestic and industrial uses, irrigation, hydroelectric power and a wide range of recreational activities. The alpine and subalpine soils of Kosciuszko National Park receive, store, process and supply a larger quantity of high-quality water than any other group of soils on the continent. The soils of the surrounding mountain forests in the park also have valuable hydrological functions. Map 6.1 illustrates broad soil group distributions in the park.

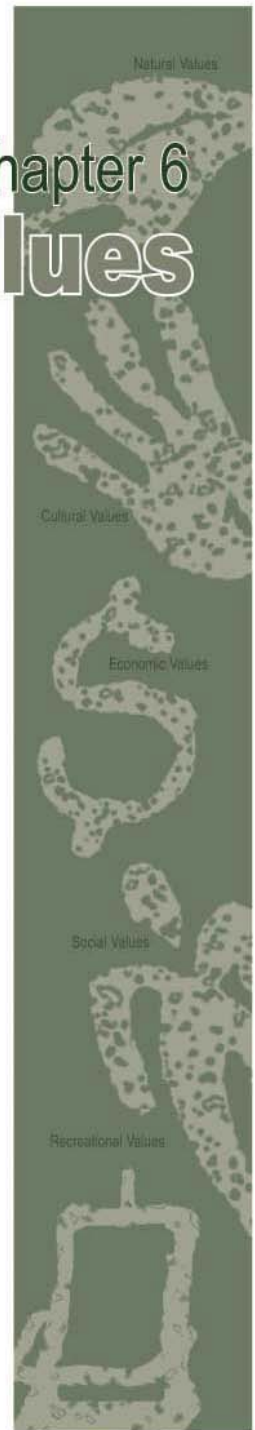
### Basis for management

A major objective of the New South Wales (NSW) National Parks and Wildlife Act 1974 and the biodiversity strategy is the conservation of natural ecosystems, including (i) habitat, ecosystems and ecosystem processes and (ii) biological diversity at the community, species and genetic levels. Soils are an important part of most ecosystems, and are the medium through which many conservation management measures operate. Soils as part of ecological integrity are therefore well protected legally in national parks in NSW.

Because of the importance of the soils of Kosciuszko National Park for catchment protection and water yield, they are safeguarded further by the Soil Conservation Act 1938 and the Protection of the Environment Operations Act 1997. In fact, it was the soil conservation legislation that played an important role in the establishment of Kosciuszko State Park in 1944, and in its subsequent protection and rehabilitation.

### Significance

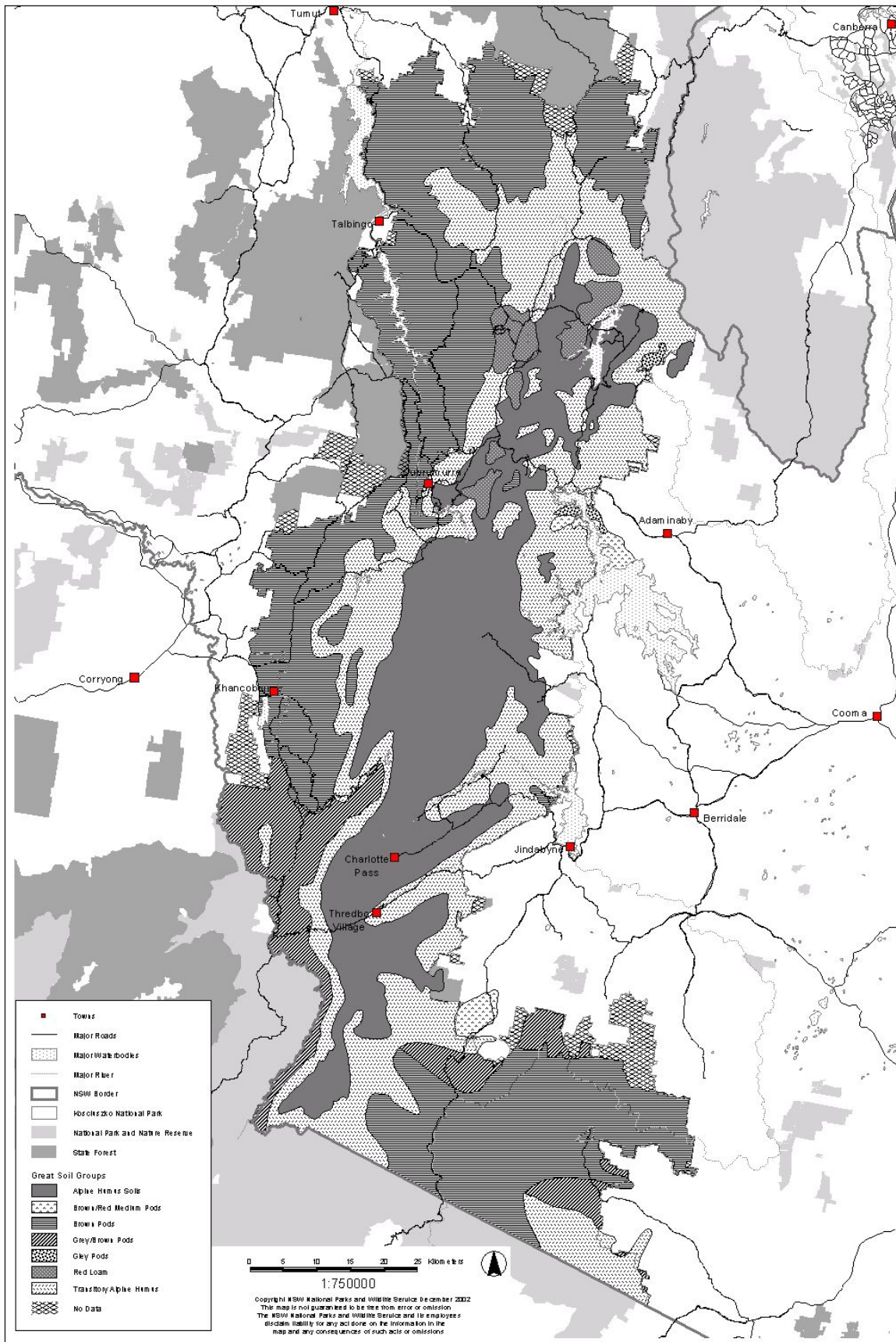
In parallel with the wide representation of plant communities in Kosciuszko National Park, the soils vary characteristically on the semi-continental scale in response to the major pedogenic factors of climate, geology and physiography, down to local aspect and catenary levels (Costin 1954, 1989, Costin et al. 1969, Good 1992). The recognition and understanding of these variations are facilitated in Kosciuszko National Park by its large size and persistence as a relatively undissected uplifted paleoplain, its wide altitudinal (225–2228 m) and climatic range, and the occurrence of soil parent materials as diverse as basic limestone and basalt, acid granites and metasediments.



*Because soils are mostly out of sight beneath plants, their values tend to be overlooked among other natural values."*

Map 6.1

Broad Soil Group Distribution in Kosciuszko National Park



Thus, the dominance of the alpine and subalpine climate on soil formation is seen in the development of one and the same soil group, the alpine humus soils, on all parent materials, in contrast to the increasing dominance of parent material on soil formation at lower levels. On a given parent material over a wide range of altitude, characteristic sequences of soils are developed: for example, alpine humus soils and various podsolics on granites and metasediments; alpine humus soils, krasnozems and chocolate soils (not in Kosciuszko National Park) on basalt; and alpine humus soils, rendzinas and terra rossas on limestone (Costin 1954, 1989).

The importance of the topographic factor (through drainage) also varies with altitude and parent material as expressed in soil catenas: in the alpine–subalpine environment, the lower–catenary soils (bog peats) are the most acid and oligotrophic, whereas at lower elevations the lower–catenary soils (meadow soils) are relatively eutrophic, reflecting the accumulation, rather than dilution and loss, of nutrients. Whilst many native plant species in Kosciuszko National Park are not particularly sensitive to soil nutrient levels, other species, and even whole communities, are nutrient-sensitive, a fact not fully appreciated in park management.

In Kosciuszko National Park the alpine humus soils of the alpine and subalpine tracts are particularly well developed. Important soil processes that have been studied, albeit inadequately, include weathering, soil moisture movement, colloid and nutrient cycling, solifluction, aeolian deposition, soil faunal and mycorrhizal activity and various types of soil erosion and remediation techniques (Costin 1954; Costin et al. 1959, 1960, 1961, 1964; Walker and Costin 1971; Johnston and Ryan 2000).

A notable feature of the alpine humus soils in Kosciuszko National Park is the absence of the podsolisation process normally found in cold wet climates on acid rocks with low-nutrient vegetation. In fact, the reverse situation occurs, with accumulation of soil colloids and nutrients in the surface soil. These soil-building processes involve recycling by the deep-rooted snow grasses and other major herbs, possibly in association with soil mycorrhiza (Johnston and Ryan 2000), accretion of windblown dusts, and vigorous decomposition and redistribution of plant remains by soil organisms, particularly invertebrates, including the mountain earthworm (affin. *Megascolex* sp) (Costin 1954, Good 1992). One of the main conditions under which these organisms can operate is the deep continuous cover of winter–spring snow insulating the underlying soil and its inhabitants. The below-snow surface soil is thus maintained at favourable soil moisture levels at temperatures above freezing. These conditions are not found in mountain areas with colder autumns and early winters and/or subsequent light snow cover (Costin et al. 1969).

The abundant alpine–subalpine insect fauna in Kosciuszko National Park of some 850 recorded species (Good 1992) may also depend on these soil conditions, because eggs, larvae and pupae can overwinter without damage, with an almost explosive emergence of adults soon after the spring thaw.

Kosciuszko National Park encompasses the foremost water catchments in Australia. Historically, appreciation of this significance by the first Soil Conservation Commissioner, Commissioner Clayton, and Premier McKell led to the establishment of Kosciusko State Park in 1944, and appreciation of the importance of nature conservation in the park has continued.

The significance for catchment performance of soil conditions, including surface cover, cannot be overestimated. Surface soil conditions have a controlling role in the balance between non-erosive infiltration of precipitation and erosive surface run-off. Depending on site conditions, surface cover of 70–100% at rates of at least 10 tonnes per hectare (oven dry weight) is necessary for soil protection from frost, wind and storm rains (Costin et al. 1960, Costin 1980, Good 1976). Reduction of surface cover below these levels by former burning practices and livestock grazing led to widespread catchment erosion, especially in the alpine and subalpine tracts. Subsequent protection from these practices has been followed by recovery of ground cover and soil stability in most areas, although some erosion 'hot spots' remain (see below). In the lower elevation sclerophyll forests, current prescribed burning programs frequently reduce cover to below these limits, as well as preventing forest successions from proceeding towards old-growth stages. More attention should be given to a fundamental conservation equation: fuel = catchment cover = habitat.

Along drainage lines within a catchment, groundwater soils have a further controlling role in spreading and filtering catchment run-off before it enters streams. The groundwater soils have to carry a heavy 'water load'; they can function successfully only if they retain their almost level even surface. Incision by gullying and deeper entrenchment impairs these functions, a situation still present in parts of Kosciuszko National Park even though there has been general catchment improvement.

## **Dependence**

Kosciuszko National Park is the only part of southeast Australia that protects such a wide range of mountain soils still in their largely natural condition and in one and the same geographic location. This applies particularly to the snow patch soils, alpine humus soils, bog and fen peats and silty bog soils of the alpine and subalpine areas. They are represented in high mountain parks in Victoria but are still subject to livestock disturbance and erosion there.

## Condition and trend in condition

Surveys of the snow leases and permissive occupancies in Kosciusko State Park, carried out in the 1940s and 1950s by the Soil Conservation Service of NSW, documented widespread soil erosion attributed to the destruction of soil cover by fires and grazing (Costin 1954; Durham 1956; Morland 1949, 1951, 1958ab, 1959, 1960; Newman 1953, 1954abc, 1955abc; Taylor 1956, 1957, 1958ab). Improved fire management and progressive removal of grazing from 1944 to 1958 have been followed by natural stabilisation of most soils in the park, associated with an increase in the soil surface cover on a catchment scale to the previously mentioned levels of 70–100% in amounts of at least 10 tonnes per hectare. Other associated soil measurements in some subalpine areas over a 20-year period show a reduction in the bulk density (ie increased porosity and infiltration of moisture) and an increase in soil organic matter (Costin et al. 1959, 1960, 1961; Wimbush and Costin 1979a). In general, the recovery trend of the last 40–50 years has reached a plateau of relative stability, but not always in the original condition. Near-original conditions have been achieved where sufficient organomineral topsoil remained, but not where topsoil loss proceeded to the residual stony erosion–pavement stage (Johnston and Ryan 2000, Wimbush and Costin 1979abc). This stage will persist for a long time, probably centuries; fortunately shrub regeneration on these stony sites is stabilising most of them. In the alpine zone these stone pavements have reached stability as ‘erosion’ fieldmarks (Good 1976, 1992).

On the Kosciuszko Main Range, and Gungartan and Bulls peaks area to the north, some of these erosion ‘hot spots’ involved losses of up to half a metre of organomineral topsoil over a total area of about 1500 hectares (Good 1976, 1992). Soil losses from the Main Range between Mount Kosciuszko and Mount Twynam were recorded by the Soil Conservation Service of NSW to be in the order of 1.2 million tonnes. Patient, hands-on soil reclamation work by the Soil Conservation Service between 1954 and 1980 eventually stabilised most sites, but there remain eroding edges and run-off/run-on erosion problems requiring future attention.

The problem of incising and eroding peats and other groundwater soils elsewhere in Kosciuszko National Park also requires attention. Measurements over a 20-year period show continuing erosion of stream-bank and stream-bed profiles in subalpine valleys, even though the initial disturbing agents are no longer present. Where incision is less severe, simple water-spreading measures in valley headwaters may halt further degradation. Where there has been only minor incision, a slow upward trend is apparent (Wimbush and Costin 1979c, 1983).

As well as the already mentioned disturbances and trends in the catchment soils of Kosciuszko National Park as a whole, localised soil damage has occurred in many areas, such as that arising from former engineering operations of the Snowy Mountains Hydro-Electric Authority (SMHEA); along transmission lines, roads and management tracks, four-wheel drive tracks, horse riding route pads and walking tracks; and in development sites such as resort areas. Much of the former damage has been repaired, but continuous maintenance work will be required.

## Pressures

The most widespread pressure on the soils in Kosciuszko National Park is that of fire, as it destroys or reduces the protective ground cover, thereby mobilising surface soil and nutrients, and potentially leading to erosion (Brown 1972, Good 1973).

During the last 50 years, there has been a reduction in the number and extent of wildfires, and in recent years there has been a reduction in the number and area of prescribed fires, with a subsequent improvement in cover and soil stability. A policy of no burning now applies in the alpine zone, much of the subalpine zone and the lower Snowy rain shadow area, where the protection of severely eroded soils on steep slopes requires the further build-up and maintenance of ground cover. In most of the remaining forest areas ‘hazard reduction’ or ‘prescribed’ burning is part of their management, but widespread prescribed burning is not practised. Wildfires are less frequent, but they have the potential to initiate extensive soil damage if the burnt areas are subject to fire of high intensity (Brown 1972, Good 1973).

On the assumption that prescribed burning will minimise the risk of future wildfires, there is a perceived need for the periodic reduction of ground cover to below 10 tonnes per hectare. However, this is not necessarily consistent with the needs of catchment protection or nature conservation. Frequent prescribed burning in the ‘safe’ winter period increases the potential for soil nutrient losses, as fire-mobilised nutrients are exposed to several months of erosion and leaching until there is sufficient recovery of vegetation to reabsorb them during the following summer. Such losses are likely to be cumulative and are always downhill. Fire managers in Kosciuszko National Park have a difficult task to get the balance right (see Chapter 12).

Recreational activities present significant, if localised, pressures on soils. As well as soil erosion, surface compaction may result from slope grooming and the use of vehicles on a shallow snow pack. Where pore space in soils is related to many years of previous soil development - as in alpine humus soils - compaction effects may last for a long time. Then there is the problem of slow ‘nutrient leakage’, as of calcium from paved tracks made with concrete or concrete blocks, onto nutrient-susceptible bogs and peats. Such leakage is associated with an increase in less oligotrophic native species and an invasion by weeds. Alternatives to paved tracks are raised walkways, provided any steel that is used is ungalvanised and hence free from toxic zinc that may remain in soils for years (Johnston and Good 1995).



The ability of soils to absorb nutrients and sediment to the benefit of catchment water supply does not necessarily benefit other park values. Nutrients in human urine and faeces, especially phosphorus, can persist for years in recipient soils, as around the many huts in Kosciuszko National Park and on long-abandoned SMHEA campsites, which are now unidentifiable except for their persistent populations of thistles and other eutrophic weeds. Even where there is tertiary treatment of sewage from resort areas, the discharge of the effluent is likely to cause localised soil fixation and subsequent remobilisation of nutrients, with the potential for changes in the natural ecosystems affected. There is an ecological case for the complete removal of sewage wastes from Kosciuszko National Park.

There are also problems of localised soil disturbance and erosion from the activities of feral animals. In the less elevated cold air plains, such as Snowy Plains, rabbit control is an ongoing requirement. Rooting by pigs, with partial destruction of native vegetation and mobilisation of soil nutrients, facilitates weed invasion. The several thousand wild horses in Kosciuszko National Park, apart from their selective grazing effects on native vegetation, selectively frequent mountain valleys that are sensitive to trampling because meadow soils and bog peats are easily incised and gullied. Such effects are seen in the south of Kosciuszko National Park in the Ingegoodbee headwaters. With wild horses there is an obvious conflict between the conservation of natural and recently identified cultural values.

### **Knowledge gaps**

As stated earlier, the soils of Kosciuszko National Park have been little studied compared with most other natural features. As one of the starting points for future work, detailed soil mapping could be considered. Among the attributes mapped would be soil cover, depth, and moisture characteristics, including infiltration capacity. Knowledge of these attributes is relevant to the management of vegetation, fauna and other ecosystem components, and would assist fire planning and resort area management.

Further research is required on the relationship of soils, vegetation and ground cover at different altitudes and aspects of erosion potential (see Chapter 12).

There is a knowledge gap in terms of appreciation and quantification of the thresholds between acceptable and unacceptable levels of vegetation and soil degradation in high-use recreational areas.

### **Opportunities**

Although much has been achieved in the control and management of soil erosion in Kosciuszko National Park, the erosion control programs started many years ago must be continued and accepted as a part of routine resource maintenance works. Specific achievable objectives include the further stabilisation of erosion 'hot spots' on the Main Range and control of their accelerated run-off effects; the rehabilitation of eroding groundwater areas, especially valley bogs, in the alpine and subalpine zones; and the control of soil degradation and erosion in all infrastructure development projects. In view of the rapidly increasing use of walking tracks, especially in the alpine area, the effects of different track systems on associated soils and vegetation should be reviewed and the most appropriate systems more widely applied.

### **Indicators and monitoring**

The long-term vegetation transects in the alpine and subalpine zones should be continued not only for the information they provide on vegetation trends but also for information on the soils. These have been documented by Roger Good and by the Alps Liaison Committee (R Good, National Parks and Wildlife Service, pers. comm., 2002) and a selection of transects for further monitoring could be made.

There are also various photographic records of soil conditions made many years ago by former officers of the Soil Conservation Service of NSW (e.g. Morland 1949, Newman 1953, Taylor 1957). These records should be located, some of the sites should be identified in the field and repeat photographs should be taken at regular intervals (e.g. Main Range, Kiandra, along roads and around construction sites). There is a good case for a professional 'ecological archivist' on the park's staff to coordinate such work.

### **Addendum on fossil soils**

Kosciuszko National Park also contains fossil soils and remnants of fossil soils. Their persistence in parts of the park reflects its relatively subdued terrain and the limited glacial and other types of natural erosion activity. Some of the older soil materials have been able to persist, with present-day soils developed within or over them. They are of high scientific value and practical importance (Costin 1972, 1989).

At the scientific level, the ages of various fossil soils contribute to the evidence of general contemporaneity of Ice Age and subsequent climatic changes at Kosciuszko and mountains in other parts of the world. Certain fossil soil features, notably the non-sorted steps, are among the best examples of their kind; their study has also shown how alpine humus soils developed (Costin et al. 1967, 1969). At the practical level, the depth and extent of slope deposits enhance catchment storage of water, but they present construction problems for engineers and are erosion hazards if disturbed.

The oldest features are topsoil remnants in extensive slope deposits formed by solifluction during previous periglacial conditions. They occur on gentle to moderate slopes on both sides of the mountains, as in the upper Murray Valley between Geehi and Tom Groggin, along the Thredbo Valley and the Snowy Valley at Munyang and below Island Bend. On sites steeper than the angle of repose of unconsolidated materials, slope materials would also have moved downhill but could not accumulate. The age of the buried topsoils, about 30 000 years, indicates when the Ice Age cooling off started (Costin and Polach 1971, Costin 1972).

At higher altitudes in the Snowy headwaters, the age of the fossil peats and sediments overlying surfaces that would have been covered by ice and snow during the Ice Age indicates that this long cold period was on the wane by 15 000 years ago. Identification of pollen grains in the peats and sediments reveals how the vegetation has changed during postglacial time to the present day (Martin 1986ab, 1999).

Solifluction terraces and non-sorted steps record more recent changes in climate, including a cold phase between about 3000 and 1500 years ago (Costin et al. 1967). The stratigraphy and surface soil and vegetation patterns of the steps also show how alpine humus soils at Kosciuszko have originated and developed, including rates of formation of various soil properties.

The peats beneath long lasting snow patches preserve remains of the specialised plants that formed them, together with varying amounts of dust blown in from the west (Walker and Costin 1971, Johnston 2001). Their further study could provide an 'aridity index' for inland Australia during the last several thousand years.

Many of these fossil features are in the Kosciuszko summit area that is now attracting increasing numbers of walkers. Some re-siting of tracks and/or replacement by raised walkways may be needed to minimise trampling damage.



# Chapter 7

# karst values

Andy Spate

## Introduction

Karsts are landscapes formed on rocks with a greater degree of natural solubility than is commonly found. Such areas are characterised by gorges, caves, deranged hydrological systems and many fascinating small-scale landscape features. Karst systems and processes are produced by a complex interplay of geology, soils, biology, climate and time (Kiernan 1988; Hamilton-Smith et al. 1998). The eight karst areas in Kosciuszko National Park are all limestone, although dolomite does occur at Cooleman Plain.

The significance and values of the karst resources of Kosciuszko National Park have been previously summarised in Nicoll and Brush (1976), Spate and Houshold (1989) and Good (1992). Since those times, little has changed in our knowledge of the karst systems except in relation to their biological and cultural values. Surveys reported in Eberhard and Spate (1995), further work by Spate (unpublished) and reviews by Thurgate et al. (2000, 2001ab) have greatly refined our knowledge in this regard, most markedly in relation to Yarrangobilly and Cooleman Plain.


In addition, our understanding of the concepts of the value and significance of these and other Australian karst areas has been refined so that we may be better able to place the eight Kosciuszko areas into their correct rank. It must be recognised that assessment of significance does not produce a finite rank. As our knowledge of these and other Australian sites grows, our concepts of importance and significance will change; thus, our appreciation of individual sites or their contents will evolve.

Over the last three or four decades, the importance of karst has been increasingly apparent, as have the dimensions and importance of its non-geologic values. This is perhaps best demonstrated - and dramatically demonstrated - by the increasing worldwide acceptance of the World Conservation Union (IUCN) guidelines for the management of caves and karst, largely developed by Australians (Watson et al. 1997). These guidelines are already in use by the New South Wales (NSW) National Parks and Wildlife Service (NPWS) for steering plans for management in other parks across the state. Their use has been reinforced by a recent textbook dealing with protected area management (Worboys et al. 2001).

The karst areas within Kosciuszko National Park have a wide range of geological, geomorphological, botanical, zoological and recreational values in addition to their cultural significance to both indigenous people and later arrivals. At least two of the eight areas appear not to have cave systems - or at least not cave systems that can be entered by humans - but they have much of interest. Carne and Jones (1919) reported additional limestone areas, notably on the Main Range, but these seem to be errors or misreporting of locations. These areas are either not listed or dismissed in Lishmund et al. (1986).

The eight karst areas are of local, regional, state or national significance, predominantly from a cultural perspective in the field of scientific endeavour. Some people, including the present author, would argue that certain features are of international significance. Whether these would ever meet the world heritage criterion for 'outstanding universal value' is very much open to discussion.

In addition to the karsts developed in soluble rocks, there are a number of small-scale pseudokarst features, chiefly in granite, scattered across the park, including boulder caves along the Snowy and Ingeegoodbee rivers (Finlayson 1981). Ephemeral caves in ice and snow should also be mentioned in passing (Halbert and Halbert 1972). These sometimes contain many forms analogous to 'traditional' karst caves.



*"The karst areas within Kosciuszko National Park have a wide range of geological, geomorphological, botanical, zoological and recreational values in addition to their cultural significance to both indigenous people and later arrivals."*

All karst and pseudokarst areas in the park have considerable value for interpretation, especially in regard to landscape development and evolution. This is especially true of Yarrangobilly and Cooleman Plain (and perhaps Cooinbil because of its easy access). The show cave tours at Yarrangobilly provide excellent interpretation of caves and karst. The situation is not as good across the rest of the park. The large range of environmental information proffered by karst terrains deserves far greater attention from the NPWS.

A number of the karsts within Kosciuszko National Park were affected by fire in January and February 2003 (Spate 2003a, Spate in press). Details of the impacts on each area are provided below although quantitative measures are not available. It may also be many years before the impacts become evident. The development of the park's karst and dependent caves has occurred over many thousands or millions of years and thus have been exposed to many fire events.

## General discussion

### Description

The eight karst areas within the park (excluding the pseudokarst granite and ice caves) are all developed in Silurian or Devonian limestones or their derivatives (Owen and Wyborn 1979, Wyborn et al. 1990, Spate and Spate in press). Nicoll and Brush (1976) provide details on many of the significant caves. See Map 7.1 for location of karst areas within the park.

All the areas are within the Lachlan Fold Belt, but there are significant differences from a geological perspective. These are described in the introductory chapters in Lishmund et al. (1986), but are not important from a karst perspective.

A grouping of the areas is discussed below, and each area is discussed in detail. It is obvious that the areas are distinct from other NSW karst areas in that they lie near the crest of the eastern highlands - the so-called Great Dividing Range - and are in alpine, subalpine or montane environments; for further discussion of their geomorphic settings see Household et al. (1986). Cooleman and Yarrangobilly have outstanding above-ground karst landscapes, particularly gorges and rising streams. Ravine has unusual Quaternary karst features – perhaps unique in New South Wales.

Each of the areas has distinctive characteristics in terms of topographic setting, broad vegetation type, degree of karstification and degree of karst hydrological integration. Only two areas, Cooleman and Yarrangobilly, have been surveyed for their dependent cave invertebrate populations (Eberhard and Spate 1995), and even these surveys were only at reconnaissance level. Both areas have endemic plant species. Some sites, particularly Yarrangobilly and, to a lesser extent, Cooleman, have significant subfossil deposits, including the Smokey Mouse (*Pseudomys fumeus*) and Thylacine (*Thylacinus cynocephalus*).

### Basis for management

Currently, the management of the eight karst areas is based on ten sets of provisions:

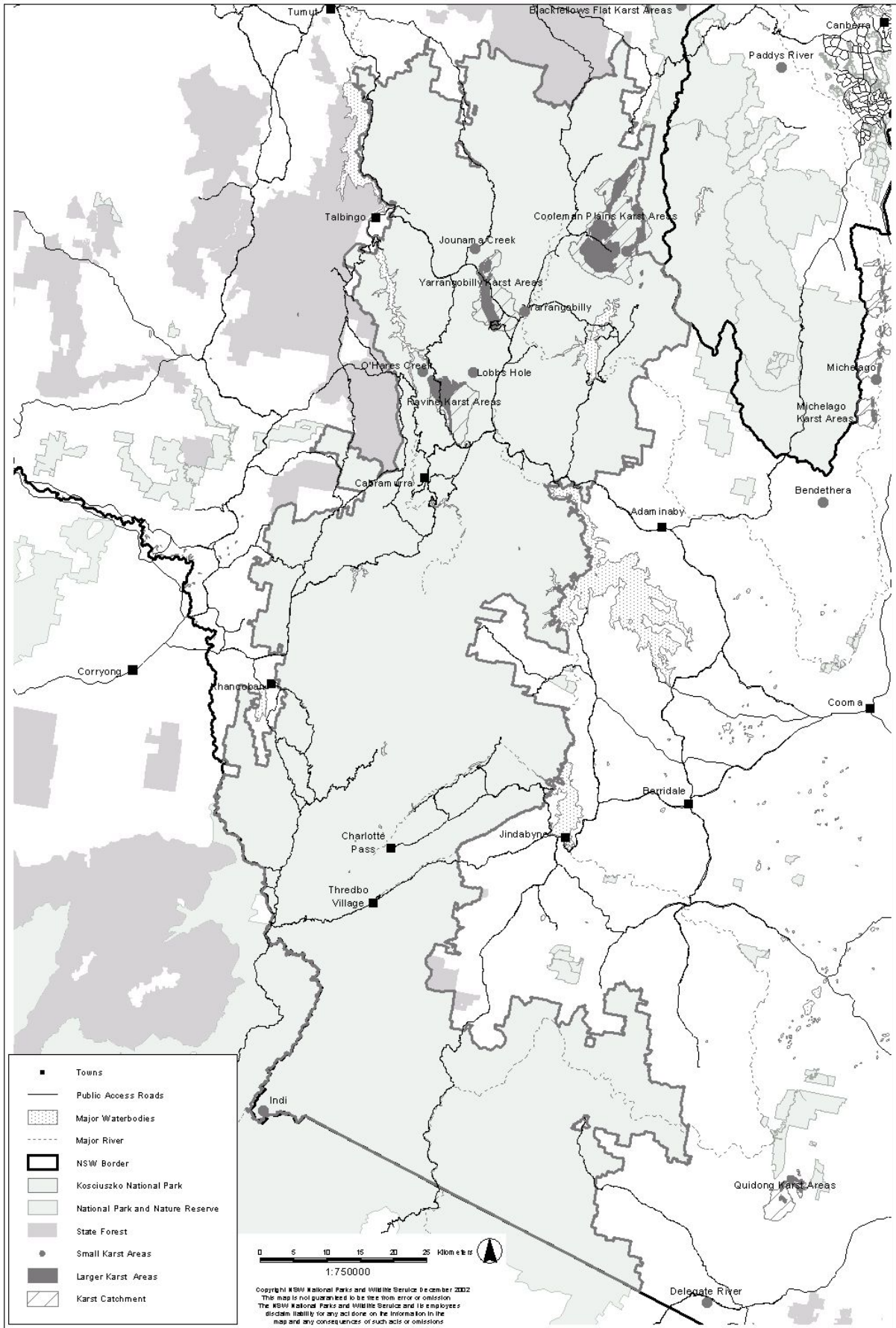
- the National Parks and Wildlife Act 1974 (NSW) and Regulations
- the 1988 Plan of Management for Kosciuszko National Park
- the 1987 Karst Area Plan for the Cooleman Plain Management Unit and consequent amendments to the 1982 plan
- a draft plan of management for the Yarrangobilly Management Unit
- the provisions relating to Kosciuszko National Park's listing on the Register of the National Estate
- the 1999 Kosciuszko National Park Fire Management Plan
- the United Nations Educational, Scientific and Cultural Organization (UNESCO) Man and the Biosphere listing
- the Wilderness Act 1987
- various policy documents issued by NPWS (e.g. field management policies)
- informal policies for cave access at Indi, Black Perry and Jounama Creek.

Clearly many of these instruments will be subsumed into the new Plan of Management for Kosciuszko National Park. However, most of the current management practices are adequate although if better staff resources were available management could be improved.

As mentioned above, the IUCN guidelines should be the guiding principles for future management of Kosciuszko's karst areas. These guidelines will need to be supplemented by specific management prescriptions for each area, and in many cases for individual caves. Previous approaches to cave and karst area management based on such cave classification schemes have been found wanting across Australia. Approaches such as those outlined by Spate and Webb (1998) might be more useful and acceptable to users who regard the 'classification for management' methodology and process as overly proscriptive and clumsy. Worboys et al. (2001) provide a partial list of the range of actions that karst managers should consider in the management and use of these areas.

Map 7.1

Location of karst areas in Kosciuszko National Park



As with all other karst areas under the control of the NSW NPWS (with the exception of Ashford, some small areas in Deua National Park and, perhaps, Yessabah), all eight karst areas in Kosciuszko National Park have their entire catchment areas within NPWS estate. This makes their management easier from the viewpoint of total catchment protection. However, the remoteness and ruggedness of most karst areas presents many management challenges.

### Significance

The significance of the eight karst areas ranges from national to local. Some might argue that aspects of Cooleman and Yarrangobilly are of international significance. Given that the whole park is internationally recognised as a UNESCO Man and the Biosphere Reserve and is nationally recognised as a result of its listing on the Register of the National Estate, an extensive discussion of significance may not be relevant here. The significance of individual areas is discussed below, disregarding UNESCO and National Estate listings.

In general, the suite of karst areas has outstanding or representative significance, at state to national scale, for geomorphology, landscapes above and below ground, and flora and fauna.

Table 7.1, updated from Spate and Houshold (1989), shows the scientific significance of each of the eight karst areas.

**Table 7.1 Degree of scientific significance of eight karst areas in the Kosciuszko National Park, after Spate and Houshold (1989)**

	<i>Geology</i>	<i>Geomorphology</i>	<i>Climate</i>	<i>Hydrology</i>	<i>Sedimentology</i>	<i>Palaeontology</i>	<i>Archaeology</i>	<i>Botany</i>	<i>Zoology</i>
<b>Cooleman Plains</b>									
Representativeness	2	2	2	1	3	3	3	3	2
Outstandingness	2	2	2	2	3	3	3	4	2
<b>Upper Goodradigbee</b>									
Representativeness	3	3	4	4	–	4	3	4	4
Outstandingness	4	3	4	4	–	4	2	4	4
<b>Cooibil</b>									
Representativeness	3	3	4	4	4	–	–	–	–
Outstandingness	4	4	4	4	4	–	–	–	–
<b>Yarrangobilly</b>									
Representativeness	2	2	2	2	2	3	3	3	2
Outstandingness	2	2	2	2	2	3	3	3	2
<b>Jounama Creek</b>									
Representativeness	3	4	4	4	4	–	4	4	4
Outstandingness	3	4	4	4	4	–	4	4	4
<b>Indi</b>									
Representativeness	3	3	3	4	3	4	4	–	4
Outstandingness	4	4	4	4	4	4	4	–	4
<b>Cowombat Flat</b>									
Representativeness	4	4	4	4	4	–	–	–	–
Outstandingness	4	4	4	4	4	–	–	–	–
<b>Ravine</b>									
Representativeness	3	2	3	3	3	4	–	–	–
Outstandingness	3	3	3	3	3	4	–	–	–

1 = international; 2 = national; 3 = regional; 4 = local; – = data not available

## **Dependence**

The karst areas are sites within the park and are thus dependent on the park. They are, in the proper sense of the word, 'unique'. Karst systems are part of complex biophysical processes operating over extended time. Proper management of karst requires environmental conditions to remain essentially unchanged over time, within the bounds of natural environmental variability. However, definition of the time scale over which natural variability is to be considered can be very problematic. For example, even conditions in, and thus management of, two closely related caves such as Jersey and Jillabenan at Yarrangobilly relate to very different time scales, ranging from 10 years to 10 million years. Such time scales are markedly different from those for most natural area management regimes and certainly much longer than political cycles or theoretical enthusiasms.

Recent work by Osborne (2001ab) has brought into question whether the fundamental tenet of karst management - that of whole catchment management - is an appropriate management strategy in New South Wales, given that many eastern Australian karst areas may have developed from rising groundwater rather than sinking surface waters. Osborne's finding may not relate to karst areas within Kosciuszko, but it is worth remembering that simple and long-held management paradigms must be questioned from time to time. Osborne (1996) has also pointed out the important role of sulfide mineralisation in the development of caves at Yarrangobilly and perhaps Cooleman. Both these concepts reinforce the comments above about time scales and environmental variability.

## **Condition and trend in condition**

In general, the condition of all eight areas is stable or improving, except in relation to the spread of weeds and possibly the impacts of feral animals (at Cooleman) and visitor pressures (at Cooleman, Indi and Yarrangobilly). Following the 2003 fire event, Yarrangobilly, Ravine, probably Indi and part of Cooleman are now recovering from fires of various intensity (Spate 2003, Spate in press).

## **Pressures**

As intimated above, pressures on karst areas arise largely from weeds, feral animals and visitor influences. Weed spraying can present considerable challenges in karst areas. Fire and fire suppression activities are also of concern. Holland (1994) and Spate (2003b) discuss the impacts of fire on karst landforms although there is little quantitative information on this subject anywhere in the world.

## **Knowledge gaps**

There has been considerable research at Cooleman and Yarrangobilly, focused largely on cave documentation, karst geomorphology and hydrology, terrestrial vegetation and cave-dependent fauna. Much more research, survey and documentation work could be done in these and other areas. Particular issues include terrestrial flora, subterranean fauna, hydrological relationships, long-term fire history and landscape evolution. As pointed out above, the manifold values of karst provide many opportunities for research and interpretation of natural environments.

The remoteness, ruggedness and problems inherent in using biocides in karst landscapes point to biological control as the only effective methods for weed control in these areas (and much of Kosciuszko National Park).

## **Opportunities**

Strategic management of the karst areas requires consideration of the maintenance of essentially natural conditions upstream and over the karst itself, on one hand, and visitor management, on the other. There are bound to be conflicts between the hopes and aspirations of users and management.

In general, the management of Kosciuszko karsts is adequate but could be improved by better control of weeds and perhaps feral animals, by more involvement of staff (especially at Cooleman and Indi) and by recognition that the availability of caves and karst is finite and that many karst features are essentially unrenewable or unrepairable, especially in human time frames.

The 1999 Kosciuszko National Park Fire Management Plan specifically addresses karst management in relation to prescribed burning and wildfire suppression. Further management guidelines and policies are set out in the various documents referred to above.

## **Indicators and monitoring**

Experience elsewhere in NSW and around the world points to the difficulty of establishing effective and reliable indicators for environmental monitoring in karstic terrains without costly monitoring programs and practices. This is particularly so given the range of environmental parameters that go to support karst and karst processes. These parameters include geology, topography, soils, climate, vegetation and, importantly, time. Some suggestions are made below for individual karst areas.

## The areas

The eight areas are considered in turn below. They fall into four groups based on geology and location as follows:

- Cooleman Plains, Upper Goodradigbee (which includes part of Bimberi Nature Reserve) and Cooinbil - Silurian limestones
- Yarrangobilly and Jounama Creek/Black Perry - Silurian limestones and skarns
- Indi and Cowombat Flat in the upper Murray headwaters - Silurian limestones
- Ravine (O'Hares Creek–Lobs Hole) - Devonian and Quaternary limestones.

The first three have varying proportions of subalpine grasslands and forests and montane forest communities. Ravine has been highly disturbed by grazing, fire and weed invasion and appears to be somewhat of a rain shadow area. The 1982 plan of management defines the main environmental type at Ravine as montane forest but this is somewhat misleading.

### Cooleman Plains

#### Description

For the purposes of this discussion, the 1982 Cooleman Plain Management Unit has been split into Cooleman Plain above the Cave Creek junction with the Mount Murray branch of the Goodradigbee River, and an area termed Upper Goodradigbee, which is discussed below. Parts of both areas lie within the Bimberi Wilderness.

The best general description of the area is to be found in the Cooleman Plain Karst Area Management Plan, adopted in July 1987 as a supplementary plan to the Kosciuszko National Park Plan of Management and formalised in the 1988 amendments to that plan.

The area includes the very popular car-based attraction of Blue Waterholes (the largest karst spring in the mainland part of the eastern highlands), a number of spectacular gorges, many caves and other karst features. It is a popular walking and horse riding area, and includes a number of sites of significance for both Aboriginal and European cultural heritage. Perhaps the most important of these is the Coolamine homestead complex. Grazing continued on part of the area until 1977.

#### Significance

Spate and Houshold (1989) argued at the First Fenner Conference that aspects of Cooleman Plain had levels of significance ranging from international to local in a number of fields of scientific endeavour. They suggested that the quality and range (and citations) of the geomorphological and hydrological research conducted by the late Joe Jennings and others gave credence to a view supporting international significance. The gorges, blind valleys, springs, caves and other karst features, including the probable exhumed Devonian karst features around 'Bung Harris Dam', are an important part of the suite of Australian karst landscapes. Others argued, in discussion at the conference, that the grounds for international significance were overstated.

Since 1989, work conducted by Eberhard and Spate (1995), reviewed in Thurgate et al. (2001ab), has demonstrated the presence of a number of aquatic crustaceans of considerable significance. These aid our understanding of the evolution of the fauna of continental Australia (George [Buz] Wilson, Australian Museum, pers. comm., 2000). Thus, this aspect of the significance of Cooleman Plain rises from regional to national. Table 1 above gives an overall assessment of the scientific significance of Cooleman.

There is much more to Cooleman Plain than scientific values, as evidenced by the number of visitors, including many who have come back frequently over many decades. The area is important for both active and passive recreation; as a destination; for its indigenous and European heritage of occupation, grazing and use of caves; and as a gateway to other parts of the park, notably the Bimberi Wilderness and Namadji National Park. Its significance for these sorts of values is at least at a regional level.

#### Dependence

The Cooleman Plain area is a very important part of Kosciuszko National Park. Much of its importance is dependent on its karst values - aesthetic, scientific and recreational. This was recognised in the 1982 plan of management through its identification as an area of 'Outstanding Natural Value' and as requiring a specific set of planning and management strategies that culminated in the Karst Area Management Plan.

Its values are dependent on the maintenance of its natural values on one hand and on the various cultural features on the other. It provides both a significant destination and an access route - features that render it susceptible both to 'being loved to death' and to being over-managed. Keeping the Blue Waterholes area in a natural condition but allowing heavy use is a particular challenge.

#### Condition and trend in condition

Most of the area is in good condition. Recovery following cessation of grazing, especially by rabbits, is proceeding adequately, although it is slow on some sites, particularly on the Blue Waterholes geological formation. There is some concern about the apparent dominance of Needlebush (*Hakea microcarpa*) and Poison Pimelea (*Pimelea pauciflora*), but this appears to be a successional phase in the recovery of the sod tussock grasslands.

Other than the impact of campers and managers - specifically at Blue Waterholes and environs - the most disturbing impacts at Cooleman are from horses and walkers, especially in Nicole Gorge up to Murrays Cave, and from illegal use of four-wheel drive vehicles away from the Blue Waterholes fire trail. Weeds, particularly briar, blackberry and willows, are also a problem, but on more limited areas, concentrated along Cave Creek, particularly below Blue Waterholes, and around the margins of the plains. Pigs are of concern around the margins and along the foot slopes, and feral horses are an ongoing concern. It can be argued that management activities such as roading and provision of facilities such as toilets and interpretive structures have also contributed to impacts on the environment.

Four caves have been quite heavily used by visitors over a long time. They are relatively robust, and in several of them occasional floods repair some of the visitor impacts. Without on-ground ranger presence, it is impossible to better manage these caves, so their use has been freely permitted in an attempt to divert attention from other, less-impacted caves. Disturbance is apparent in all of these, but is not regarded as critical, although three of the four have only a limited ability for self-recovery.

### **Pressures**

As noted above, the pressures on this area arise from the presence of visitors, weeds, feral animals and illegal activities. Wildfire and fire suppression activities are of potential concern. The issues are addressed in the 1999 Kosciuszko National Park Fire Management Plan.

The 2003 fires burnt the area north of the Blue Waterholes Fire trail both as backburn and wildfire. Although the area has not been closely examined it would appear that the lack of fuel on the grasslands and in the gorges has not led to significant impacts on this area.

There may be potential for visitor use to impact on water quality at Blue Waterholes. Water testing over many decades has indicated that the plentiful algae at this site are a natural feature. Sediments, perhaps arising from overgrazing and consequent erosion, have partially silted up the main rising at Blue Waterholes and will be in train through the system for many millennia.

### **Knowledge gaps**

The Cooleman Plain Karst Area Management Plan identifies a number of research avenues available or needed in the area. Because of the many years of research at Cooleman, we probably have better knowledge of this area than much of the rest of the park, with the exception of the alpine areas. However, historical research into indigenous values and uses of the area and into biospeleological aspects deserves attention. Examination of the Campbell papers<sup>1</sup> in the National Library of Australia if and when they become available, may provide much of interest on both European and Aboriginal use of the area.

### **Opportunities**

Management of the area should continue to be as outlined in the Karst Area Management Plan, the 1999 Kosciuszko National Park Fire Management Plan and the currently used policies and practices for cave access.

Management of the Blue Waterholes area requires considerable, careful attention, both to prevent ongoing degradation and to avoid over-development, which has led to some degradation in the past. Placing of infrastructure requires considerable care for both aesthetic and karst sensitivities viewpoints.

There may well be a need to consider carefully the management of both feral horses and horse riding, especially in gorges.

### **Indicators and monitoring**

There is a demonstrable need to monitor the spread of weeds and the activities of horses and pigs, and to act where necessary. It is suggested that a formal photo-monitoring program be instituted to document any environmental changes in:

- foot tracks in the gorges;
- horse tracks in the gorges;
- creek crossings in the gorges;
- visitor impacts in Murrays, Cooleman and Barbers Caves; and
- campsites, fireplaces and various sites in the Blue Waterholes environs (particularly access points to the Waterholes themselves).

## **Upper Goodradigbee**

### **Description**

Upper Goodradigbee is defined here as the various karst features along the Mount Murray branch of the Goodradigbee River, above the Cave Creek junction, and those along the Goodradigbee River down to Brindabella, below the Cave Creek junction. Most of the area is within the Cooleman Plain Management Unit as defined in the 1982 plan of management but some is within Bimberi Nature Reserve. It all falls within the Bimberi Wilderness.

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<sup>1</sup> The Campbells of Duntroon were early settlers of the area and the family papers are under embargo.



Its remoteness suggests that it should not be considered, in a management context, in conjunction with Coleman Plain proper. There are also some geological grounds for this argument. Many of the caves are described in Montgomery (1971).

The area is accessed by foot through the Bimberi Wilderness from Mount Ginini, from Pockets Saddle, or from Blue Waterholes.

There are a number of items of natural and cultural heritage value, including a number of caves, Aboriginal sites and a cave bat roost.

### **Significance**

The significance of Upper Goodradigbee is probably at best regional to local (Table 1). However, the long-documented Aboriginal heritage (Spate 1993) and recent discoveries reinforce the importance of this area. Its pristine nature adds to its value.

### **Dependence**

The area is an important part of Kosciuszko's heritage.

### **Condition and trend in condition**

The condition is stable apart from the spread of weeds and perhaps of feral animals.

### **Pressures**

The remoteness of this area and the lack of disturbance mean that this area is in good condition. Weeds and feral animals are a problem, especially blackberry, briar, pigs and possibly horses. Some illegal horse riding occurs in the area, and perhaps construction of yards and camping areas has taken place.

The area has not been inspected since the 2003 fires. The presence of forest and understorey and steep slopes may have resulted in high fire intensities and some destruction of surface karst features or sedimentation of caves.

### **Knowledge gaps**

The area is not well known. There are persistent written and oral historical accounts (Spate 1993) of significant items of Aboriginal heritage associated with caves, and recent discoveries perhaps confirm these accounts. The area has not been investigated for its biospeleological values. One cave is probably an important roost for the Large Bentwing Bat, *Miniopterus schreibersii*, although at what stage in its life cycle is not known. The roost here is probably part of the population dependent on the maternity site in Church Cave, Wee Jasper.

### **Opportunities**

Specific site management practices have recently been instituted to protect Aboriginal heritage sites. The area should be managed under the provisions of the Coleman Plain Karst Area Management Plan, the 1999 Kosciuszko National Park Fire Management Plan and the existing provisions of the Bimberi Nature Reserve Plan of Management.

### **Indicators and monitoring**

No specific recommendations are made for this area. However the spread of weeds in remote areas such as this should not be ignored and efforts should be made to provide some form of long-term documentation of condition.

## **Cooinbil**

### **Description**

The tiny Cooinbil karst (< 2 hectares) is a fascinating site. It is within the 1982 Long Plain Management Unit. Although located very near the intensely used Cooinbil Hut horse use area, it is not disturbed by current park use.

### **Significance**

The area has local significance, but is potentially significant a site for education about and interpretation of karst and the impacts resulting from climate change and European occupation.

### **Dependence**

There is a relatively robust and accessible display of a range of surface and subsurface karst features.

### **Condition and trend in condition**

The condition of the area is stable at this time, but is demonstrating the impacts of post-glacial climate change, Aboriginal burning regimes and possibly some impacts of European settlement, *via* erosion that may be a result of rabbits, grazing or fire.

### **Pressures**

There may be some pressure from visitor use associated with horse riding and weeds. This area was not burnt in January/February 2003.

### **Knowledge gaps**

There has been no proper assessment of this fascinating site, but it is unlikely to possess significant biospeleological values.

### **Opportunities**

The site has potential as an interpretation site for karst and the impact of factors such as climate change and grazing on karst.

### **Indicators and monitoring**

The spread of weeds, and the potential impacts of horses and pedestrians, should be monitored and controlled if necessary.

## **Yarrangobilly**

### **Description**

The 1982 Yarrangobilly Management Unit (Management of Outstanding Natural Resources) includes the very large Yarrangobilly karst area. Parts of the management unit lie within the Goobarragandra Wilderness. It also includes the Jounama pine plantation (currently being harvested and returned to native species) that partially overlies the karst. There is also a small, and enigmatic, part of the Yarrangobilly karst in the Bogong Peaks Management Unit (Management of Special Scientific Values) and the Bogong Wilderness. This area, to the west of the Jounama pine plantation, is of uncertain hydrological affinities and lies in the Jounama Creek catchment rather than that of the Yarrangobilly River.

The Yarrangobilly karst area is considered in one block in the discussion below, but can be arbitrarily split into three broad zones based largely on the degree of disturbance, visitor use and management intensity. From south to north these are as follows:

- the show caves precinct (up to the north side of Harriewood Gorge and including Grotto and Castle caves), which is intensely disturbed, used and managed; this area has been termed the Yarrangobilly Caves Precinct in a variety of planning documents;
- the so-called Yarrangobilly 'Plateau' from Harriewood Gorge to the north side of Wombat Creek (the creek line along which Yans Crossing fire trail runs), including all drainage to Coppermine Cave. Cave access is tightly controlled but the area is little disturbed (except by the presence of the Snowy Mountains Highway) and is minimally used. The area has allegedly not been burnt by wildfire since 1909 (Jack Bridle, Talbingo, pers. comm., November 2002); and
- this area is largely north of the Snowy Mountains Highway and includes the former Yarrangobilly racecourse, Garnet Hill, Yarrangobilly village and Jounama pine plantation; and a small area in the headwaters of Jounama Creek around GR 305 567 (Yarrangobilly 1:25,000) - outside of the 1982 Yarrangobilly Management Unit but within the Bogong Peaks Management Unit and. This area is intensely disturbed, being heavily used for recreation, pine harvesting and rehabilitation.

There are several hundred caves at Yarrangobilly as well as a large number of other karst features (for example, blind valleys and pinnacle fields like 'The Tombstones'), endemic plants and animals (including rare and endangered species), and a considerable number of European cultural features. The number of Aboriginal sites and cultural features appears to be limited, although this may reflect a lack of knowledge rather than the actual situation. This is changing through better communication with the local Aboriginal Land Council and through identification of whole-of-landscape values as well as specific sites.

The area south and west of the Snowy Mountains Highway (that is, the first two zones defined above were burnt by wildfire and backburn in January 2003. The fire varied very widely in intensity dependent on fuels, slopes and weather conditions. The impacts are further discussed below.

### **Significance**

The scientific significance of the Yarrangobilly karst area is summarised in Table 1. The levels of both scientific and cultural significance range from local to national. These assessments have been reinforced most recently by NPWS (2000). There is a suite of rare and endangered plant and animal species here as well as limestone-endemic species. The Blackthorn species, *Bursaria calcicola* and *B. spinosa* var. *lasiophylla* have recently been identified. The presence of the latter variety is of considerable interest as it is the host for the Bathurst Copper Butterfly, *Paralucia spinifera*, and its associated ant, *Anonychomyrma itinerans*. If the butterfly is confirmed at Yarrangobilly it will be a very large extension of range for this rare and endangered species. There are significant subfossil deposits within some of the caves.

The area has very considerable aesthetic and recreational significance. The gorges, blind valleys, springs, caves and other karst features are an important part of the suite of Australian karst landscapes and a number are described in the Australian Landform Example series published in the *Australian Geographer* and are thus of national significance. A very large number of recreational activities are undertaken within the management unit and karst area. The area is recognised nationally as a site of very great recreational value (Davey 1984). The show caves at Yarrangobilly are widely recognised for the excellence of their speleothems and for the quality of their cave tours.

## **Dependence**

As with all karst areas, the ongoing health of the karst requires that soil and vegetation conditions remain essentially unchanged through time. However, it must be recognised that karst areas and processes provide some buffer to environmental change and that the area provides a record of environmental conditions going back many million years.

Visitor pressures on the surface and underground need to be managed, as do wildfire, fire suppression activities, and maintenance activities on the Snowy Mountains Highway and in the caves precinct.

## **Condition and trend in condition**

The condition of the karst area varies enormously from very intensely disturbed (e.g. Jounama pine plantation, Yarrangobilly village, along the Snowy Mountains Highway and in the Yarrangobilly Caves Precinct) to completely pristine (e.g. deep in North Deep Creek Cave). Recent work on the mosses, comparing the situation between 1906 and the late 1990s, shows just how insidious vegetation change can be (Downing and Oldfield 2002).

The condition of the cultural resources similarly ranges from very actively managed, as is Yarrangobilly Caves House, to the decomposing ruins of Spicers Hut.

Weeds are an ongoing, severe and possibly intractable problem, especially in the precinct, in and around the plantation and along rivers and creeks. Feral animals are not currently as big a problem as they have been in past decades. There is a certain irony in the fact that blackberries may be providing protection from feral cats for the endangered Smoky Mouse (*Pseudomys fumeus*).

## **Pressures**

Pressures on the area are evident from the discussion above: fire, visitors, weeds, feral animals, inappropriate management operations and possibly climate change all present challenges. Several of the caves (for example, Village, Coppermine and Old Inn Caves) are all susceptible to 'illegal' caving pressures and therefore may be more at risk than those less easily located.

Specific issues that confront the Yarrangobilly karst include maintenance of the Snowy Mountains Highway and Main Road 324. The use of salt for de-icing on the highway is of concern. The sewerage system at Yarrangobilly Caves is undergoing a much-needed upgrade, which will reduce pressures from this source.

The wildfire and backburn that occurred in January 2003 has had a greater affect on Yarrangobilly than on the other karst areas within Kosciuszko National Park although the Indi area has not been inspected (Spate 2003, Spate, in press). The much lower slopes there probably mean that fire intensities were lesser. At Yarrangobilly the intensities ranged from unburnt through the entire spectrum to extreme (or beyond) fire behaviour.

There appears to have been no direct impact on the caves at the time of writing (mid-April) although there may have been some sediment transfer into caves and dolines. The absence of torrential rainfall in this area has certainly helped in this regard. However, there are many unstable, steep, soil and scree deposits on slopes of up 50° - much more movement on these of these can be expected.

In areas of high intensity fire, there has been spalling or calcining (the conversion of limestone to calcium oxide, quicklime) of the limestone surface (Holland 1994, Spate 2003b). This results in a white, rather than blue-grey, limestone surface and some localised destruction of minor solution features. Judging from experience in Tasmania and in the nearby Jounama Pine Plantation the transition it will take a few decades before the limestone surface are re-occupied by the algae and lichens which give these limestones their characteristic colour. New karren to replace that destroyed will take centuries. By the very nature of karren fields, they do not usually have much fuel and thus any destruction is very localised.

These karst landscapes have not developed in the absence of fire and we have the very human difficulty of relating our 'three-score years and ten' to that of complex biophysically produced landforms and ecosystems. However, fire disturbance is in addition to the impacts produced by human use of these areas.

## **Knowledge gaps**

The Aboriginal resources of the management unit and its karst area are inadequately documented. More work is required on the biospeleological aspects, especially on the aquatic fauna, which appears to be depauperate at Yarrangobilly, unlike similar-sized areas across New South Wales.

Although there has been some research into the sediments in Yarrangobilly caves, this is incomplete and little has been written up. A record of bushfires preserved in Jersey Cave is nearly half a million years old and is currently receiving research attention.

Survey work in the mid-1970s identified a number of limestone endemics amongst the higher plants; this should be confirmed.

## **Opportunities**

There is an adequate basis for management under the existing provisions of the 1982 plan of management, the 1999 draft karst area management plan, the Jounama Environmental Impact Statement and the policies and practices in place for cave access.

However, even if the instruments exist, there is a need for more active management of areas such as Yarrangobilly village, for better area-wide interpretation (for which there is an amazing array of opportunities in very many disciplines) and for a better understanding of the nature and distribution of the resources of the area.

Weeds, wildfire and wildfire suppression activities are all of ongoing concern.

### ***Indicators and monitoring***

There is a demonstrable need to monitor the spread of weeds and the activities of feral animals and to act where necessary.

It is suggested that a formal monitoring program be instituted to document changes in:

- the distribution of weeds;
- tree lines in the Y45–Garnet Hill–Yarrangobilly village area;
- vegetation change on the Yarrangobilly plateau;
- European cultural sites outside the Yarrangobilly Caves Precinct;
- visitor impacts in both show and 'wild' caves; and
- campsites, fireplaces and various sites around Yarrangobilly village.

## **Jounama Creek/Black Perry Mountain**

### ***Description***

The area consists of a north-westerly extension of the Silurian Yarrangobilly Limestone in the valley of Jounama Creek and its tributary Cave (or Clive) Creek. Most of the carbonate rocks are found in the highly metamorphosed and mineralised ridge that forms Black Perry Mountain. A single small, and unusual, cave is found high up on the eastern flank of the ridge and 15 small caves are found further north in the Cave Creek valley. Other areas of limestone may exist on Jounama Creek below the Cave Creek junction. The area is within the Bogong Wilderness and the Bogong Peaks Management Unit (as defined in the 1982 plan of management) set aside for the 'Management of Special Scientific Values'.

The Black Perry ridge is accessed by foot from the Snowy Mountains Highway. The caves in Cave Creek are best accessed from the Waragong fire trail.

This area was not burnt in early 2003.

### ***Significance***

The significance of the karst and caves is probably little more than local, although the cave on Black Perry may rank more highly than this. The topography and mineralisation of Black Perry Mountain and the ridge leading to it are of state to national significance. At least one mineral present here (Babingtonite) is only known from a few (perhaps only two) other localities worldwide (Gole 1981).

### ***Dependence***

The continued existence of the unusual minerals is dependent on collection only under a NPWS scientific consent. The karst features require continued catchment, soil and vegetation stability to maintain their current environmental conditions.

### ***Condition and trend in condition***

Other than the spread of weeds, chiefly blackberries, briar and *Pinus* wildings from the Jounama pine plantation and from the plantations to the west of the Tumut River, the environmental condition is stable. The caves are very infrequently visited and are in excellent condition.

### ***Pressures***

The spread of briar, pine and blackberries and possibly wildfire threaten the area.

### ***Knowledge gaps***

The caves have been relatively thoroughly documented. Archaeological values appear to be absent and geomorphic values appear minimal. The area has not been assessed for its biological values.

### ***Opportunities***

The area requires no specific additional management, weed control is more than desirable, but probably impossible given the access difficulties. Current cave access conditions are adequate.

Some 'vista clearing' and good interpretation at the Black Perry rest area on the Snowy Mountains Highway would be valuable because Black Perry Mountain is an unusual and spectacular landscape element.

### ***Indicators and monitoring***

The spread of weeds should be monitored.

## **Indi**

### **Description**

This small area consists of two small limestone lenses north of McHardies Flat on the upper Murray River. There may be more limestone outcrops further north. They are accessed via four-wheel drive tracks from Victoria (with little prospect of these being closed) and are essentially isolated in winter. Indi is within the 1982 plan's Murray Headwaters Management Unit (Management of Outstanding Natural Resources). Part may lie inside the Pilot wilderness, depending on exactly where the wilderness boundary runs.

The area is unusual in that the 13 small caves are perched on a small terrace 10–15 metres above river level. It is not known if this bench is structural or a river terrace cut in the limestone. The caves appear to be hydrologically isolated by thick clayey sediments in their lower parts, so small ephemeral lakes exist in wetter periods.

It is not known if this area was significantly affected by wildfire in early 2003 as inspection has not been possible. The lower slopes and lesser fuel loads on this karst probably mean that fire intensities were not high and thus impacts may not have been high. The catchment geometry means that erosion and sediment deposition will probably not be an issue.

### **Significance**

The significance of the Indi karst is local to regional (Table 1). Although some research on the geomorphology of the karst and its regional setting has been undertaken, the results have not been published.

The regional level of significance here arises from the perched watertable, the possible palaeoclimatic significance of the clay sediments, and the associations with Aboriginal prehistory (Spate 1993). The area has not been adequately surveyed for its biospeleological attributes, especially aquatic invertebrates.

### **Dependence**

The ongoing stability of this area is dependent on the maintenance of soils and vegetation of the site.

### **Condition and trend in condition**

The condition of the area is generally stable apart from the spread of dense thickets of blackberry along the Murray River and some problems with other woody weeds. Feral animals may be a problem.

Closure of the Murray River vehicular crossing has allowed for some improvement in the area's condition.

### **Pressures**

The spread of weeds is an ongoing issue. As was demonstrated several years ago, fire suppression activities may present problems, as the values of the area are not well known. Remoteness and unfettered access have resulted in some excessive visitor impacts such as rubbish, graffiti and un-needed 4WD tracks.

### **Knowledge gaps**

The biospeleological aspects deserve further attention. Documentation of the European history might prove of interest. For example, it would be interesting to know who McHardie (of McHardie's Flat) was.

### **Opportunities**

The need for weed control, especially along the river, is demonstrable, but such control is probably impossible. Only closure of the Victorian track would seem to offer options for better regulation of the use of the caves. Some gating might be used to protect some parts of some caves but the remoteness means that the required inspection and maintenance are probably not going to occur.

### **Indicators and monitoring**

The remoteness of the area means that almost all cave use is unregulated and the levels of use are unknown. Thus some monitoring of cave condition is required. Monitoring and control of weeds and feral animals are also required.

## **Cowombat Flat**

### **Description**

Cowombat Flat, precisely on the border between Victoria and New South Wales, possesses a few small dolines, demonstrating that there are both soluble rocks and a subterranean drainage system. A karst system must be present, albeit in an area of only a hectare or so. The NSW part is within the Pilot Wilderness and the 1982 Murray Headwaters Management Unit.

It is not known if this area was significantly affected by wildfire in early 2003 as inspection has not been possible. The lower slopes and lesser fuel loads on this karst probably mean that fire intensities were not high and thus impacts may not have been high. The catchment geometry means that erosion and sediment deposition will probably not be an issue.

### **Significance**

The area's significance is at the local level.

### **Dependence**

As in all karst areas, there is a need to maintain soils and vegetation in their natural condition.

### **Condition and trend in condition**

I have not visited this area for many years so cannot provide a definitive statement about the area's condition other than to say that it was in good condition in the mid 1980s, with some modification resulting from human activities.

As both sides of the state border are now within defined wilderness areas, and vehicular access is barred, the condition of this area should improve if weeds and feral animals are held in check.

### **Pressures**

Pressures on the area arise from weeds, horses, pigs, remoteness, ignorance and cross-border management differences.

### **Knowledge gaps**

The remoteness, setting and site mean that we know virtually nothing about the karst, karst processes or biological attributes of this site. It has a low priority for research into karst.

### **Opportunities**

Weeds and feral animals should be controlled as necessary. Continued control of vehicular access and maintenance of the tree lines (where humans have planted trees) are also recommended.

### **Indicators and monitoring**

Monitoring of weeds, feral animals and tree lines is needed.

## **Ravine (O'Hares Creek–Lobs Hole)**

### **Description**

Although there is a great deal of limestone at Ravine, most is very thinly bedded, flaggy or impure and thus karst features are generally absent although there are persistent rumours of caves and one photograph of a cave entrance alleged to be on O'Hares Creek has been seen by the author. Andrews (1991) and Dunkley (2002) have discussed the journals of Granville W C Stapylton that contain a reference to "*Limestone Rock and Entrance to Caves*" in 1833. These caves have now been relocated (Spate and Spate in press). Searching over many years has not revealed any caves in the Devonian limestones although some small holes have been reported since the 2003 fires in the O'Hares Creek catchment (Tony Stubbs pers. comm.).

Groundwater has dissolved calcium carbonate from the Devonian limestones. This has been re-deposited in a number of places where the waters of the ephemeral streams tumble over the cliffs of the Milk Shanty Walls. In these sites, there are large tufa banks containing some caves of construction, massive stalactites and other karst forms (Spate and Spate, in press). Better intelligence and easy access following the January 2003 fires has revealed a number of small caves, including one about 20 metres long, containing significant speleothems, small mammal bones and possible some evidence of use by indigenous people. The fires have also revealed a suite of tufa terraces several hundred metres long partially buried by soil – possibly mobilised by European landuse practices.

These may be the largest deposits of tufa south of Far North Queensland. They have probably been deposited very recently — through the Quaternary Period (the last 2 million years). They are certainly the largest suites of this sort of constructural karst landscape in New South Wales.

Ravine has been highly disturbed by grazing, mining, recreational use, timber cutting, fire and weed invasion. It appears to be somewhat of a rain shadow area and soils are generally infertile.

The limestones lie within the 1982 Tumut Management Unit (Management of Natural Values).

### **Significance**

The karst significance of this area appears to reside entirely in the massive tufa deposits and caves of construction that are considered to be of regional or wider significance (Table 1). It may be that the tufa preserves some record of vegetation and hence climatic change. The fossiliferous Lickhole Limestone is one of two sites identified as 'Geological Sites of Significance' by the Geological Society of Australia (NSW Division) within Kosciuszko National Park.

### **Dependence**

The ongoing stability (and indeed preservation) of the tufa deposits requires the continuing supply of dissolved limestone from the Devonian limestones. This in turn requires stable catchment conditions without major changes in evapotranspiration rates. The occupation of the tufa deposits by blackberries may lead to their destruction.

### ***Condition and trend in condition***

The condition of this area is reasonable to poor and is deteriorating under the influence of past clearing, grazing and inappropriate fire regimes, and through the invasion of weeds as a result of these disturbances. The weed problem is particularly acute.

### ***Pressures***

The main pressure is from weeds: blackberries are claiming the tufa deposits.

### ***Knowledge gaps***

The tufa deposits have not been investigated for any evidence of vegetation or climate change. More study of these Quaternary landscape features is warranted.

### ***Opportunities***

A very intensive weed control program is required for the conservation of the karst and non-karst values of the Ravine area. The level of disturbance since the mid-1860s means that re-forestation is needed.

### ***Indicators and monitoring***

The weed problem is beyond monitoring; weed control action is required at a level considerably above current activity.

## **Conclusions**

The conclusions of this brief survey of the karst resources and their significance in Kosciuszko National Park are as follows:

- each of the areas has some level of significance, and together they contribute to a high value for Kosciuszko's karst;
- there are many potential avenues for research activities, especially in the areas of landscape development and environmental and climatic change;
- there is some need for ongoing research, primarily in the biospeleological aspects;
- there is a park-wide need for better methods of control - and application of those methods - to address the very substantial weed problem in all areas, with the possible exception of Cooinbil;
- feral animals are an issue in some karst areas; and
- current cave access policies and practices are generally adequate. It is probably desirable that cave visitor use for all karst areas is managed centrally from Yarrangobilly Caves. Clearly, on-ground management at Indi would remain within the purview of Jindabyne Region.

## **Acknowledgments**

I would like to thank the many cavers academics, researchers, NPWS staff and local residents who have assisted me in so many ways over the 40-odd years that I have been working within Kosciuszko National Park and its surrounds. They are too many to list individually, and any attempt to do so would inevitably result in accidental omissions.

However, I would particularly like to thank Jo Ingarfield, Manager, Yarrangobilly Caves, and Jane Gough, Karst Officer, Southern Conservation Programs and Planning Division, for their very considerable assistance over the past five years and for their inputs to this discussion paper. Input from my fellow members of the Independent Scientific Committee is also acknowledged.



# Chapter 8

## aquatic values

Dr Richard Marchant

Freshwater habitats in Kosciuszko National Park comprise rivers, lakes (plus underground water bodies) and dams. I will deal with the values of each of these ecosystems separately, primarily from a biological point of view. Previously, freshwater habitats have not been specifically considered in management plans for Kosciuszko National Park (Cullen and Norris 1989), despite the fact that the water catchments, and hence water quality, of the region were of central concern for development of the Snowy Mountains Hydro Electric Scheme. The headwaters of the Murray, Murrumbidgee, Tumut, Swampy Plains and Snowy rivers all lie within Kosciuszko National Park. These rivers are highly important economically as they provide irrigation water and hydro-electricity.

The Scheme captures and diverts the headwaters of 12 rivers and 71 creeks (Bevitt et al. 1988). This capture and diversion totals 99% of the stream flows in the Snowy Mountains area. The natural flows in the affected streams are therefore greatly reduced, and in some rivers the timing of flow has also been changed by the operation of the Scheme. These changes to natural stream flow have greatly affected the geomorphology and ecology of these rivers and streams (Bevitt et al, 1998) and have resulted in fragmentation of the habitat cutting off the headwaters from downstream reaches.

### Lakes

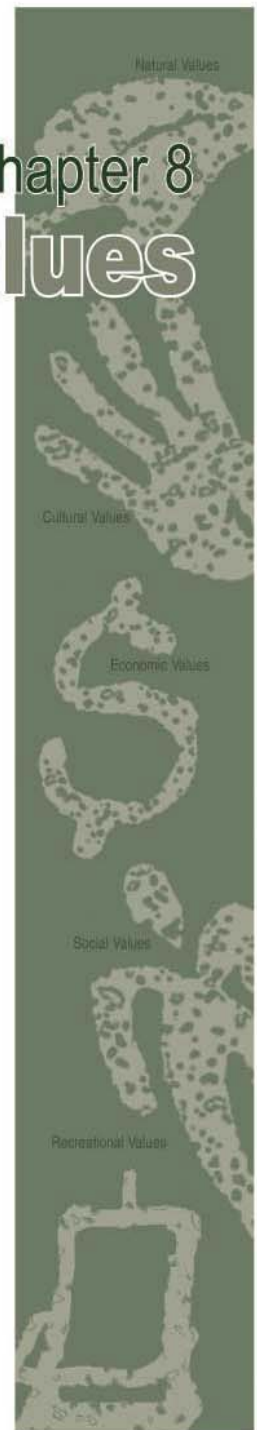
#### Basis for management

Lakes are discrete and clearly recognised habitats. One of the objects of the *NSW National Parks and Wildlife Act 1974* is the conservation of habitats. A management principle stated in the Act is to protect and conserve 'outstanding or representative ecosystems and an objective of a plan of management (defined in the Act) is 'the conservation of biodiversity, including the maintenance of habitat'. By all these criteria, lakes in Kosciuszko National Park fit the definition of objects that require conservation and management. Furthermore, one lake (Blue Lake) is also listed under the Ramsar Convention, which is an international treaty for the conservation of wetlands, of which Australia is a signatory. The management objectives for this area are listed under the *Environmental Protection and Biodiversity Conservation (EPBC) Act*.

#### Significance

There are four small (1.6–14.4 ha) natural lakes in Kosciuszko National Park (Albina, Blue, Club and Cootapatamba). These are unique in that they are the only lakes on the Australian mainland that were formed by glacial action. (Tasmania is the only other region in Australia to have glacially-formed lakes.) Thus, at the state, regional or park scales, these glacially formed lakes are significant habitats; they are also the highest lakes (1890–2070 m) in Australia. Such alpine or glacially formed lakes are, however, not unique or uncommon on an international or national scale; they occur widely in Tasmania (Boulton and Brock 1999) and in the northern hemisphere (Europe, North America, Asia and Africa), New Zealand and South America. Blue Lake and the associated smaller water body of Hedley Tarn (see below) are also considered significant as RAMSAR Wetlands and as such recognised as having international significance. Map 8.1 shows the location of these five glacial lakes.

There are some other small natural lakes in Kosciuszko National Park. Hedley Tarn is downstream from Blue Lake, on the stream that connects both water bodies to the upper Snowy River. Two further lakes, both less than one hectare, are found in the north of Kosciuszko National Park. Both are associated with karst systems and are dolines (karst depressions) fed by ephemeral streams. 'Bung Harris Dam' is found at Coleman Plain and is part of the integrated karst drainage system rising at Blue Waterholes.



*“Previously freshwater habitats have not been specifically considered in management plans for Kosciuszko National Park.”*

The other, unnamed, is several hundred metres to the west of the Jounama pine plantation. Its karstic affinities are unclear. Nothing is known about the ecology of any of these lakes, although the two northern lakes contain trout (A Spate, Optimal Karst Management, pers. comm., September 2002). In addition to the lakes there are small bogs and wetlands of significant conservation value for various reptiles and amphibians (see Chapter 10). Unfortunately these habitats have not been systematically investigated.

There are a number of subterranean water bodies within Kosciuszko National Park, the most obvious being those associated with karst systems, which are discussed more fully by A Spate in Chapter 7. Cooleman Plain is of at least state, and possibly higher, significance as a result of its relatively rich aquatic invertebrate fauna (Thurgate et al. 2001). Hyporheic systems (underground water in the gravels and sands underlying and adjoining rivers and streams) are widespread, but their communities, let alone ecology, have not been investigated within Kosciuszko National Park. The same comment applies to the potential ecosystems dependent on the deep leads underneath the basalt flows in the northern parts of the park.

### **Dependence**

As these are the only glacial lakes on the mainland, their continued existence undisturbed by human development relies strongly on their inclusion in Kosciuszko National Park. It is very probable that if they were anywhere other than in a national park their nutrient status (see below) at least would be altered. The northern lakes are dependent on unchanged karst hydrological regimes.

### **Condition and trend in condition**

Physicochemical measurements indicate that water in all the alpine lakes is very fresh, with extremely low salinities (< 3 ppm), slight acidity (pH 6.0–6.2) and very low levels of nutrients (Williams et al. 1970). No other lakes in mainland Australia have lower salinities, and few glacial lakes anywhere are as dilute. The low nutrient levels are comparable with those measured in highland regions in the United States and United Kingdom. Salinity records taken in the late 1960s and early 1980s in Lake Cootapatamba are virtually identical (Benzie 1984).

The only section of the aquatic biota to have been examined in detail in these lakes is the invertebrate community. Approximately 8–11 species of benthic invertebrates have been identified from deep (0.5–26 m) regions of these lakes and 15–26 species from samples taken in the shallow littoral region (Timms 1980a, Hancock et al. 2000). Littoral samples were taken in December and March; benthic samples were taken once in January. In one lake (Cootapatamba), seasonal observations during the ice-free period have also been made on the zooplankton. Eight planktonic species were recorded over two ice-free seasons (Benzie 1984).

The invertebrates in these lakes are typically found in other upland regions in south-eastern Australia, and species richness is comparable to that of highland lakes in Tasmania (Timms 1980b, Hancock et al. 2000). Species richness is higher in lowland lakes and in many northern hemisphere lakes with similar rocky shorelines. It is thought that this relative impoverishment is a result of the small size of these lakes. Two of the lakes (Blue and Club) contain native fish (Mountain Galaxias) and their benthic fauna is dominated by aquatic insects and molluscs (largely bivalves). The two fishless lakes are dominated by crustaceans (isopods and amphipods). None of the invertebrate species currently recognised is confined solely to these lakes. There is however a species of mayfly (*Tillyardophlebia alpina*) that appears to be confined to the lakes and streams of the Kosciuszko region. Future taxonomic work may well modify this conclusion.

No indication of seasonal variation in the benthic fauna can be given because sampling has occurred only in summer. In Lake Cootapatamba, zooplankton densities were highest in March and declined to zero before the lake froze. Long-term variations in these assemblages are unknown. However, a species of oligochaete worm, first discovered in Blue Lake in 1906, was found in that lake, Club Lake, Lake Cootapatamba and nearby rivers in 1992 (Pinder and Brinkhurst 1997). This species was not found by Timms (1980a) or Hancock et al. (2000) during their surveys, indicating that some of the invertebrate species may be cryptic but present over long periods. Such irregularities demonstrate the difficulty of providing complete species lists of the benthic invertebrate fauna from any particular survey. Recent sampling in January 2002 in Lake Cootapatamba (Timms 2002) confirms the presence of this oligochaete. The benthic species composition of this lake was essentially unchanged from that found in earlier studies.

It is thus not possible to come to any specific conclusions about temporal trends in the invertebrate fauna of these lakes. Given the nature of the habitat and the current very low concentrations of nutrients and ions, it seems unlikely that marked changes in physicochemical conditions have occurred since European settlement. As both the benthic and planktonic communities would be sensitive to changes in these conditions, it is reasonable to suggest that neither of these assemblages has changed greatly in the last 200 years as a result of changes in water quality. However, random changes in species composition cannot be excluded.

Developed karst hydrologic systems are found in all the karst areas of Kosciuszko National Park. Only those at Cooleman and Yarrangobilly have been examined for aquatic taxa - and not all systems in those areas have been surveyed even at a reconnaissance level (Eberhard and Spate 1995, Thurgate et al. 2001). Cooleman, in common with a number of the other major karst systems within New South Wales, has an aquatic fauna that includes a number of undescribed crustaceans, including isopods, amphipods, copepods and, very significantly, a syncarid (Eberhard and Spate 1995, Thurgate et al. 2001). Cooleman ranks third, behind Wombeyan and Jenolan, in terms of aquatic invertebrate richness, and there are probable endemics.

Surprisingly, the same cannot be said of Yarrangobilly in spite of greater survey effort there (A Spate, Optimal Karst Management, pers. comm., September 2002). Taxonomic knowledge of this fauna is incomplete, but it seems likely that endemic species with restricted distributions are present and that these species are essentially confined to subterranean habitats.

### **Pressures**

Very low concentrations of ions and nutrients have been recorded in these lakes. Disturbance in their catchments may cause nutrient release, which in turn may cause changes in the composition of aquatic biota. Apparently, there has been some release of septic tank effluent into Lake Albina (Timms 1980a), and both this lake and Blue Lake have fairly large amounts of decomposed leaves and twigs in bottom sediments. It does not appear that such inputs of organic material have caused major changes in the benthic invertebrate fauna compared with that found in the other two lakes.

Two of the lakes also contain native fish, whose presence has apparently resulted in changes to the dominant invertebrate taxa. If trout were introduced to any of the lakes, substantial changes to invertebrate species composition could be expected based on what has happened to such fauna in Tasmanian highland lakes (Williams 1974, Knott et al. 1978). It is also possible that trout may eliminate the native galaxiids in the lakes, much as they have done in rivers (Campbell et al. 1986).

### **Knowledge gaps**

As emphasised above, little seasonal and no long-term data on species composition is available for the benthic fauna. Sampling of at least the littoral zone of the four lakes once every few years in summer would be feasible, would indicate how stable these assemblages are (data that are sorely lacking from most freshwater habitats in Australia), and might give some idea whether climate change is affecting lakes in Kosciuszko National Park.

### **Opportunities**

Trout in the lakes may cause large changes to benthic species composition. There should be regular checks for the presence of trout, and they should be removed if found. Regular water quality measurements (as indicated below), particularly of nutrients, would indicate whether changes to the catchments of the lakes are occurring.

### **Indicators and monitoring**

The benthic invertebrate fauna is the obvious biotic indicator for the lakes. It would also be useful to monitor aspects of water quality such as conductivity, pH and nutrients, which may provide early warning of problems, as noted above.

### **Dams**

A number of reservoirs or large dams (constructed by the Snowy Mountains Hydro-Electric Authority) occur within Kosciuszko National Park. Information on the water quality of some of these dams is available (Bowling 1995) but it seems that no data on their biota have been obtained. In fact, the limnology of very few of the many human-made lakes in Australia has been examined. Those few that have been studied are quite different from each other in size, depth, location and many other features; it would be pointless trying to generalise. About all that can be said is that the benthic diversity of dams is poor, and certainly lower than found in natural lakes (Timms 1980b).

Given this lack of knowledge, there is little that can be said under any of the headings used above for lakes. The dams could not be considered as significant habitats under any of the scales of measurement. There are more than 450 large dams in Australia. Recent work in south-eastern Australia (Marchant and Hehir 2002) has shown that large dams inevitably cause disruption to downstream invertebrate communities, probably because they act as barriers to recolonisation of river reaches that have been disrupted by the associated engineering works. It is also well known (Boulton and Brock 1999) that water quality problems (e.g. low water temperatures, low oxygen concentrations and high levels of toxins such as hydrogen sulfide) can occur below deep dams that release bottom water. As the Kosciuszko National Park dams probably release bottom water, the quality of their discharges should be monitored.

### **Streams and rivers**

#### **Introduction**

An expert panel was commissioned in 1998 to assess the environmental flows of various rivers affected by the Snowy Mountains Scheme (Bevitt et al. 1998). They concluded that:

*The Snowy Mountains Scheme has affected the hydrological, geomorphological and ecological condition of many streams in the Snowy Mountains. These impacts are particularly severe in the Tumut, Eucumbene, Snowy and Gungahlin Rivers and some of the reaches of the Tooma and Geehi Rivers.*

The impacts of the Scheme on stream flow in most of these rivers are:

- reduced flood frequency and magnitude;
- reduced volumes of flows at all times;
- reduced seasonal flow variability; and
- in some cases, unnaturally rapid and aseasonal changes in water levels from power station releases.

The geomorphological outcomes of these changes to stream hydrology have been:

- channel contraction due to reduced discharge;
- lack of channel adjustment to reduced flows in some reaches, resulting in isolation of the channel from riparian vegetation;
- loss of rapids, chutes and riffles in many reaches; and
- lateral isolation of pools and sedimentation.

The impacts of the hydrologic changes on water quality are greatest in the pool sections of streams, and include:

- warmer summer water temperatures and freezing over winter because of the reduced flows;
- lower dissolved oxygen;
- nutrient concentration due to low flows;
- high algal productivity; and
- anoxia and stratification in the Tumut and Eucumbene Rivers.

Ecological integrity has been greatly affected by the Scheme, both directly (through the changes to the natural flow regime) and indirectly (through the impacts of changes to hydrology, geomorphology and water quality).

Macroinvertebrate communities have changed from lotic to lentic in many areas where flow, habitat and water quality have changed those typical of a mountain stream to those typical of a lake or lowland stream. This indicates that important ecological processes have been disrupted, and ecological integrity is low. This is clearly not conducive to the conservation of native fauna in a National Park (Bevitt et al, 1998).

The assessment that follows assumes that these effects will continue as prescribed by the Snowy Corporatisation process (Heads of Agreement, 6/12/200).

### **Basis for management**

As with lakes, the streams and rivers in Kosciuszko National Park fit the definition of objects in the *National Parks and Wildlife Act* that require conservation and management. They are discrete aquatic habitats that are easily recognised. In spite of this, river managers today generally acknowledge that the whole of the catchment is the unit of management rather than just the river itself. This approach recognises that activities anywhere in a catchment can ultimately affect the quality of running water habitats.

### **Significance**

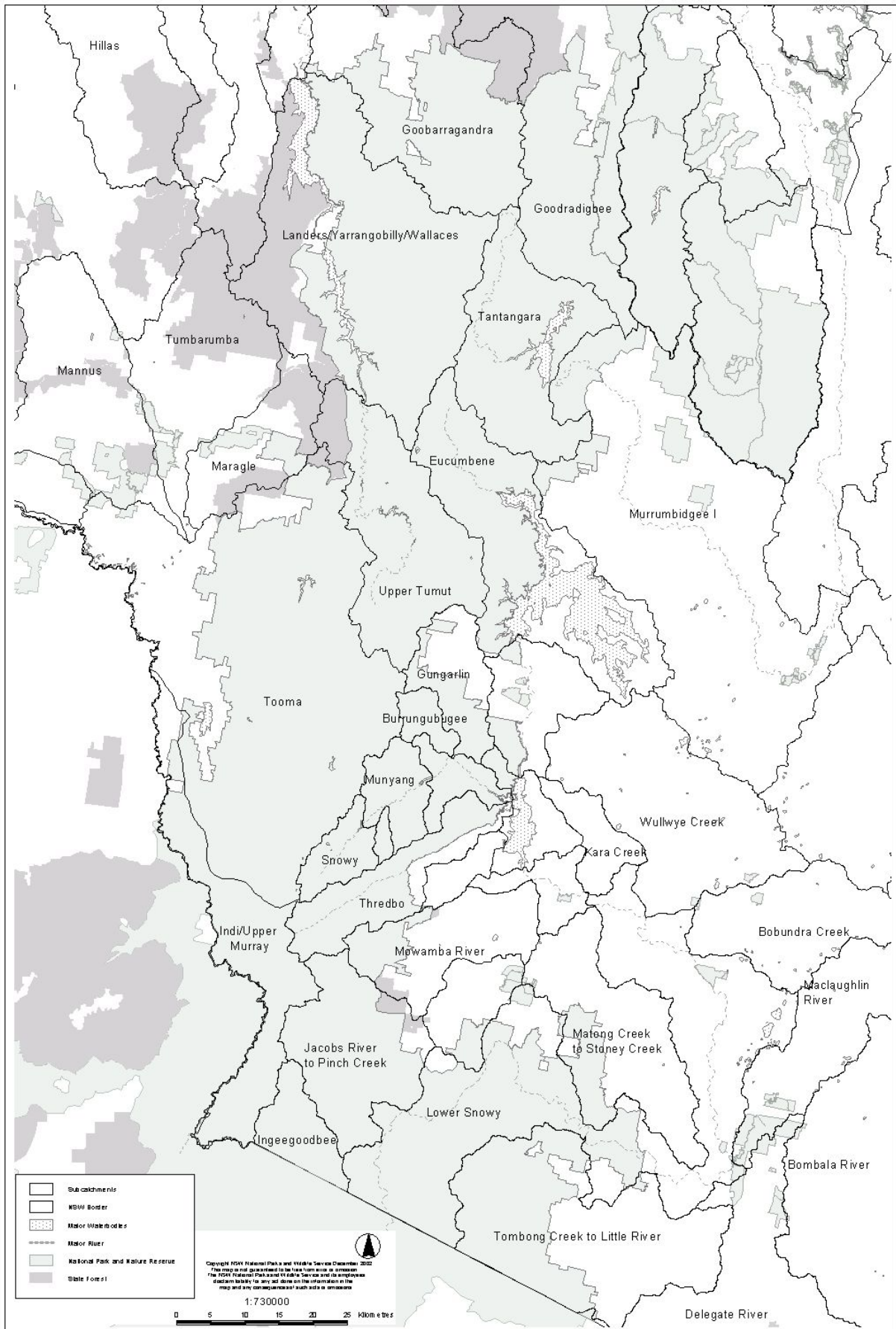
The alpine rivers in Kosciuszko National Park are not obviously significant at state or national levels, given that alpine running waters are found elsewhere in New South Wales (NSW) and in Victoria and Tasmania. At an international level, all Australian alpine rivers are significant because they form only a very small percentage of running waters nationally and they harbour a number of endemic species of aquatic insect and other invertebrates. On a world scale, alpine rivers are not scarce; they are common, for example, in Europe (Alps, Pyrenees, Norway) and North America (Rocky Mountains), where many are fed by glaciers.

All the large rivers in Kosciuszko National Park (Snowy, Murrumbidgee, Tumut, Swampy Plain) are dammed either within the park or just outside the park boundary. In some cases extensive reaches of riverine habitat have been inundated (for example, 50 km of the Tumut River are submerged by Blowering and Talbingo dams). Thus Campbell et al. (1986) concluded that large rivers above altitudes of 900m could be considered an endangered habitat in the Snowy Mountains region. Small streams are still common in Kosciuszko National Park and surrounding regions. Map 8.1 illustrates the major river catchments and dams in the Kosciuszko region.

### **Dependence**

As noted above, rivers are an integral part of their catchment. Thus, to maintain a river in an undisturbed state requires that its catchment is also undisturbed. In this sense rivers in Kosciuszko National Park are dependent on the state of their catchments within the park.

**Map 8.1 Major river catchments and dams in the Kosciuszko region**



## Condition and trend in condition

Measurements of water quality and biological condition have been taken in the Thredbo River for over 20 years (Norris et al. 2002). Similar measurements have been made on various tributaries of the upper Snowy River since the early 1990s (Cunningham and Norris 2001). In all cases, the aim has been to detect whether the ski resorts in these areas and their attendant infrastructure such as car parks and sewage treatment plants (STPs) are having an impact on riverine ecosystems. Biological condition has been assessed by examining the composition of the stream invertebrate community, although observations have also been made on algal populations. Water quality has been assessed by measuring nutrient (phosphorus and nitrogen) levels and turbidity, electrical conductivity, pH and dissolved oxygen; all these variables are widely used as indicators of water quality. Since the mid-1990s it has also been possible to use the AUSRIVAS predictive models for assessing invertebrate composition. These models enable the macroinvertebrate fauna expected at a site to be predicted from measurements of a small number of environmental factors that are unaffected by human activities, such as longitude, altitude, distance of site from source, percentage of river bed composed of various sized stones and sediment. Predictions are based on the relationship between these factors and the macroinvertebrate fauna at a set of reference or minimally disturbed sites.

At least one site on each of the four tributaries of the upper Snowy River (Spencers Creek, Perisher Creek, Pipers Creek and Sawpit Creek) was assessed as impaired on a number of occasions. The first three creeks were more frequently contaminated than the last one (Cunningham and Norris 2001). Discharge from two STPs, plus run-off from resorts, roads and car parks, all contributed to this pattern. Road de-icing salt may also have been a factor, particularly at sites receiving run-off. At Sawpit Creek, the main source of contamination was a campground, but impairment was relatively less frequent. A site on the Thredbo River directly downstream of the Thredbo resort was also shown to be quite frequently impaired (Norris et al. 2002), but two sites further downstream (and downstream of an STP) were usually in better condition. Water quality values at all sites were usually within recommended guidelines, but nutrient levels were elevated at sites below STPs on at least one occasion. Further details on water quality at these sites are given by Davies and Norris (1999).

The Kosciuszko National Park AUSRIVAS model used for assessing biological quality was more sensitive than water quality variables in detecting impairment, detecting about twice as many instances of impairment (Norris et al. 2002). The model indicated that impairment was present if the ratio of the observed (O) number of taxa (in this case, families of aquatic insects such as mayflies, caddis flies, stoneflies, various beetles and dipterans, plus other invertebrates) to the expected (E) number of taxa (O/E score) was less than 0.86. At reference sites where there was no impairment, O/E averaged 1.0. Thus, impaired sites had lost at least 15% of the 11–15 families expected to occur at a site. Some of these families are known to be intolerant of sewage effluent. The O/E scores from the Kosciuszko National Park AUSRIVAS model could be placed in four bands of progressively increased impairment. On most occasions, when impairment was detected it was considered mild; that is, O/E was in the first band (0.57–0.85) below the unimpaired band.

A single broad-scale survey of invertebrates in rivers throughout Kosciuszko National Park and in alpine parks in the Australian Capital Territory and Victoria has also been undertaken (Cooperative Research Centre for Freshwater Ecology 2000). In summer 2000, 79 reference sites and 16 test sites were sampled once; 59 of these sites were in Kosciuszko National Park. An alpine AUSRIVAS model (at the family level) for use throughout the high country of south-eastern Australia was developed, and enables the sites on the Thredbo and upper Snowy rivers to be put into a broader perspective. The expected number of families (16–19) at a site was somewhat higher than predicted by the Thredbo AUSRIVAS model, and impairment was evident when the O/E ratio was less than 0.85. The assessments for the Thredbo and upper Snowy sites were much the same as before. Sites below the three STPs and the ski resorts in Kosciuszko National Park were again judged to be mildly impaired, as was the site below a campground on Sawpit Creek; O/E ratios varied from 0.70 to 0.83. The model also demonstrated that sites in the Victorian Alps affected by cattle grazing had lower O/E ratios (0.50–0.71). A single site in Kosciuszko National Park used by brumbies as a watering hole had an O/E greater than the reference value (1.16), possibly due to mild nutrient enrichment leading to higher family diversity. Thus, deviations from the reference condition at sites on the Thredbo and upper Snowy rivers were not the most extreme encountered. Further work by a student using the alpine model (L Simpson and R Norris, Cooperative Research Centre for Freshwater Ecology, pers. comm., September 2002) has demonstrated that stream modification from past grazing continues to disturb invertebrate communities, but not to the same extent as current grazing; and that the presence of brumbies also affects these communities.

Both the Kosciuszko National Park and the alpine AUSRIVAS models provide suitable standards against which to compare family composition at sites where some disturbance is suspected. The O/E scores also provide a measure that can be used to detect trends in disturbance. The evidence so far suggests that STPs on Spencers Creek and Perisher Creek create chronic sewage pollution, which has changed little in severity since monitoring began in the early 1990s. Effluent from the STP on the Thredbo River appears less damaging. The fact that more nutrients are removed at the Thredbo plant probably explains this difference (Norris et al. 2002).

Both AUSRIVAS models are constructed for family level data and thus do not indicate what the genus or species level reactions to disturbance might be. As far as is known, there are no aquatic invertebrate species that are confined to rivers in Kosciuszko National Park (Campbell et al. 1986), but it must be admitted that taxonomic knowledge of these groups is by no means complete, and species endemic to Kosciuszko National Park may yet be discovered. The mayfly mentioned above (in the section on lakes) is an example of an aquatic insect that may exist only in the rivers and lakes of the park.



Recent collecting in January 2002 in the Thredbo and upper Snowy Rivers (Suter et al. 2002) caught 114 taxa (mostly mayflies, stoneflies and caddisflies) from 10 locations, but none of these appeared to be confined solely to the park.

Freshwater fish are the other obvious component of the riverine fauna in Kosciuszko National Park. Unfortunately no systematic distribution studies have been made either of fish in rivers near the resorts or on a wider scale throughout the park. However, during 1994–96 NSW Fisheries undertook a survey of freshwater fish at 80 sites in NSW (Harris and Gehrke 1997). Two of these sites were in Kosciuszko National Park. Five species of native fish (Short and Long-finned Eels, Climbing Galaxias, Australian Smelt and Congolli) and three species of introduced fish (Brown Trout, Rainbow Trout and Goldfish) were found at these two sites. Records from the Museum of Victoria and the Australian Museum, and from other sources (Tilzey 1976, Koehn 1990, Lintermans 1998), indicate that at least two other native species (Mountain Galaxias and Two-spined Blackfish) and two more introduced species (Mosquito fish and Redfin) occur in the park. Current taxonomic work (Raadik and Kuitert 2002) suggests that the Mountain Galaxias may in fact be a complex of species with three forms recognised from Kosciuszko National Park each with a very restricted local distribution. None of the other six species of native fish is confined to Kosciuszko National Park and none appears endangered, each having an extensive distribution in southern Australia.

Given the lack of systematic sampling for native species through time anywhere in Kosciuszko National Park, it is not possible to discuss trends. However, Brown and Rainbow Trout, which were introduced to the Monaro region in 1888 and 1895 respectively (Tilzey 1976), are known to prey on various galaxiid species and probably compete with Two-spined Blackfish for benthic food, mostly invertebrates (McDowall 1996). Tilzey (1976) has produced compelling evidence that the distribution and abundance of both species of galaxiids in Kosciuszko National Park has been greatly altered since the arrival of trout.

Finally, it is worth noting that Platypus (Grant 1995) and Freshwater Crayfish (R Norris, Cooperative Research Centre for Freshwater Ecology, pers. comm., September 2002) are known to occur in the Thredbo River; and probably occur throughout Kosciuszko National Park. Unfortunately nothing can be said about how or whether their distribution within the park has been affected by past and present disturbances within the park.

### **Pressures**

As detailed above, effluent from STPs and run-off from ski resort areas are causing chronic, but generally mild, pollution of various streams within the park. Nutrients released in the effluent are the most likely culprit. As many alpine streams in south-eastern Australia, including those in Kosciuszko National Park, are not heavily shaded, increased growth of benthic algae is a very probable result of nutrient input into an ecosystem poor in nutrients. Run-off of road de-icing salt is also a potential problem for stream communities and has been shown in North America to cause increased drift of stream invertebrates (Crowther and Hynes 1977). Given the very low salinities recorded in rivers in Kosciuszko National Park (Cunningham and Norris 2001), saline inputs could impose additional stress on the stream biota.

The presence of two species of trout, probably throughout Kosciuszko National Park, may well threaten populations of native fish, especially galaxiids. Much of the damage was probably done when trout were first introduced over a century ago. Whether they are continuing to have a deleterious effect on native fish can only be determined by further investigation.

Annual burning and livestock grazing no longer occur within Kosciuszko National Park, although both wildfire and, at lower altitudes, hazard reduction burning do occur. However, the hydrological after-effects may continue to affect various rivers in the park. Wimbush and Costin (1983) have shown that creeks in Kosciuszko National Park continued to erode over a 20-year period after grazing and burning in the region ceased. However, there is no evidence that directly links such erosion with changes in lotic communities in Kosciuszko National Park. The input of sediment to streams (by erosion or other means) is widespread in many parts of the world, and excessive amounts impair benthic habitats that are vital for both invertebrate and fish life cycles (Waters 1995). Thus the potential for damage to these communities by sediment is present in Kosciuszko National Park even if actual damage has not yet been noted.

Highway construction at Yarrangobilly in the 1970s resulted in the input of fine sediments to the various cave systems. The Yarrangobilly fauna may be depauperate as a result, because there are fewer molluscs and crustaceans in these cave streams than would be expected (A Spate, Optimal Karst Management, pers. comm., September 2002). Rainbow (1907) reported very large numbers of a collembolan in an unnamed cave (almost certainly River Cave) that are no longer present (A Spate, Optimal Karst Management, pers. comm., September 2002).

Other hydrological and riparian changes have occurred as a result of European settlement of the region. The Snowy Mountains Scheme has diverted water from the large rivers in the park, but much of this diversion actually takes place outside the park boundaries. Tributaries of these large rivers within Kosciuszko National Park have also been affected by this Scheme. For example, the upper Snowy River, upstream of Lake Jindabyne, has had essentially all of its discharge diverted: flow below the Island Bend dam on this river has ceased completely except when the dam spills (Wimbush 1998, Bevitt et al. 1998). Similar removal of flow has occurred in a number of rivers within the park, resulting in exposure of the riverbed for prolonged periods, invasion of the riverbed by riparian vegetation and consequent destruction of lotic habitat and organisms.

Riparian changes have occurred with the introduction of willows to many of the rivers of the park. The Tumut and Snowy Rivers (especially downstream of Lake Jindabyne) have well established willows along many kilometres of bank (Wimbush 1998, Bevitt et al. 1998). Along the Thredbo River, work to remove willows has recently begun.



These exotic trees displace native riparian vegetation. Whether they have important effects on the aquatic habitat itself is less clear. Willow roots are known to encroach onto riverbeds, especially where flow has been reduced. However, studies in Tasmania (Read and Barmuta 1999) comparing benthic invertebrate communities in reaches lined with either willows or native vegetation have shown few differences.

### **Knowledge gaps**

Streams and rivers have been examined only in small sections of Kosciuszko National Park. Park-wide surveys of freshwater invertebrates should be made, especially of groups such as mayflies, stoneflies and caddis flies, which are thought to be most sensitive to human disturbance. Such surveys should emphasise taxonomic aspects, as there may well be undescribed species in these groups that could be endemic to Kosciuszko National Park. Preliminary surveys of these taxa in small areas (around the Thredbo and upper Snowy rivers) have been made recently (Suter et al. 2002), but more comprehensive collecting throughout Kosciuszko National Park is needed.

The broad-scale sampling of reference sites for the alpine AUSRIVAS model should also continue. The current model is based on collections from a single summer period. Additional sampling will increase the reference site database, which should improve the reliability of model predictions; and continued sampling may indicate the extent of any secular changes in benthic fauna due, for instance, to climate change.

### **Opportunities**

If removal of nutrients from the effluent of the STPs at Charlotte Pass and Perisher can be achieved, this should noticeably reduce the degree of pollution in Spencers and Perisher creeks. Restrictions on, or banning of, the use of road de-icing salt should also be considered, or at least attempts should be made to demonstrate that current use is not causing unacceptably large increases in the salinity or conductivity of the rivers.

As there is good evidence that the introduction of trout has damaged native fish communities, stocking of streams with trout within Kosciuszko National Park should not be countenanced. Stocking of waters outside the park —such as Lake Eucumbene - that are fed by rivers from within (and that provide breeding habitat for trout from the lake) should at the very least be reduced. Stocking streams that contain populations of wild trout is ineffective and costly, and has been known to be so for at least 50 years (Pollard et al. 1980, Davies et al. 1988). Stocking trout in lakes can also cause problems: the trout fishery in Lake Eucumbene has suffered from a variety of management difficulties stemming from overpopulation of Brown Trout (Pollard et al. 1980).

Currently, management of fish populations within Kosciuszko National Park (and probably other aquatic biota) rests with NSW Fisheries rather than NSW National Parks and Wildlife Service (NPWS). This institutional arrangement simply subverts any efforts to conserve freshwater ecosystems and their biota in Kosciuszko National Park, as noted by Cullen and Norris (1989). However, 13 years later, the arrangement is still in place (M Adams, NSW NPWS, pers. comm., October 2002). Both the aquatic and terrestrial components of Kosciuszko National Park must be managed together by a single authority (in this case, obviously, the NSW NPWS), because, as has been noted above, activities anywhere in a catchment can ultimately affect aquatic ecosystems.

One outcome from the Snowy Mountains Corporatisation and Water Inquiry, is that there are 150 gigawatt hours of water to be allocated to the montane streams of the Snowy Mountains (Heads of Agreement, 6/12/2000). More research and monitoring will be required to specify how and where this water should be allocated. As part of this effort the extent of fragmentation of the stream system within the park resulting from engineering works should be documented and plans made to reconnect key streams.

### **Indicators and monitoring**

Water quality and benthic invertebrates are obvious indicators, and monitoring as described above should continue. The distribution of native fish within the park is poorly known. Knowledge of their distribution may enable some assessment of the degree to which this section of the fauna has been disrupted by introduced trout.

### **Postscript**

One can only speculate about the after effects of the wildfires in summer 2003 on the lakes and rivers in Kosciuszko National Park. An indication of what might happen comes from observations on water quality made after the summer 1983 wildfires at 11 sites on low altitude rivers in east Gippsland, Victoria (Chessman 1986). Reduced oxygen levels only occurred in burnt catchments, but were related to stagnant conditions caused by drought as much as to the oxygen demand of fire generated material washed in during the first rain after the fires. Oxygen concentrations returned to normal levels when discharge increased after the first post-fire storms. The export of sediment and nutrients was also higher in burnt than unburnt catchments after the fires. All sites were subject to heavy autumn rainfall and Chessman concluded that the effects on water quality were not as severe as might have been expected with such levels of run-off. The same sorts of changes may occur in the rivers of Kosciuszko National Park, but it is not possible to predict the degree of change or whether the invertebrate and fish communities will respond.

# Chapter 9

## flora values

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Kosciuszko National Park has a rich and varied flora and vegetation. It is convenient to discuss these values according to their distribution in the main physiographic regions of the park, the elevated alpine and subalpine tracts comprising the “snow country”, the steeper montane tract descending to lower slopes and tablelands and the deeply dissected Lower Snowy Valley.

### Vegetation above the tree line

#### Introduction

The area above the tree line in Kosciuszko National Park, extending from about 1830m to 2228m at the summit of Mount Kosciuszko, covers some 250 square kilometres (Good 1992). Although this is only about 10% of the total area of snow country in the Australian Alps as a whole, it constitutes by far the largest truly alpine area on the mainland and includes the largest contiguous area of alpine vegetation (Good 1992, Green and Osborne 1994). Its assemblage of plant communities is found nowhere else in the world and has attracted attention from scientists and others since Europeans first ascended the alps around 1830 (Costin 1989, Good 1992).

The vegetation includes herbfields, heaths, bogs and fens, as well as very restricted areas of feldmark and snow patch communities, each with its distinctive assemblage of species, many of them unique to Kosciuszko (Costin et al. 2000). The position of each community in the alpine landscape is controlled by the distribution of snow and groundwater, which in turn are determined by the physiography (Costin 1954, Costin et al. 2000, Wimbush and Costin, 1983). The distribution of certain alpine communities is illustrated in Map 9.1.

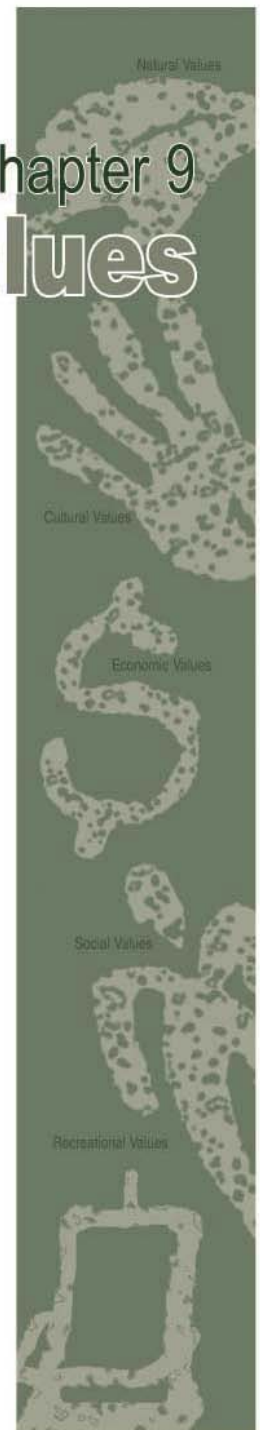
Because of the limited flowering season, there are massed displays of wildflowers in the summer months that attract an ever-increasing number of visitors (Worboys and Pickering 2002). Less well known, but equally attractive, are the contrasting hues of the different vegetation patches in the autumn.

#### Basis for management

Section 2A(1)(a) of the *NSW National Parks and Wildlife Act 1974* clearly states the objectives of the Act to be: the conservation of nature, including (i) habitat, ecosystems and ecosystem processes and (ii) biological diversity at the community, species and genetic levels.

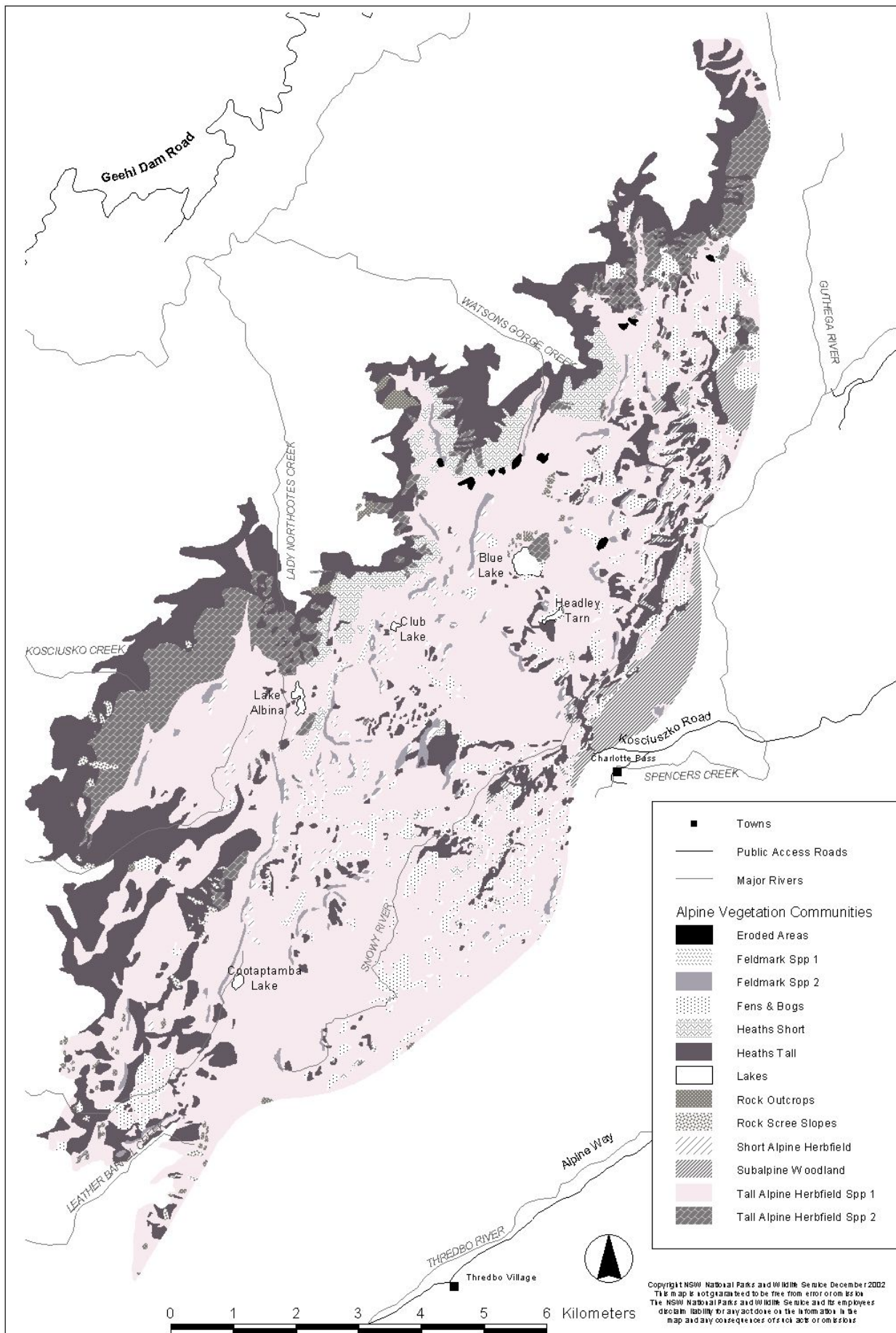
Under the management principles for national parks (section 30E), the Act repeatedly emphasises the principle of conserving biodiversity and protecting the ecological integrity of ecosystems.

The objectives of plans of management (section 72AA) include: (b) the conservation of biodiversity, including the maintenance of habitat, ecosystems and populations of threatened species, and (g) the maintenance of natural processes.



*“Kosciuszko National Park’s assemblage of plant communities is found nowhere else in the world.”*

Map 9.1 Distribution of certain alpine communities



### **Significance**

The alpine areas of Kosciuszko National Park are of international significance. They are a world-class example of mid-latitude alps, of which there are few in the southern hemisphere. They are also unusual in the development of alpine humus soils on a gently rounded landscape (Costin 1954, Good 1992).

The alpine vegetation contains some 204 species of flowering plants, of which at least 21 are endemic and 33 are rare (Costin et al. 2000). A list of species considered significant in Kosciuszko National Park is presented in Attachment 9A.

The alpine area is of critical importance nationally as it is the part of the water catchment area of the Snowy Mountains that receives the highest precipitation (Good 1992).

### **Dependence**

Most of the plant community types that occupy the alpine areas of Kosciuszko National Park are present elsewhere in the Australian Alps, but nowhere else are they as well represented or present on so large a scale (Costin et al. 2000). Much of the Victorian high country is still grazed by cattle; consequently the vegetation is highly modified (McDougall 1982, Walsh et al. 1994). The 21 species endemic to Kosciuszko National Park are, by definition, totally dependent on the park for their existence (Costin et al. 2000).

### **Condition and trend in condition**

Much of the area was damaged by grazing in the days of snow leases, but since the leases were withdrawn and soil conservation work was completed there has been some recovery, especially of the tall herbfields (Wimbush and Costin 1979c, Good 1992, Scherrer et al, in press). Loss of topsoil on parts of the Main Range has caused a change in vegetation that is virtually permanent, with feldmark species colonising bare erosion pavements (Wimbush and Costin, 1979c). On the edges of these areas the remaining alpine humus profile is still subject to erosion and needs further conservation work. However, most of the vegetation on the Kosciuszko plateau has achieved a relatively stable state, with changes being cyclic in response to short-term changes in climate (Scherrer et al, in press). An exception is the continuing increase in some species such as Ribbony Grass (*Chionochloa frigida*) and the Anemone Buttercup (*Ranunculus anemoneus*) that were greatly reduced under stocking (Rath 1999, Costin et al. 2000).

The northern area of the Kosciuszko plateau was withdrawn from grazing in 1944. Legal grazing continued for a further 14 years, and illegal grazing above the tree line for somewhat longer (Good 1992, Worboys and Pickering 2002). Subsequent changes to the vegetation have been monitored in a limited number of sites and these changes appear to be continuing, particularly in the recovery of *Sphagnum* bogs and the change from a grazing-induced disclimax short herbfield to tall herbfield (Scherrer et al, in press; authors' personal observations).

### **Pressures**

The main and immediate pressure on the alpine vegetation in Kosciuszko National Park is the increasing number of people visiting the area in the summer (Pickering et al, in press, Scherrer and Pickering 2001, Worboys and Pickering 2002). The number of visitors in winter is low and of low impact, though over-snow service vehicles have the potential to damage vegetation when snow cover is light (Pickering and Hill, in press). However, by the summer of 1982, the passage of feet causing multiple track erosion prompted a radical solution: the construction of a raised steel walkway between Thredbo top station and Rawson Pass. Although the walkway solved the track erosion problem, it encouraged larger numbers of people to visit the summit, and also made access to other areas easier (Worboys and Pickering 2002).

The increasing foot traffic on and around the Main Range will inevitably cause similar damage in other places unless a great deal of attention is paid to the siting and maintenance of tracks and the education of visitors in their use (Worboys and Pickering 2002). Damage is already evident, for example, on the track between Charlotte Pass and Mount Stillwell, and the track between the Snowy River Bridge and the Crackenback chairlift. Another example of visitor damage is the popular Lakes Walk, which traverses the rare windswept feldmark, interrupting the natural movement of prostrate shrubs downwind across the community (Good 1992).

Other threats to the vegetation include feral horses, which increasingly invade the alpine area in summer. The direct effects of trampling and selective grazing are becoming evident. There are also pressures from hares on the alpine communities. Weed invasion is another threat that has escalated over the years, with new species being recorded every time weeds are surveyed (Mallen 1986, Johnston and Pickering 2001a).

### **Opportunities**

A number of management issues need to be addressed in order to improve the current condition and trends in condition of the flora values of the park. These issues include the following priorities:

- elimination of horses from the alpine area is both essential and achievable, in order to protect sensitive species and communities and their ecological integrity;

- control of exotic plants, particularly recent invaders such as yarrow (Johnstone and Pickering 2001b) - some invaders that are largely confined to disturbed areas (e.g. track verges) may be reduced, but it is unlikely that they can be eliminated (Johnstone and Pickering 2002);
- restriction of the numbers of walkers in peak visitor periods is a possibility, particularly at the Thredbo end of the walkway (Worboys and Pickering 2002); and
- improvements in visitor education concerning the sensitivity of the alpine landscape, and interpretation of alpine vegetation pattern and process (Worboys and Pickering 2002).

### **Knowledge gaps**

Global warming may affect the Kosciuszko National Park alpine plant communities in unknown ways. Concern has been expressed about decreasing snow deposition and its effects on the communities that depend on snowdrifts (Good 1998, Pickering and Armstrong 2000).

There are many gaps in knowledge about the ecology and taxonomy of Australian alpine plants and their relationships to plants in other countries (Smith 1986, Costin et al. 2000).

### **Indicators and monitoring**

Permanent transects in tall herbfield, sod tussock grassland and heath over the last 42 years have produced results that elucidate changes in vegetation due to short-term climate fluctuation as well as recovery from livestock grazing. It would be useful to maintain these transects and remeasure them periodically.

Long-term monitoring of snow patch vegetation using permanent reference points could indicate changes correlated with long-term changes in climate.

## **Tree lines**

### **Introduction**

Tree lines are the boundaries between areas dominated by trees and those in which trees are absent. They may occur where summer warmth is insufficient to support the growth of trees (Daubenmire 1954, Wardle 1974), or may occur as a result of tree kill by ponded cold air (Slatyer 1989) or suppression of tree growth by waterlogging (Gilfedder 1988). Also, trees may be excluded because their establishment is reduced by competing dense tussock grasses on the better soils of flats (Fensham and Kirkpatrick 1992).

### **Significance**

Internationally significant ecophysiological work has been undertaken on the tree lines of Kosciuszko National Park (e.g. Slatyer 1976, 1989). The upper slope tree lines are amongst few in the world in which the wooded side is dominated by open-crowned evergreen angiosperms (Kirkpatrick 1994b). The same characteristic applies to the inverted tree lines that are so well developed in the park. Good (1992) and Banks (2002) have suggested that Kosciuszko National Park has the most outstanding development of subalpine treeless flats and valleys in the world, because of its relatively deep soils, gentle topography and tree species that are not particularly frost resistant.

The schedule of significant features for Kosciuszko National Park (set up under section 8.1.4 of the 1988 plan of management) classifies long term (> 20 years) scientific study sites, such as those on the tree line, as extremely significant. The tree lines of Kosciuszko National Park have state significance because they are the only upper slope tree lines in New South Wales (NSW), and are the best examples of inverted tree lines in the state. Similarly, they are likely to have national significance as the best examples of tree lines in Australia, and possibly also international significance as the best examples of a structurally unusual type of tree line.

### **Dependence**

Because the upper slope tree lines of Kosciuszko National Park are the only ones in NSW, the conservation of this ecological phenomenon in the state is totally dependent on activities within the park. Inverted tree lines can be found elsewhere in NSW (e.g. Barrington Tops and New England), but most of their length is in the Kosciuszko National Park.

At a national level, eucalypt-dominated upper slope tree lines are also found in Victoria and Tasmania. However, their best development is in Kosciuszko National Park. Inverted tree lines caused by cold air ponding do occur in Victoria (e.g. Wearne and Morgan 2001), but do not seem to occur in Tasmania, where other factors are apparently responsible for treelessness in the subalpine zone (Gilfedder 1988, Fensham and Kirkpatrick 1992).

### **Condition and trend in condition**

Most of the tree lines of the park are intact as structural features. However, during the grazing era a substantial length of natural inverted tree line was eliminated through ringbarking of trees and burning of the forest (Banks 2002). There has been relatively little reinvasion of trees into these areas (Wimbush and Costin 1979ab, Banks 2002). On the treeless side of the tree line, the vegetation is still in the process of recovery from grazing (Wimbush and Costin 1979bc, Costin et al. 2000).

In general, the tree lines are in the process of recovery, the main exception being where they have been cleared for ski runs. Little (2000) has suggested that particular soil calcium and manganese concentrations can be used to discriminate between areas that supported trees before the grazing era and those that did not. Soil microtopography and extrapolation along contours from surviving tree lines are other methods that could be used to locate the original tree lines. If such a reconstruction were achieved, improvement in the condition of tree lines could be measured in terms of the proportion of the tree line being structurally intact.

The desired outcome would be an increased proportion of structurally intact tree lines.

### **Pressures**

Clearance for ski runs is the major threat to tree lines, in both the present and the future.

### **Opportunities**

Where no trees exist within dispersal distance of cleared areas, it may be possible to restore tree lines opportunistically by sowing the seed of local tree species after severe fire events.

### **Knowledge gaps**

There is a need for research to establish the exact location of pre-European tree lines in areas where they have been destroyed.

## **Subalpine areas and frost hollows**

### **Introduction**

Subalpine areas in Kosciuszko National Park cover a total of about 1627 square kilometres comprising nearly 24% of the park (Good 1992). They are dominated by Snow Gum (*Eucalyptus niphophila*), and occupy a band between about 1400 m altitude, the upper limit of montane forests and the climatic tree line at about 1860 m (Good 1992). The distribution of all vegetation complexes in the park is shown in Map 9.2.

Associated eucalypts of considerable scientific importance but occurring in a small area, and which are usually marginally subalpine, include the mallees *E. perriniana* and *E. kybeanensis*, *E. stellulata*, *E. debeuzevillei*, *E. lacrimans* and *E. rubida*. The last two of the species in this list occur in frost hollows.

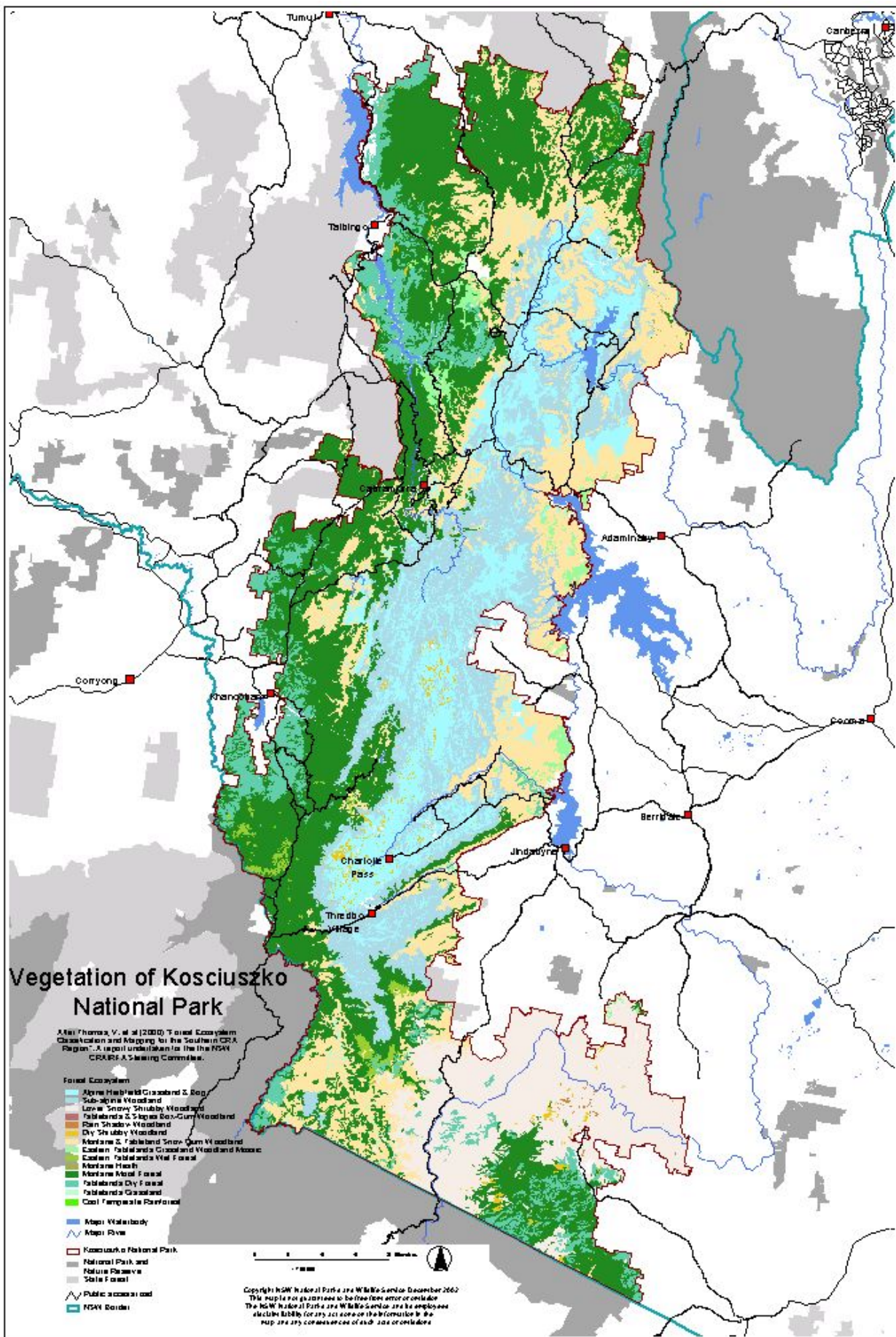
Treeless frost hollows occur with inverted tree lines around their margins where there are broad valleys with restricted exits for the drainage of cold air within the subalpine area and extending into the upper montane tract (Slatyer 1989). Bogs, fens, heaths and grasslands are associated with these hollows and are also found in other subalpine areas.

### **Significance**

Subalpine woodlands in Australia are unique in that they are dominated exclusively by broad-leaved evergreen species, whereas in most other countries, conifers and deciduous species form the tree line (Good 1992). They occur elsewhere in NSW (e.g. Barrington Tops) and in the Australian Capital Territory (ACT), Victoria and Tasmania, but those in the Kosciuszko National Park are of national significance because they are by far the largest.

Frost hollows that concentrate and retain cold air are particularly well developed in the Kosciuszko National Park due to the gently sloping terrain over much of the park. Alps elsewhere in the world usually have steep-sided, deeply dissected valleys (Slatyer 1989). Moreover, examples of frost hollows in the Kosciuszko National Park span nearly the complete spectrum of altitudes, from near the tree line, where the vegetation is barely distinguishable from alpine vegetation in its floristics, to montane examples with very different characteristics. The subalpine, montane and lowland tussock grasslands (*Themeda triandra*) in the valley bottoms have high conservation significance because of the severe loss of this vegetation type elsewhere. The *Poa* tussock grasslands on carbonate rocks in the north of the park are among the best examples of this type of vegetation. The Kosciuszko National Park frost hollows therefore have a high degree of national significance.







The subalpine ecosystems at Kosciuszko provide habitat for a number of rare animal species. Two examples are the Mountain Pygmy-possum in *Podocarpus* heath, and the Corroboree Frogs in *Sphagnum* bogs (Green and Osborne 1994). These ecosystems are therefore of international significance.

Together with the alpine areas of the park, the subalpine areas are of critical importance in southeast Australia as water catchments and for this reason alone should be protected from disturbance and pollution.

The park conserves a hydrologic complex that is essential to the well-being of the country, from the major snowfields of the main range through alpine and subalpine groundwater areas and woodlands that trap snow and cloud, to the montane forests that stabilise the steep slopes of the eastern and western escarpments (Costin et al. 1960, Costin et al. 1961, Costin et al. 1964, Costin and Wimbush 1961, Good 1992).

### **Dependence**

While not exclusive to Kosciuszko National Park, subalpine woodlands and frost hollows are best represented in the park. The frost hollows are unique among conserved areas in containing populations of *Eucalyptus lacrimans*, together with other endemic species (Good 1992).

### **Current condition and trends**

As with many alpine areas at Kosciuszko, the subalpine tract suffered extensive damage from burning and grazing during the first 100-odd years of European occupation (Costin 1954, Costin et al. 1959, Wimbush and Costin 1979a, 1979b, Good 1992). The damage included large areas of deforestation where livestock prevented the regeneration of Snow Gums after hot wildfires. Since 1958, when leases were withdrawn above 1400 m, the trend has been one of slow but steady recovery. Areas occupied by tussock grasses in 1958 are still covered in both grasses and a greatly increased number of other herbs. Areas denuded of vegetation are now largely occupied by shrub species. Where some topsoil remained, there was a slow decrease in shrubs and an increase in herbs, but where the soil profile had eroded down to pavement, shrubs seem likely to persist.

In some instances, subalpine groundwater areas have seen an increase in bog mosses and shrubs as streamlines became blocked and the watertable was raised locally. However, many streamlines were deeply eroded and have reached a new entrenchment that is unlikely to be reversed without active conservation work (Wimbush and Costin, 1983).

### **Pressures**

As with the alpine areas, the main pressures on subalpine sections of the park come from increasing tourism, both in the ski fields and in the back country. The ski fields are at present situated mostly below the tree line and provide concentrations of people (staff, resident and non-resident tourists) in both summer and winter (Buckley et al. 2000). The tourists can be a threat to subalpine ecosystems both within and around the lease areas through tracking, soil compaction, faecal contamination, demands on water and destruction of aesthetic amenity (Buckley et al. 2000).

The combination of an apparent long-term downward trend in snow depth plus the increasing numbers of recreational downhill skiers means that there will inevitably be a threat to areas adjacent to the present lease areas from ski field operators wishing to extend their leases.

With back-country pressures, there are conflicts between nature conservation and recreation, particularly in wilderness areas. Among these conflicts are disturbance effects that favour weeds and feral animals (Johnston and Pickering 2001a).

Various aqueducts constructed by the Snowy Mountains Hydro-electric Authority capture subalpine streams and lead them into high-altitude dams. Examples are the Perisher Range, Falls Creek, Rams Flat and Mungah River aqueducts leading to Guthega dam, and the Goodradigbee River aqueduct leading to Tantangara reservoir. These stream diversions alter both riparian and aquatic ecosystems. It could be argued that these aqueducts do not contribute to irrigation water, since the water they divert would flow west anyway in their absence and they add only a small proportion to hydro-electric capacity.

As in the alpine areas, encroaching weeds (mainly associated with disturbance) remain a constant threat, which is even greater at these lower altitudes. Serrated Tussock, Yarrow, Broom, Cat's Ear and various clovers are among many weeds present in numbers now past the possibility of eradication (Johnston and Pickering 2001a). Broom in particular poses a continuing threat to biodiversity and ecological integrity, as can be seen, for example, in the Barrington Tops National Park.

Feral horses and pigs pose an increasing threat to ecosystems. Rooting pigs can cause much disturbance, particularly in frost hollows (Green and Osborne 1994). Rabbits are well established in the lower subalpine tract in such areas as Kiandra and Snowy Plains where snow depths are not generally sufficient to prevent them from digging out of their burrows (Leigh et al, 1987). In areas such as roadsides, rabbits are able to push into higher country where snow clearing occurs.

### **Knowledge gaps**

In describing the flora of a subalpine frost hollow, several species of particular conservation and/or taxonomic significance are listed in a recent paper (McDougall and Walsh, in press). Other frost hollows in Kosciuszko National Park have not been well studied and it is likely that their flora would also be of interest.

The non-vascular flora of Kosciuszko National Park has been little studied.

## Opportunities

Protection of the Kosciuszko National Park subalpine flora depends upon a number of priority issues. These issues must be addressed within the new plan of management and assigned appropriate objectives and aims. Some issues for the subalpine areas are listed below.

- There are previously wooded areas where, through lack of recruitment, trees are still absent (Miller 2002). Some of these areas have been planted with tube stock grown from local seed, and the trees are now flourishing. This work could be continued.
- Streams such as Dicky Cooper Creek and Spencers Creek could be progressively semi-blocked in their headwaters using permeable barriers. This measure would reduce further erosion, increase sedimentation and raise watertables, thus encouraging the spread of valley bogs.
- Only a very small percentage of Snow Gum woodland in the park can be regarded as old growth. Most of it is in a seral state after top-kill by fire (Gill et al. 1973, Good 1973, Wimbush and Forrester 1988). Succession towards old-growth woodland would be improved by management measures aimed at keeping fires out of the subalpine tract in the park. Such measures would also encourage secondary succession in subordinate strata where pyric shrubs have partly replaced herbaceous species.
- Closure of high-level aqueducts would restore subalpine stream ecosystems. There is some water already allocated for montane streams for this purpose, stemming from the Snowy corporatisation process.
- Feral horses, pigs, goats and deer should be eradicated from the alpine and subalpine areas. Rabbit and fox numbers should be reduced as far as possible, and the most aggressive weeds should be controlled.
- Skifield lease boundaries should be permanent and not subject to review and associated clearing should be carried out in such a way that it does not further affect subalpine communities or species.
- The inclusion of the remaining portion of Snowy Plains still outside the park boundary would conserve virtually all high-level frost hollows and complete the altitudinal series. This inclusion would obviously be dependent upon availability.

## Indicators and monitoring

Subalpine vegetation transects were established in the Guthega catchment in 1959 and measurements were continued for 20 years (Wimbush and Costin 1979ab), spanning eroded tussock, treeless areas and intact woodland. Some of these transects could be relocated and remeasured to give an accurate picture of long-term change in parts of the subalpine landscape.

A periodic low-level aerial photographic survey of areas under particular pressure, such as those within and surrounding ski fields, would give valuable information. For example, advance warning could be given of walking tracks proliferating due to the summer use of ski lifts.

An extremely telling way to monitor change is simply to locate the sites of old photographs, retake them periodically and assess any changes.

## Lower Snowy Valley

The general sequence of environments in Kosciuszko National Park - an extensive north-south plateau of alpine/subalpine snow country steepening both on the western and eastern sides through montane forests to fringing tablelands - is deeply incised by the lower Snowy River south of Dalgety as it turns first westwards then southwards towards the Tasman Sea. The scenery of the Lower Snowy Valley is spectacular (see Map 8.1).

The juxtaposition of elevated cold moist watershed and the lower dry and warm valley produces ecosystems and groups and sequences of ecosystems not found elsewhere in the park, or as well developed elsewhere in Australia.

Of particular interest are the xeromorphic-mesothermal White Box (*E. albens*)-White Cypress Pine (*Callitris glaucophylla*) (box-pine) ecosystems within the valley. Although geographically isolated from coastal and inland areas, they show great affinities with both areas. They are also in close proximity to tableland, montane and subalpine ecosystems of the park. White Box woodlands in the wheat/sheep belt are under extreme pressure and have recently been listed as endangered ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999*. The box-pine community is considered by some ecologists to be a relict of earlier more widespread climatic conditions, still preserved within the refugium of the Snowy Valley.

On the steep western slopes of the valley, the usual more extensive sequence of subalpine woodland, wet sclerophyll forest and dry sclerophyll forest is telescoped into a few kilometres before passing into the box-pine woodlands and scrubs. By contrast, on the up-slope sequence on the drier eastern side of the valley, the dry sclerophyll forest persists above the box-pine vegetation but with patches of 'black scrub' or 'Byadbo scrub' characterised by *Acacia silvestris* and other species such as *Eriostemon trachyphyllus*, also found near the NSW south coast.

The aquatic environment of the lower Snowy River, although now much modified by upstream dams and diversions above Jindabyne, is also unusual within the Kosciuszko National Park. Several short, fast-flowing, cold-water subalpine rivers (e.g. Jacobs River, Pinch River and Ingegoodbee River) discharge directly into the warmer waters of the lower Snowy River itself. Headwater diversions of these rivers have been considered.

The natural values of the Lower Snowy Valley are enhanced by their Aboriginal and early-European cultural history. The valley was an important living area and corridor for Aboriginal people (Scougall 1991). It also provided the exploration route from the Monaro into East Gippsland, soon followed by southward land occupation and increasing livestock movement between the two regions. Before about 1900, the box-pine woodlands apparently were more open and grassy with stable soils, but with livestock grazing and invasion by rabbits, the steeper slopes lost their ground cover and topsoil. With a decline in rabbits, the box-pine woodlands were partly replaced by dense regenerating stands of pine scrub. With little topsoil now remaining in which a protective grassy cover can re-establish itself, soil stability (now precarious) depends on the accumulation of leaf and bark remains on the surface. For this accumulation to happen, 'no fire' management is needed (Pulsford 1991). On the other hand, localised occasional fire may be necessary to regenerate the 'black scrubs' (Clayton-Greene and Wimbush 1988).

The river ecosystem has also been changed by the upstream diversion of most of its waters, especially the snow melt waters which caused strong freshes or flooding in the Lower Snowy Valley every year. Lack of regular flooding has also been associated with large changes in the extent and composition of the riparian scrubs along the river including invasion and spread of willows and other exotic weeds. The recent decision to increase Snowy River flows by 28% may ameliorate this situation but is unlikely to reverse it unless other weed control measures are also adopted.

Despite these partly irreversible changes in the terrestrial and aquatic ecosystems, the Lower Snowy Valley contains some of the most outstanding natural and cultural resources of the park, certainly of local and national and arguably of international importance.

### **Pressures**

Riverine forest and woodland ecosystems with associated riparian scrubs (species of *Callistemon*, *Kunzea*, *Leptospermum* and *Melaleuca*) along the Snowy River and elsewhere inside and outside the park are under particular threat from various species of willow, which have in some instances replaced the native vegetation.

### **Opportunities**

There is still an opportunity to eliminate willows from the park, beginning with those species capable of producing seed, then working down from river headwaters to eliminate those that reproduce only vegetatively (Cremer, 1999).

### **The eucalypts - an ecological overview**

Costin (1989) noted that southeastern Australia was unique in the world, in that one genus of trees, *Eucalyptus*, dominated the landscape continuously from sea level to the upper slope tree line, with many species of eucalypt replacing each other in altitudinal sequence, rather than species from different genera. Eucalypts are uniquely and characteristically Australian, possessing a globally unusual set of adaptations and ecological relationships, and also a globally outstanding propensity to evolve through wide and rapid radiation, adaptation and hybridisation (Kirkpatrick et al. 1987, Costin 1989, Williams and Woinarski 1997).

Some of the ecological sequences are outlined below, with emphasis on the eucalypt communities that provide the strongest unifying thread. The longest sequences are those from north to south of the park along the main axes of the Fiery Range and Great Dividing Range. These are mostly sample subalpine woodland and high-montane sclerophyll forest, and reflect the limited altitudinal range. The west to east transects ascending from the moist western side of the mountains across the high divide then descending the drier eastern side are more complex (NPWS 2002).

The major sequence - from Kosciuszko eastwards towards the coast - starts with narrow fringing woodlands of Black Sally (*Eucalyptus stellulata*) and Broad-leaved Sally (*E. camphora*) along the Geehi and Upper Murray rivers. On the steep ascent there is dry sclerophyll forest on drier slopes - Brittle Gum (*E. mannifera*), Red Stringybark (*E. macrorhyncha*) and Broad-leaved Peppermint (*E. dives*). Then there is a broad band of wet sclerophyll forest of two main types, the lower belt including Ribbon Gum (*E. viminalis*), Brown Barrel (*E. fastigata*), Eurabbie (*E. bicostata*) and Narrow-leaved Peppermint (*E. robertsonii*); and the upper belt Alpine Ash (*E. delegatensis*), Mountain Gum (*E. dalrympleana*), White Sally (*E. pauciflora*) and the rarer Bogong Gum (*E. chapmaniana*). Within the wet sclerophyll forest belt, for example, near Geehi, there are patches of cool temperate rainforest with *Sassafras* (*Atherosperma moschatum*) (see Map 9.1).

Above the sclerophyll forest there is a steep, narrow belt of subalpine woodland and scrub of Snow Gum, then the complex of alpine vegetation along the main range beyond the tree line before the more gradual descent through snow gum woodland and sclerophyll forest on the drier eastern side. Here, the upper wet sclerophyll forest.

communities contain less Alpine Ash and the lower wet sclerophyll forest belt is largely replaced by dry sclerophyll forest of Broad-leaved Peppermint and Candlebark (*E. rubida*). Associated savannah woodland on the gentler slopes contains White Sally, Candlebark and Ribbon Gum.

To the south, the Lower Snowy Valley descends steeply to elevations as low as 225 m above sea level, enclosing a drier and warmer environment with mesothermal woodlands and scrubs not found elsewhere in the park. Important species include White Box, Bundy (*E. goniocalyx*), Yellow Box (*E. melliodora*), Apple Box (*E. bridgesiana*), White Cypress Pine, Currawang (*Acacia doratoxylon*), Coast Myall (*A. binervia*) and Bodalla Wattle (*A. silvestris*).

The steep ascent of the eastern (west-facing) slopes of the Lower Snowy Valley is through woodland and dry and wet sclerophyll forest, including a few stands of Alpine Ash around Mount Tingaringy, and approaches the easternmost occurrence of this species (Delegate Mountain). On the elevated (1448 m) marginally subalpine summit of Mount Tingaringy itself there is a disjunct patch of the wet mallee Tingaringy Gum (*E. glaucescens*). The descent from Tingaringy approaches the southeast boundary of Kosciuszko National Park near the southern Monaro tableland around Delegate, with remnants of savannah woodland of White Sally and associated species.

Not far distant are the Snowy River, Erinundra and Coopracambra National Parks of Victoria and the South-east Forests National Park of New South Wales, containing sclerophyll forests rich in coastal eucalypt species, and the Croajingalong (Victoria), Nadgee and Ben Boyd (NSW) reserves along the NSW–Victorian coastline. Although other regions of Australia may contain more eucalypt species than the Kosciuszko- to-coast corridor, it is ecologically richest, with eucalypts able to exploit every habitat available to trees from climatic tree line to the ocean coastline. No other genus of trees has been shown to do this. The wide adaptive capacity of the genus *Eucalyptus* reflects the continuous gene flow within and between its species, providing suitable genetic combinations able to take advantage of almost any ecological challenge that might arise.

The eucalypts show responses to environmental gradients similar to those described earlier in the main zones of vegetation. There is also systematic variation at the species level, as seen in the various forms of what was formerly known as *E. pauciflora* sens lat. The normal woodland ecotype is clinally related to the taller forest form, the extreme cold air plain form (*E. lacrimans*), the large-fruited form (*E. debeuzevillei*) and the subalpine form (*E. niphophila*). Some of the old-growth Snow Gums on Mount Bimberi near the Kosciuszko National Park–Namadgi National Park border record in their growth rings and fire scars several centuries of ecological history (Banks 1987).

### **Basis for management**

Eucalypt-dominated communities are natural features created by ecosystem processes. They are also rich in biodiversity. Thus their protection is an objective of the *National Parks and Wildlife Act 1974* under section 2A (1)(a). Section 30E (2)(a) makes the conservation of biodiversity, natural phenomena and landscapes a principle in national park management. Section 72A(1)(g) makes the maintenance of natural phenomena and processes a matter that should be considered in the drafting of a management plan.

The sequence from tree line to the sea would satisfy criteria 1 (a) for national significance, in that it is important in the pattern of Australia's natural history. It satisfies the definitional criterion (i) for World Heritage listing in that it is constituted of a group of biological formations that is of outstanding universal significance from the scientific point of view. It also satisfies listing criterion (ii) in that it is an outstanding example of ongoing ecological and biological processes in the evolution and development of communities of plants and animals.

### **Dependence**

The 'snow country' (alpine and subalpine areas) of Kosciuszko National Park, especially the main range area around Mount Kosciuszko itself, is a focal attraction both for scientific study and for mountain recreation (Barlow 1989, Good 1989, 1992, Green 1998, Buckley et al. 2002, Worboys and Pickering 2002). These attractions tend to obscure the scientific significance and appreciation of other natural environments of the park, particularly the forest and woodland ecosystems below the winter snowline. These ecosystems occupy both a larger area than those of the snow country and extend through a greater altitudinal range (see figure 9.1). Furthermore, their contiguity or near-contiguity with other national parks and reserves in NSW, Victoria and the ACT extends them geographically from the inland across the Great Dividing Range to the south-east coastline. Superimposed on this broad climatically controlled pattern are the further variations associated with differences in geology, topography and soils. Such a comprehensive continuum of near-natural environments largely protected as national park has few parallels elsewhere in the world.

A more northerly west to east transect across the Tumut River near Ravine through Yarrangobilly and across the headwaters of the upper Murrumbidgee–upper Goodradigbee to Namadgi National Park in the ACT provides other examples of the Kosciuszko National Park's ecological diversity. In this example, the high-elevation alpine environment is lacking, but cold air plains with inverted tree lines are better developed. Geological variation is greater, from acid granites and metasediments to basic basalt and limestone, with corresponding differences in some of the ecosystems. For example, the cold air plain near Coleman contains few *Sphagnum* bogs, presumably because of free drainage of groundwater through the limestone, but on the limestone itself there is a richer moss flora.

The recognition of the summit to sea ecological story by national or international legal processes does not necessarily depend on the inclusion of Kosciuszko National Park, because the same sequence is found in Victoria. However, the case for listing would be strongest with the inclusion of all the Australian alps (Kirkpatrick 1994b).

### **Significance**

Kosciuszko National Park has more than 30 eucalypt species, distributed from the western foothills of the Great Dividing Range to the rain shadow valley of the Snowy River. It contains a large part of the catena of eucalypts from the tree line to the sea that many have argued is of outstanding universal significance (Costin 1989, Good 1992, Busby 1990, Kirkpatrick 1993, Mosley and Costin 1992 and others).

The Blue Mountains area was successfully nominated for world heritage listing, largely because it was considered to be the best example, in a state of high integrity, of the diversity of eucalypts and the communities they dominated. In the process of nomination the World Conservation Union (IUCN) suggested that a serial listing, including the Australian alps and other areas, might be more appropriate than the Blue Mountains by themselves. The Australian government replied that it could achieve the effect of such a serial nomination through its national listing process under the *Environmental Protection and Biodiversity Conservation Act 1999*. There therefore is little doubt that the tree line to sea story has both international and national significance.

### **Condition and trend in condition**

Most of the eucalypt forest and woodland in the Kosciuszko National Park has a minor component of introduced animal or plant species, and a large proportion has been structurally changed by high fire incidence and stock grazing. There is relatively little old-growth forest compared with the likely situation in the mid-eighteenth century (Good 1992). If stock grazing were totally excluded and fires less frequent, Kosciuszko National Park would be on a trajectory back to its probable mid-eighteenth century condition.

Trend in condition might thus be best measured by the proportion of old-growth eucalypt forest and woodland, with the management goal being to have this increase to pre-European levels, a necessarily protracted process.

### **Pressures**

Eucalypts are regarded by many as one of the world's most important groups of trees. But the Achilles heel of the genus is its seed. The small size and high density of the seed limit dispersal to within a few tree-heights of the parent tree, and short seed longevity implies that even small areas that completely lose their tree cover may be unable to regenerate naturally other than by the slow peripheral spread from more distant communities. Genetic interchange between separated communities is also broken. This is why the large continuous sequences of eucalypt communities are of such ecological value and importance, with the potential of extending them further via other reserves.

Fire regimes that cause the death of older eucalypts are a threat to the transition to old growth. Invasion of exotic species is another threat associated with inappropriate fire regimes.

### **Opportunities**

The preservation of the ecosystems of the Kosciuszko National Park, intact and in contiguity, and hopefully in conjunction with the ecosystems of associated parks and reserves, is arguably the greatest safeguard to biodiversity in southeastern Australia, and is also of significance at national and international levels. National and international recognition of the importance of the eucalypt forests and woodlands is possible.

### **Knowledge gaps**

The fire regime requirements for a transition towards old growth need to be determined for some of the montane and lowland eucalypt dominated communities.

### **Indicators and monitoring**

The proportion of old-growth eucalypt forest and woodland to total eucalypt forest and woodland is an appropriate indicator, and could be measured every decade. Sets of permanent plots in which the occurrence of exotics will be monitored every three years will be established randomly within eucalypt forest and woodland easily accessible by road. The data will relate to signs of exotic vertebrate animals (e.g. scats and prints) and broad cover classes for exotic plants. Once a reconstruction is achieved, the indicator will be the proportion of original tree line that is structurally intact, to be monitored once a decade.

## **The 2003 wildfires in Kosciuszko National Park**

Wildfire is a natural phenomenon. The fires that were started by lightning at the beginning of 2003 were exceptional firstly in that they occurred at the end of a record drought, secondly that they started from multiple strikes in inaccessible country and were able to join up, and thirdly, that they ran into extreme fire weather - a combination of factors unlikely to occur very often.

As with all large wildfires, the effect on the vegetation was variable, depending upon the weather at the time the fire front reached it and the previous fire history and consequent state of litter accumulation and vegetation regrowth.

Viewing the post-fire vegetation from the air along the Main Range, the most remarkable feature was the intensity of the fire as it swept up the western face of the range and its abrupt halt when it reached the crest.

The entire plateau from Kosciuszko to Twynam and from the crest of the range across the upper Snowy River to the top of the Kangaroo Range - except for a small patch of shrubs on the west-facing slope above the Blue Lake track and a small area of windswept feldmark north of Carruthers - was unburnt. Further north it was a different picture, the fire having carried across the range in Snowgum woodland and sod tussock grassland, even burning through *Sphagnum* bogs.

In the steep valleys to the east and west of the range the montane forests showed a mosaic of fire effects. Little of the understorey was unaffected, but many of the tall tree canopies remained unscorched. Those that were burnt were, by mid-February, starting to sprout from epicormics. Even Alpine Ash, normally extremely fire sensitive and in many places killed outright, had in other places survived the fire unscathed except for the blackened rough bark along the bottom section of their trunks.

It had been our experience after previous fires (notably the Grey Mare fire of 1972) that Snowgum was very easily top-killed by any fire in its understorey. In February 2003 large areas of Snowgum were ringbarked by the fire, their canopies slowly turning pale green, others had canopies scorched brown and some had no canopy at all. Whether by 2003 the shrubs germinated by previous fires had reached maturity and were not so dense, or perhaps the long drought had caused the tree cambium to be less sensitive to fire. The fact is that unlike the case with other fires there were many areas of Snowgum where the fire had travelled underneath but whose canopies looked perfectly healthy.

The subalpine bogs are in a sorry state. A few areas escaped the fires, but most of the bogs we saw between Valentines and Snakey Plain were badly burnt, the odd remaining hummocks of *Sphagnum* brown and undercut and the bog shrubs blackened sticks. The wetland sedges were sprouting from the base but it is hard to see how the bogs will recover in the short term.

The widespread fires in forest and woodland areas will put back plant successions there towards earlier stages, characterised by shrubby understoreys and regrowth trees (seedling and epicormic/lignotuber regeneration). Many of the relatively few stands of near-old growth communities have also been affected in this way. Future management should give particular attention to the protection of surviving old growth communities and to the encouragement of successions elsewhere towards middle and old growth conditions.

Species	Threatened Species Conservation Act 1995	Environment Protection & Biodiversity Conservation Act 1999	Endermic to Kosciuszko National Park	Plan of management significant feature	All NSW populations in Kosciuszko National Park	Alpine	Subalpine	Montane	Low total number of plants (< 1000)	Small number of populations (< 10)
<i>Abrotanella nivigena</i>				S	✓	✓				
<i>Acacia dallachiana</i>				S	✓			✓		
<i>Aciphylla glacialis</i>				S	✓	✓				
<i>Agrostis joyceae</i>			✓				✓			
<i>Agrostis muelleriana</i>				S	✓	✓				
<i>Agrostis thompsoniae</i>					✓	✓				
<i>Asperula euryphylla</i>					✓					
<i>Astelia alpina</i> var. <i>novae-hollandiae</i>					✓	✓	✓			
<i>Astelia psychrocharis</i>			✓	S		✓				
<i>Astrotricha</i> sp. 4					✓			✓	✓	✓
<i>Bertya findlayi</i>				S	✓			✓		
<i>Brachyscome stolonifera</i>			✓			✓				
<i>Brachyscome tadgellii</i>			✓	S		✓	✓			
<i>Brachyscome tenuiscapa</i> var. <i>tenuiscapa</i>					✓	✓				
<i>Calotis glandulosa</i>	V	V		Vs			✓			
<i>Calotis pubescens</i>	E				✓		✓		✓	✓
<i>Caltha introloba</i>					✓	✓				
<i>Cardamine</i> sp. A2			✓			✓				
<i>Carex archeri</i>					✓	✓				✓
<i>Carex canescens</i>					✓	✓				
<i>Carex cephalotes</i>				S	✓	✓	✓			
<i>Carex hypandra</i>				S	✓	✓				
<i>Carex jackiana</i>					✓	✓	✓			
<i>Carex raleighii</i>	E			H	✓	✓	✓			✓
<i>Carpha alpina</i>					✓	✓				
<i>Carpha nivicola</i>					✓	✓	✓			
<i>Celmisia costiniana</i>					✓	✓				
<i>Chiloglottis comuta</i>					✓		✓			
<i>Chionochoa frigida</i>			✓	Vs		✓				
<i>Chionogentias muelleriana</i> subsp. <i>alpestris</i>			✓			✓				
<i>Chionohebe densifolia</i>				Vs	✓	✓				
<i>Colobanthus affinis</i>					✓	✓	✓			
<i>Colobanthus nivicola</i>			✓	Vs		✓				
<i>Colobanthus pulvinatus</i>			✓	Vs		✓				
<i>Coprosma niphophila</i>			✓	Vs		✓				
<i>Coprosma nivalis</i>					✓		✓			

Species	Threatened Species Conservation Act 1995	Environment Protection & Biodiversity Conservation Act 1999	Endermic to Kosciuszko National Park	Plan of management significant feature	All NSW populations in Kosciuszko National Park	Alpine	Subalpine	Montane	Low total number of plants (< 1000)	Small number. of populations (< 10)
<i>Correa lawrenciana</i> var. <i>rosea</i>			✓				✓	✓		
<i>Craspedia alba</i>				S	✓	✓				
<i>Craspedia costiniana</i>			✓	S		✓				
<i>Craspedia lamicola</i>				S	✓	✓				
<i>Craspedia leucantha</i>			✓	Vs		✓				
<i>Craspedia maxgrayii</i>			✓	S		✓				
<i>Cystopteris tasmanica</i>				S	✓	✓	✓			
<i>Derwentia nivea</i>				S	✓		✓			
<i>Deyeuxia affinis</i>				S	✓	✓	✓			
<i>Dichosciadium ranunculaceum</i>					✓	✓				
<i>Diplaspis nivis</i>					✓	✓	✓			
<i>Discaria nitida</i>	V	V		H	✓		✓			
<i>Drosera arcturi</i>					✓	✓				
<i>Epacris glacialis</i>					✓	✓				
<i>Epilobium curtisiae</i>					✓		✓			
<i>Epilobium sarmentaceum</i>					✓	✓	✓			
<i>Epilobium tasmanicum</i>					✓	✓				
<i>Erigeron paludicola</i>					✓	✓				
<i>Erigeron setosus</i>			✓	Vs		✓				
<i>Eucalyptus chapmaniana</i>					✓			✓		
<i>Eucalyptus lacrimans</i>				S			✓			
<i>Eucalyptus saxatilis</i>	E	V		H	✓			✓	✓	✓
<i>Euchiton argentifolius</i>					✓	✓	✓			
<i>Euchiton fordianus</i>					✓	✓	✓			
<i>Euchiton nitidulus</i>	V	V		Vs	✓	✓	✓			
<i>Euchiton poliochlorus</i>					✓		✓			
<i>Euchiton traversii</i>					✓		✓			
<i>Euphrasia alsa</i>			✓	Vs		✓				
<i>Euphrasia collina</i> subsp. <i>diversicolor</i>					✓	✓	✓			
<i>Euphrasia collina</i> subsp. <i>glacialis</i>			✓	S		✓				
<i>Euphrasia collina</i> subsp. <i>lpidosa</i>			✓	S		✓				
<i>Euphrasia</i> sp. 3			✓	Vs		✓			✓	✓
<i>Ewartia nubigena</i>					✓	✓				
<i>Galium roddii</i>			✓	Vs			✓			✓
<i>Genoplesium turfosum</i>				Vs	✓		✓			
<i>Geranium sessiliflorum</i> subsp. <i>brevicaule</i>					✓		✓			
<i>Gingidia algens</i>			✓	S		✓	✓			
<i>Glycine latrobeana</i>		V			✓			✓	✓	✓



Species	Threatened Species Conservation Act 1995	Environment Protection & Biodiversity Conservation Act 1999	Endemic to Kosciuszko National Park	Plan of management significant feature	All NSW populations in Kosciuszko National Park	Alpine	Subalpine	Montane	Low total number of plants (< 1000)	Small number of populations (< 10)
<i>Grammitis poeppigiana</i>					✓	✓				
<i>Haloragis exalata</i> subsp. <i>exalata</i>	V	V						✓		
<i>Herpolirion novae-zelandiae</i>					✓	✓	✓			
<i>Hierochloa submutica</i>				S	✓	✓				
<i>Hovea</i> sp. aff. <i>heterophylla</i>			✓				✓		✓	
<i>Huperzia australiana</i>					✓	✓	✓			
<i>Irenepharsus magicus</i>	E			H	✓			✓	✓	✓
<i>Isolepis montivaga</i>					✓	✓	✓			
<i>Juncus antarcticus</i>					✓	✓				
<i>Juncus thompsonianus</i>					✓	✓				
<i>Kelleria dieffenbachii</i>					✓	✓				
<i>Leucopogon maccraei</i>					✓		✓			
<i>Luzula acutifolia</i> subsp. <i>nana</i>			✓	S		✓				
<i>Luzula alpestris</i>					✓	✓				
<i>Luzula atrata</i>					✓	✓				
<i>Luzula australasica</i> subsp. <i>dura</i>			✓			✓				
<i>Luzula novae-cambriae</i>					✓	✓	✓			
<i>Muehlenbeckia diclina</i> subsp. <i>stenophylla</i>					✓			✓		✓
<i>Olearia aglossa</i>				S				✓		
<i>Olearia lasiophylla</i>			✓	Vs				✓		
<i>Olearia stenophylla</i>			✓				✓			✓
<i>Oreobolus pumilio</i> subsp. <i>pumilio</i>					✓	✓	✓			
<i>Oreomyrrhis brevipes</i>				S	✓	✓				
<i>Oreomyrrhis pulvinifca</i>					✓	✓				
<i>Oschatzia cuneifolia</i>				S	✓	✓	✓			
<i>Pelargonium helmsii</i>					✓	✓	✓			✓
<i>Pentachondra pumila</i>					✓	✓				
<i>Phebalium ovatifolium</i>			✓	S		✓	✓			
<i>Pimelea alpina</i>					✓	✓	✓			
<i>Pimelea axiflora</i> subsp. <i>alpina</i>					✓	✓				
<i>Pimelea bracteata</i>				S	✓		✓			
<i>Plantago alpestris</i>					✓		✓			
<i>Plantago glacialis</i>					✓	✓				
<i>Poa fawcettiae</i>					✓	✓	✓			
<i>Poa petrophila</i>				S	✓		✓			
<i>Pomaderris cotoneaster</i>	E	E		H				✓		
<i>Pomaderris pallida</i>	V	V		H				✓		
<i>Prasophyllum retroflexum</i>	V	V	✓				✓			

Species	Threatened Species Conservation Act 1995	Environment Protection & Biodiversity Conservation Act 1999	Endemic to Kosciuszko National Park	Plan of management significant feature	All NSW populations in Kosciuszko National Park	Alpine	Subalpine	Montane	Low total number of plants (< 1000)	Small number of populations (< 10)
<i>Ranunculus acrophilus</i>			✓			✓				
<i>Ranunculus anemoneus</i>	V	V	✓			✓				
<i>Ranunculus clivicola</i>			✓	Vs			✓			
<i>Ranunculus dissectifolius</i>			✓	Vs		✓				
<i>Ranunculus gunnianus</i>					✓	✓	✓			
<i>Ranunculus muelleri</i> var. <i>brevicaulis</i>			✓			✓				
<i>Ranunculus muelleri</i> var. <i>muelleri</i>					✓	✓				
<i>Ranunculus niphophilus</i>			✓	Vs		✓				
<i>Ranunculus productus</i>			✓	Vs			✓			
<i>Rytidosperma pumilum</i>	V	V			✓	✓				✓
<i>Rutidosia leiolepis</i>	V	V		Vs			✓			
<i>Rytidosperma australe</i>					✓	✓				
<i>Rytidosperma nivicola</i>					✓	✓				
<i>Schizellema fragoseum</i>					✓	✓				
<i>Schoenus calyptratus</i>					✓	✓	✓			
<i>Scleranthus singuliflorus</i>					✓	✓				
<i>Senecio</i> sp. 1 ( <i>Fl. Vict.</i> )					✓	✓	✓			
<i>Stackhousia pulvinaris</i>					✓	✓				
<i>Taraxacum aristum</i>							✓			✓
<i>Thesium australe</i>	V	V		Vs			✓			
<i>Trisetum spicatum</i> subsp. <i>australiense</i>					✓	✓	✓			
<i>Uncinia compacta</i>					✓	✓				
<i>Uncinia sinclairii</i>					✓	✓				✓
<i>Uncinia sulcata</i>					✓	✓				
<i>Wahlenbergia densifolia</i>					✓		✓			

E = Endangered V = Vulnerable, Vs = Very significant, H = High significance, S = Significant

## Attachment 9B

## Regional Context of Vegetation Communities in Kosciuszko National Park

After: Thomas, V, Gellie, N, and Harrison, T. (2000) *Forest Ecosystem Classification and Mapping for the Southern CRA Region*. A report undertaken for the NSW CRA/RFA Steering Committee, Project No NS 08EH.

Non-alpine communities	Total area in park (ha)	Total area extant (ha)	Total original area (ha)	Reserved area (ha)	% extant in park	% of original cleared	% extant reserved
Number in brackets, ie: (157) refer to forest ecosystem classifications used in the CRA mapping process.							
ACT/Monaro dry grassland (157)	2	289	84685	2	1	100	1
Bogong gum Western escarpment shrub/grass forest (88)	587	587	587	587	100	0	100
Central tableland/ACT montane dry shrub forest (107)	586	36301	60798	3842	2	40	11
Central tablelands shrub/grass dry forest (76)	8623	39908	111951	8672	22	64	22
Eastern tableland dry shrub/grass forest (73)	282	72286	266778	2139	0	73	3
Kosciuszko western escarpment cool temperate rainforest (172)	106	106	106	106	100	0	100
Lower Snowy dry shrub/tussock grass forest (77)	42974	69920	74513	42974	61	6	61
Lower Snowy rain shadow woodland/shrubland (41)	345	705	705	345	49	0	49
Lower Snowy white box dry shrub/herb woodland (78)	33684	37392	41277	31805	90	9	85
Montane/subalpine dry rocky shrubland (36)	2660	3038	3040	2699	88	0	89
Montane acacia/dry shrub/herb/grass forest (97)	49740	81896	84082	51541	61	3	63
Montane dry shrub/herb/grass forest (99)	6293	17060	17080	8698	37	0	51
Montane dry shrub/tussock forest (106)	28454	29543	30126	28454	96	2	96
Montane riparian moist shrub/grass/herb forest (83)	10	945	973	238	1	3	25
Montane riparian moist shrub/sedge/grass/forest (85)	230	5010	5094	652	5	2	13
Montane wet heath/bog (123)	162	892	892	872	18	0	98
Montane wet heath/herb grassland (125)	0	312	313	19	0	0	6
Northern slopes dry grass woodland (160)	4	12902	335030	102	0	96	1
North-western montane dry shrub/herb/grass forest (101)	18390	41243	42858	18390	45	4	45
South coast and Byadbo acacia scrubs (35)	1191	3980	3981	1876	30	0	47
Southeastern dry shrub/grass/herb forest (74)	6	50223	131522	2453	0	62	5
Subalpine dry shrub/herb/grass woodland (127)	74	1144	1144	178	6	0	16
Subalpine dry shrub/herb woodland (128)	41174	45870	45943	41009	90	0	89
Subalpine herbfield (131) - complex of various communities	32736	32810	35100	32677	100	7	100
Subalpine shrub/grass woodland (130)	65979	66429	66925	66000	99	1	99
Tableland acacia/herb/grass forest (104)	29530	41113	46452	28382	72	11	69
Tableland acacia moist herb forest (95)	9316	36537	46816	12515	25	22	34
Tableland and escarpment wet layered shrub forest (58)	4022	21891	23331	12028	18	6	55
Tableland dry heath shrub/herb/grass woodland (38)	242	1629	1636	782	15	0	48
Tableland dry herb/grass woodland (146)	278	2111	11124	241	13	81	11
Tableland tussock grassland/sedgeland/woodland (148)	1	3307	15646	1	0	79	0
Tablelands dry shrub/grass forest (110)	860	18475	22252	2612	5	17	14
Tablelands shrub/tussock grass forest (75)	14131	34635	43810	17418	41	21	50
Western escarpment dry shrub forest (70)	1180	1567	1578	1180	75	1	75
Western escarpment moist shrub/herb/grass forest (87)	54751	69708	69860	54751	79	0	79
Western montane acacia fern/herb forest (82)	66508	105000	163642	64526	63	36	61
Western montane dry fern/grass forest (103)	20386	49502	74061	25502	41	33	52
Western montane moist shrub forest (98)	46307	81333	86082	47692	57	6	59

Non-alpine communities	Total area in park (ha)	Total area extant (ha)	Total original area (ha)	Reserved area (ha)	% extant in park	% of original cleared	% extant reserved
Number in brackets, ie: (157) refer to forest ecosystem classifications used in the CRA mapping process.							
Western montane wet heath/herb grass woodland (124)	136	4390	5527	76	3	21	2
Western slopes grass/herb dry forest (121)	8042	68732	104415	11637	12	34	17
Western subalpine moist shrub forest (86)	4043	4060	4061	4044	100	0	100
Western tableland dry shrub forest (71)	457	769	1487	457	59	48	59
Western tablelands dry herb/grass forest (108)	28087	75053	125092	25423	37	40	34
Western tablelands dry shrub/grass forest (119)	4	36146	136156	4	0	73	0
Western tablelands herb/grass dry forest (93)	9506	32412	85523	9506	29	62	29
Tall heath	2168	2168	2168	2168	100	0	100
Tall alpine herbfield (Poa - Celmisia)	5298	5298	5298	5298	100	0	100
Tall Alpine Herbfield (Brachyscome - Austroanthonia)	616	616	616	616	100	0	100
Fens and bogs	558	558	558	558	100	0	100
Feldmark (Epacris - Chionohebe)	162	162	162	162	100	0	100
Short alpine herbfield	78	78	78	78	100	0	100
Feldmark (Coprosma - Colobanthus)	27	27	27	27	100	0	100
Short heath	265	265	265	265	100	0	100

Source: Costin, A. et al. (2000)

# Chapter 10

## fauna values

*Dr Ian Mansergh,  
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### Summary

This report was commissioned by New South Wales (NSW) National Parks and Wildlife Service (NPWS) as part of the brief to the Independent Scientific Committee (ISC) to examine the scientific significance and condition of attributes of the Kosciuszko National Park. The park's diverse habitats support populations of about 300 native terrestrial (non-aquatic) vertebrate species - mostly Australian endemics - and an unknown number of invertebrate species. The Kosciuszko faunal assemblage is of national significance, and it makes a major contribution to an internationally significant environmental region that includes the adjacent Alpine National Park in Victoria and Namadgi National Park in the Australian Capital Territory (ACT).

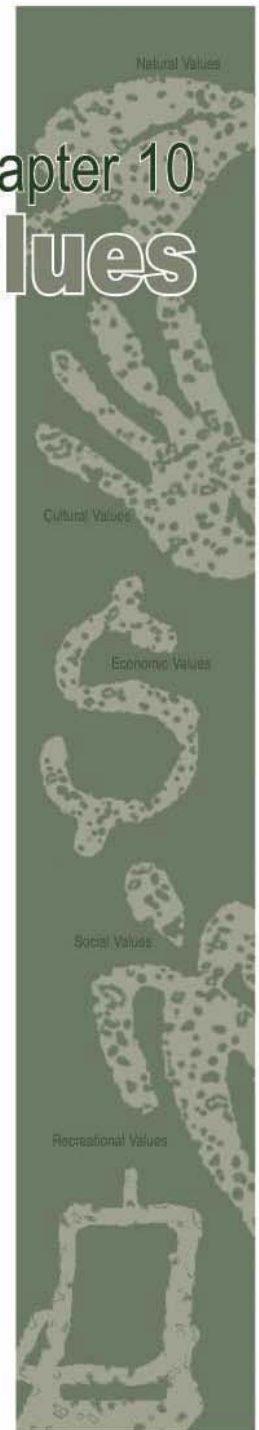
### Contribution to international significance

- The total vertebrate biodiversity of Kosciuszko National Park compares very well with other (large) temperate montane/alpine national parks in North and South America, and is significant for the presence of representatives of all subclasses and infraclasses of mammals (Monotremata, Marsupialia and Eutheria). The high diversity of reptile species, especially above the snowline, is also notable.
- Thirteen vertebrate taxa with populations in the park are listed as threatened or near threatened by the World Conservation Union (IUCN).
- The international significance of the mountain pygmy-possum *Burrhamys parvus* and a variety of other features lends strength to the acceptance of the area under World Heritage criterion (i). If invertebrates - poorly known at present - are considered, criterion (iii), perhaps criterion (i), and the biodiversity representation aspects of (iv) would be met or exceeded.
- Some long-term studies in the park are internationally important in helping to resolve global scientific-conservation questions, and the park is well placed to assist the international investigations into greenhouse climate change and its effects on biodiversity.

### Contribution to national and state significance

- Terrestrial habitats of the alpine and subalpine zone (15% of the park area) support populations of 100 native species, including endemic or alpine specialists - one mammal, four frogs, four reptiles and a range of invertebrates (e.g. 10 species of Orthoptera and 10 species of megascolecid earthworms).
- The unique features of the Australian Alps bioregion and the high percentage of its area that is managed for biodiversity conservation indicate that its actual and potential value in a continental context will increase in the future.
- The size and land management status (national park) and altitudinal gradients of the forest and woodland habitats surrounding the alpine environment enable a wide range of taxa to be supported. Habitats in these areas support numerous populations of threatened species and provide critical elements of habitat that have been depleted elsewhere (e.g. mature seral stages). From an ecological viewpoint, the fauna contributes to the health of the vegetation and the provision of ecosystem services.
- Predications of the effects of enhanced greenhouse climate change suggest that the alpine environments and their dependent biota are amongst the most vulnerable environments in Australia, and their protection and that of the adjacent eucalypt montane forests and woodlands are vital for biodiversity conservation at the national scale.

*“The park’s diverse habitats support populations of about 300 native terrestrial (non-aquatic) vertebrate species – mostly Australian endemics – and an unknown number of invertebrate species.”*



## Condition

General assessments of condition and trends are difficult to make. An important element that is yet to be undertaken is a systematic evaluation of the condition of vegetation and habitats in Kosciuszko National Park, based on a scientifically valid methodology.

- Although most of the land area is managed positively or benignly for biodiversity conservation, populations of some species (and the taxa themselves) are declining or remain highly threatened - most notably, amphibians and some mammals in the alpine area and drier forests.
- The extent of mature seral vegetation types and the consequent critical resources (e.g. tree hollows) affects the distribution and abundance of many threatened species, and needs to be maximised in management. Fire regimes are a critical process in this regard, and in the distribution and abundance of other functional elements (e.g. nutrient- cycling fungi).
- About 20 exotic vertebrate species have established feral populations in Kosciuszko National Park and each adversely affects the native fauna, and/or its habitat and trophic level function, in various ways. These pest animals include grazing ungulates (feral horse, *Equus caballus*, sambar deer, *Cervus unicolor*), rabbits, *Orytolagus cuniculus*, mammalian predators, (red fox, *Vulpes vulpes*, feral cat, *Felis catus*) and a variety of birds. The natural pre-European grazing regime is under pressure.
- The pre-European predator hierarchy (dingo, *Canis familiaris dingo* and two quoll species) is highly disrupted and being replaced by a dingo/dog-fox-cat regime. Restoration of the prior regime should be a major priority of management. This will make a major contribution to the conservation of many threatened species. The disruption of the predator regime is likely to have a 'trophic cascade' effect on other trophic levels.
- The large number of exotic herbivores in the park collectively is a major threat to Kosciuszko National Park.

## Introduction

This report was commissioned by NSW NPWS as part of the brief given to the ISC to examine the scientific significance, condition and trends of attributes of the Kosciuszko National Park. This is being done in the context of the review of the Kosciuszko National Park Plan of Management (NSW NPWS 1992) which, although revised in 1992, essentially dates from over two decades ago. Since the publication of the management plan in 1982 (NSW NPWS 1992 rev.), there have been scientific advances in our understanding of the biology, ecology and conservation of the vertebrate fauna. A major reason for these advances has been studies on threatened species, and taxonomic work has further clarified the status of several species.

This report examines the terrestrial fauna, with particular emphasis on native vertebrates. The basic structure (e.g. basis for management, examination by broad habitat types), themes (e.g. ecological function) and time frame were provided to the NPWS as part of the broader work of the ISC. The condition and trends of the biodiversity assets is a difficult and complex issue, data sources are few and, where they exist, what is the baseline? Here we endeavour to present and synthesise some available knowledge, discuss relevant issues and, hopefully provide some perspectives and insights that may inform both the community and future management of Kosciuszko National Park.

Comments from public submissions on the ISC Interim Report (NSW NPWS, 2003) have been used to amend the text. Fourteen submissions provided criticism and comment on the chapter. There were also major fires that affected 67% of KNP during January – February 2003 and as a result the text was revised in a general sense to take this into account although the full implications of these fires remain unknown at this stage.

## Basis for management

The fauna of the park is protected under legislation that is specific to the park as well as under other NSW and Commonwealth legislation. Thus, the *National Parks and Wildlife Act 1974* (NSW) provides for a plan of management for the park, and requires that consideration be given to a range of objectives. In addition to conservation of wildlife, the plan of management includes other objectives relating to fauna conservation, such as maintaining the natural environmental processes as far as possible, and encouraging scientific and educational inquiry into environmental features and processes.

In addition to the *National Parks and Wildlife Act 1974*, the *Threatened Species Conservation Act 1995* (NSW) provides for the protection of threatened animals and plants native to NSW (with the exception of fish and marine plants) and requires the integration of threatened species into the planning process for national parks. The Act also provides for the conservation and recovery of threatened species and makes provision for the management of threats to species.

The *Threatened Species Conservation Act 1995* lists species that have been classified as threatened. Threatened species are listed under two categories: schedule 1 (endangered species) and Schedule 2 (vulnerable species). Schedule 1 (endangered species) includes endangered species, endangered populations, endangered ecological communities and species presumed extinct.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires any proposal that may have an impact on a matter of 'national environmental significance' to be referred to Environment Australia for assessment and approval. This Act also lists nationally threatened species and communities. Matters of national significance include species that are listed as vulnerable or endangered species under the EPBC Act (see Attachment 10A).

The Japan–Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA) provide legal protection for all international migratory bird species between the respective countries. Latham's Snipe (*Gallinago hardwickii*) is listed under JAMBA and CAMBA, and is the most frequent visitor to the park of all the listed migratory species.

Some faunal species found in the park are also recognised in the IUCN list of threatened species. A list of all threatened fauna recorded from the Australian Alpine National Parks, and their conservation status from various jurisdictions and the IUCN, is provided in Attachment 10A.

The 1992 Rio Earth Summit produced the *Convention on the Conservation of Biological Diversity*, which provides the international framework for biodiversity conservation. Australia signed the Convention and as a result the Commonwealth produced the *National Strategy for the Conservation of Australia's Biological Diversity* in 1996. The *NSW Biodiversity Strategy* was published in 1999. All these strategies emphasise the need for conservation at the ecosystem, species and genetic level, and reserved areas, particularly large national parks, are recognised as having a key role at all scales, from regional to global. A review of the national strategy was undertaken by the Australian and New Zealand Environment and Conservation Council, which indicated that results varied widely from achieved to not achieved (ANZECC 2001).

## International, national and bioregional context and significance

### Introduction: observations on significance

Significance is a somewhat anthropocentric and relativist term. For species of fauna, some 'significance' classification systems exist (e.g. IUCN - threatened species), some of which may have legal meaning (*Threatened Species Conservation Act 1995*) (Appendix 10). Broad diversity (species counts) may assist in comparisons and it is possible to weight the 'uniqueness' of a faunal complement. We analysed the significance of the fauna under the following headings, although it is recognised that these overlap:

- international comparison;
- degree of uniqueness, comparative extent of biological diversity;
- unusual ecological functioning (e.g. trophic layers);
- national (continental) – state – bioregional context;
- degree of uniqueness on (continental) Australia and significance to adjacent environments;
- individual species and communities;
- endemism;
- rarity and conservation status (this may have legal significance; see Attachment 10A for listings);
- cultural importance, icon species, Aboriginal use (e.g. bogong moths);
- scientific studies and long-term monitoring studies providing insight to conservation science questions, some of which may be of international significance;
- Contribution to ecological services and the functioning of ecosystems; including externalities such as catchment protection.

The Australian Alps are significant for being 'soil mountains' (Costin 1989) and thus it is argued that the fauna that played a major role in their formation and their continued health (e.g. 10 species of megascolecid earthworms) are of immense importance. Kirkpatrick (1994) recognised the eucalypt forest from 'alps to sea' as part of the international significance of the area. In these forests, as elsewhere, the role of fauna in pollination, nutrient cycling and other ecological functions is widely recognised as an integral part of all functioning ecosystems.

Also related to significance for elements that can degrade (e.g. biota) is capacity or the 'potential' condition. In NSW, legal land use and responsibility for biodiversity conservation and potential habitat manipulations (e.g. use of fire) is the highest in national parks and conservation reserves. In the present report, the Kosciuszko National Park has very high significance because of its status under the *National Parks and Wildlife Act 1974* (NSW).

What is culturally significant may change over time. Most of the vertebrate species in the park are Australian endemics and the ecosystems 'Australian.' These are part of our collective 'sense of place' - our culture. Australia has the worst record of mammal extinctions of any country in the last 200 years, and this is also part of our history and culture. Our perceptions of our native fauna appear to be changing toward a more conservation ethic, and places such as Kosciuszko National Park have an important role in this change.

## International context and significance

As most of the fauna is endemic to Australia it has a uniqueness and consequent significance. Good (1992) observed a significance for Kosciuszko in 'its parallel evolutionary radiation in isolation from other alpine regions'. Other comparative factors include: the extent of biological diversity (numbers of species); the ecological differences (e.g. the role of fauna in maintenance of the distinctive 'soil' mountains); and the differing dominance of classes of fauna in the ecological functioning of the Australian Alps.

A comparison of the faunal complements of three temperate (latitudinally) montane national parks on three different continents (Table 10.1) indicates that, despite its much smaller size and narrower altitudinal range, Kosciuszko National Park supports a similar number of species. What is distinctive is the relatively high number of reptiles in Kosciuszko National Park. The Australian Alps and the park are also significant for the number of reptile species that occur above the snowline (Green and Osborne 1994; Green, K, pers. comm., September 2002). The Kosciuszko mammalian fauna is also distinctive for its lack of native ungulates (hoofed grazers) and diversity of marsupials. The park (and the Australia Alps in general) has representatives of all subclasses and infra-classes of mammals (Monotremata, Marsupialia and Eutheria), which is unique compared with the temperate regions of other continents.

In examining the mainland alps as a whole for international significance, Kirkpatrick (1994) summarised the work of Good (1992) and Busby (1990). He concluded that the international significance of the mountain pygmy-possum and a variety of other features 'lends strength' to the acceptance of the area under World Heritage criterion (i). When considering the invertebrates (poorly known at present), Kirkpatrick (1994) thought it is likely that criteria (iii), perhaps (i), and the biodiversity representation aspects of (iv) will be met or exceeded. Since that publication our knowledge has advanced, notably: the formal bioregionalisation of Australia; long-term assessment of amphibian populations; advances in taxonomy and genetics; the importance of the alpine–montane areas in the context of greenhouse and long-term refugia; and advances in our ecological understanding of the ecology of some environments. Most recent work (Williams et al. 2003) support the significance of the Australia Alps.

Thirteen taxa with populations in the park are listed as threatened (endangered and vulnerable) or near threatened by the IUCN (Attachment 10A). They include the endangered mountain pygmy-possum.

Several faunal studies that have been or might be conducted in the park are of international scientific importance. They include studies on: alpine species such as the mountain pygmy-possum; global declines in amphibians, particularly high altitude; restoration of the predator hierarchy in large conservation reserves; and monitoring the effects and adaptive strategies for climate change.

**Table 10.1** Number of indigenous vertebrate species recorded in three alpine montane national parks on three continents: Kosciuszko (Australia), Yellowstone (North America) and Patagonia (South America)

Vertebrate group	Kosciuszko Latitude 33-35°S Area 6800km <sup>2</sup> Altitude 800-2200m	Yellowstone <sup>1</sup> Latitude 43-46°N Area 40800km <sup>2</sup> Altitude 1372-4177m	Patagonia <sup>1</sup> Latitude 39-42°S Area 40800km <sup>2</sup> Altitude 200-3554m
Frogs	15	9	19
Reptiles	41	9	20
Birds	196	203	152
Mammals	41	83	48
<b>Total</b>	<b>293</b>	<b>304</b>	<b>239</b>

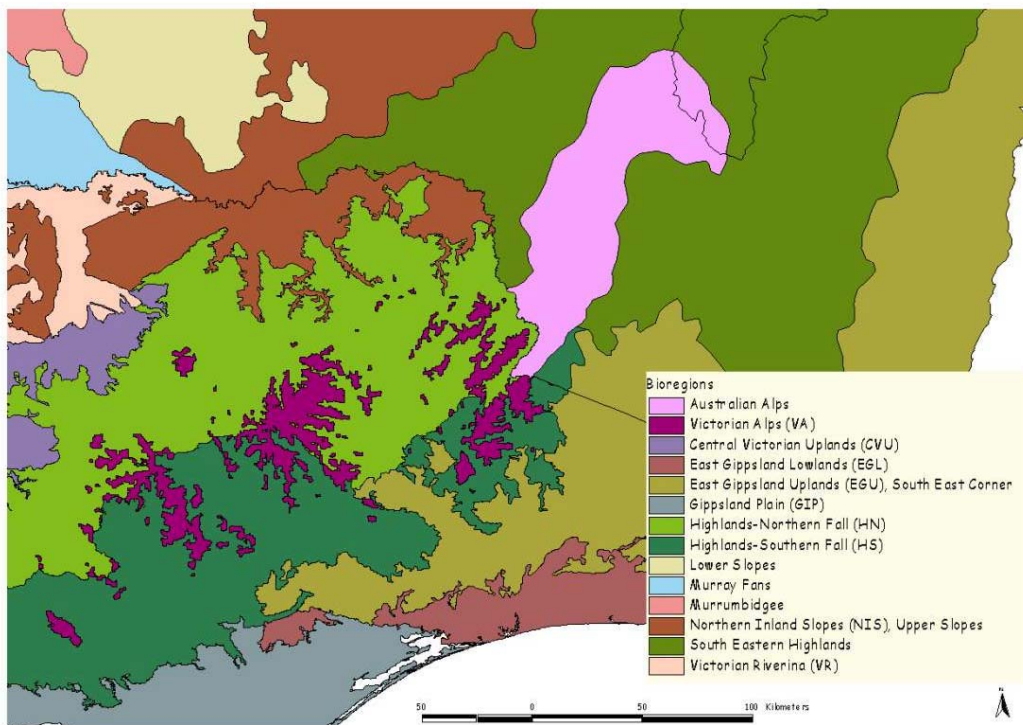
<sup>1</sup> From Baronsky et al (2000)

## National and bioregional context and significance

The alpine area of mainland Australia is the highest and coldest area of the Bassian zoo-climatic region. It encompasses the Australian Alpine bioregion, which straddles NSW, ACT and Victoria (Figure 10.1). The Australian Alpine bioregion has many unique intrinsic biological features, noted for Kosciuszko by Good (1992). Of the bioregions in southeastern Australia, the Australian Alpine bioregion has the largest proportion set aside in a reserve system (Williams et al. 2003). The Kosciuszko National Park forms the central segment of the Australian bioregion (Figure 10.1), which supports *all* the alpine endemic fauna species found on the Australia mainland. The Kosciuszko National Park forms about 50% of the area of the Australian Alpine National Parks system (with Victoria and ACT) and is less fragmented than the alpine regions of Victoria, which are separated by dissected landforms (Figure 10.1, Williams et al. 2002).



**Figure 10.1 The Australian Alps Bioregion**



The attributes and importance of the alpine region and its biota have been discussed by various observers (e.g. Good 1992) and most recently by Williams et al. (2003). The alpine–subalpine area of the park (above 1500 m), which supports populations of some of the most significant specialised cold-climate fauna species, covers about 15% of the park. These higher altitudes are surrounded by a range of predominantly latitudinally and topographically influenced forests, woodlands and shrublands (Figures 10.2 and 10.3, Table 10.3). Many of the latter vegetation types, and the vertebrates populations that they support, are more extensive outside the park (e.g. private property, forestry areas), where biodiversity conservation might not be a major management priority.

The National Land & Water Resources Audit (2003); a national assessment of biodiversity based on the bioregional approach found the ecosystems in the Australian Alps were relatively well catered for within the reserve system.

The park supports populations of about 300 native terrestrial vertebrates and an unknown number (thousands) of invertebrate species (Table 10.3). Over 20 introduced vertebrates have been recorded, and many of these pose significant and ongoing threats to the native species and their habitats. The diversity and distribution of the native species reflects the range of habitats available in the park: the vegetation and its condition; the geology and geomorphology; and, wetland associated habitats.

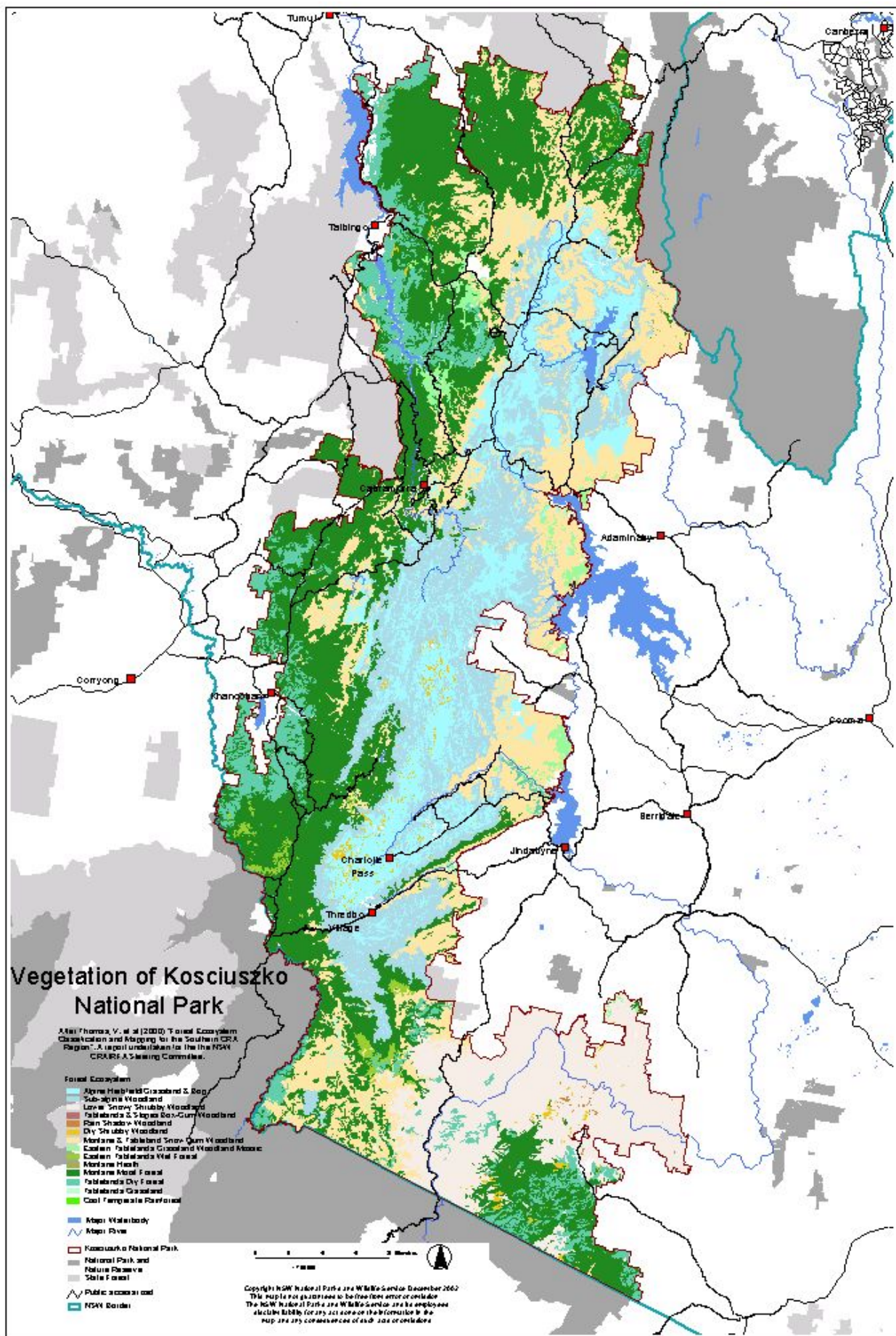
Coyne (2000) compiled a complete list of the threatened terrestrial and freshwater fauna that occur in the Australian National Park system (Attachment 10A.1-8). Although some of these species (e.g. regent honeyeater *Xanthomyza phrygia*, trout cod *Maccullochella macquariensis*) are marginal to the alpine park environments, the list records 17 mammals, 15 birds, 9 reptiles, 9 frogs and 11 fish. In addition, 30 invertebrates are regarded as significant. A suite of significant invertebrates is restricted to the karst cave complex (Table 10A.7 in Attachment 10A; Thurgate et al. 2001a,b; also see Chapter 7).

The fauna of the alpine environment (and the alpine environment itself) is generally acknowledged as among the most vulnerable in Australia to future climate change caused by the enhanced greenhouse effect (Brereton et al. 1995). Most literature supports the proposition that montane areas will become critical refugia for fauna under enhanced greenhouse scenarios (e.g. Bennett et al. 1992). The altitudinal range and the diversity of habitats is therefore an important feature of the park at the continental scale.

### **Generalised habitats of Kosciuszko National Park**

The fauna of Kosciuszko National Park depends on the availability of habitats that support it and in which it performs its ecological function (consumer, decomposer, pollinator, predator, etc). Fauna play a critical role in the health, and in some cases, the microdistribution of these habitats. The broad vegetation types and their extent are shown in Figure 10.2 and Table 10.2.

Figure 10.2 Vegetation classes of Kosciuszko National Park



(Note that Figure 10.2 does not show wetlands, streams, and other specialised habitats such as caves). For the purposes of this discussion, the terrestrial environments are categorised as alpine–subalpine, tall wetter forests, drier woodlands, wetlands and bogs, and ‘specialised’ habitats (e.g. caves and rocky outcrops). More specific descriptions of the habitats of the park have been made by Good (1992) and Green and Osborne (1994).

Costin (1989) provides an idealised cross-section of part of Kosciuszko National Park (Figure 10.3) which, in conjunction with Figures 10.1 and 10.2, indicates the ‘island’ nature of the alpine habitats - an important feature of the evolution and conservation of alpine fauna. The subalpine and alpine environments are those broadly above 1500m altitude. In Kosciuszko National Park the treeline lies between 1800 and 1900m, above which lies the alpine zone and below which (down to the winter snowline) lies subalpine woodland dominated by Snow Gums *Eucalyptus pauciflora* (Figures 10.2 and 10.3, Table 10.2). Above the treeline is a mosaic of vegetated, geomorphological and wetland habitats (Costin et al. 2000). This paper emphasises the alpine and subalpine environments because of their uniqueness in Kosciuszko National Park in the context of NSW.

More than 85% of the non-alpine area consists of a variety of eucalypt forests and woodlands, with about 16% subalpine woodland (Table 10.2). The different distribution of the taller forests and drier woodlands reflects rainfall, topography and soil types. The number of species varies in each broad habitat. For example, the diversity of the avifauna varies between treed environments - subalpine woodland supports only half the number of species as woodland at lower altitudes - and the number of species declines with altitude (Table 10.3).

Critical habitat components, such as tree hollows, for a wide range of vertebrate species occur in all treed environments. The density of hollows increases with the maturity (seral stage) of the vegetation and hollows may take more than a century to develop in eucalypts. Management of and to maturity must be a critical element of management. It is noteworthy that *all but three* threatened bird species in Kosciuszko National Park (pink robin *Petroica rodinogaster*, olive whistler *Pachycephala olivacea* and Latham’s snipe) are hollow-dependent species (e.g. owls, cockatoos and parrots) (Table 10A.2 in Attachment 10A).

The treed environments also link to habitats outside the Kosciuszko National Park. Because some of the larger species that rely on the treed environments have relatively large home ranges (e.g. powerful owl *Ninox strenua*, > 500 ha; spotted-tailed quoll *Dasyurus maculatus*, many square kilometres), the available habitat in the park may support only part of a metapopulation. Indeed, the Kosciuszko National Park population(s) may not be large enough for long-term conservation. However, populations of such species in Kosciuszko National Park emphasise the role of the park as a refugium. Kosciuszko National Park may well be, or become, a source for population recruitment to other areas. This is particularly evident for forest and woodland dependent species. Management of such populations should be coordinated with habitat management by adjacent land managers.

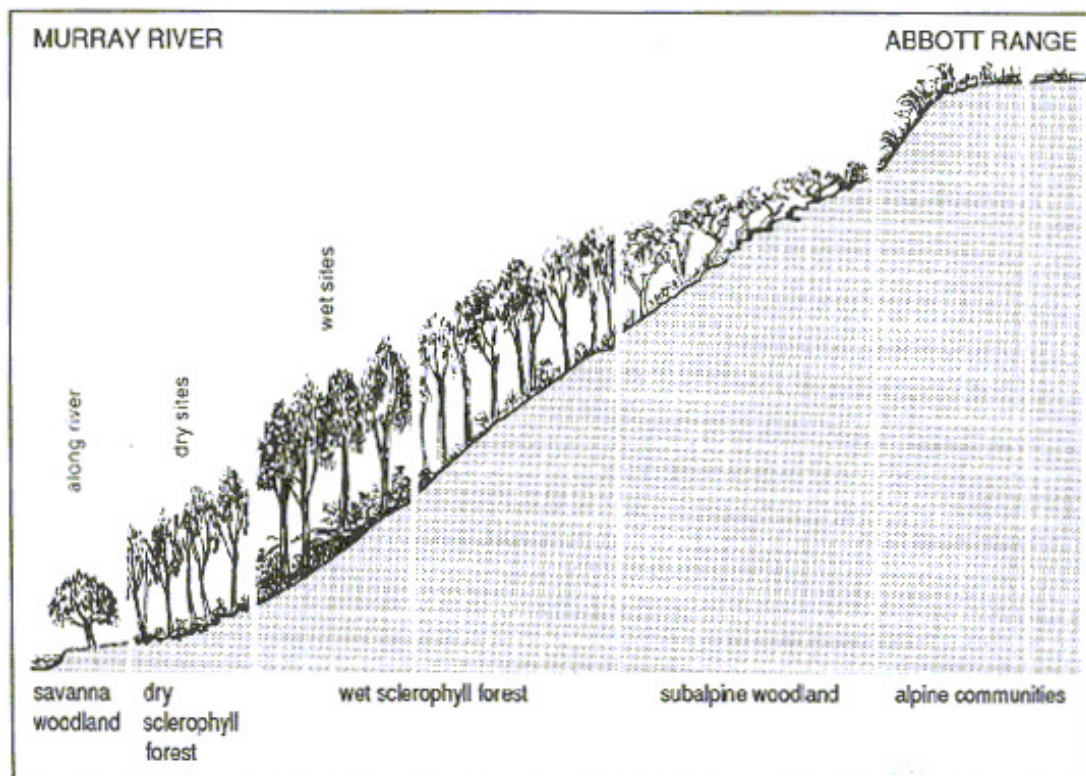
**Table 10.2 Areas of vegetation types in Kosciuszko National Park\***

Vegetation type	Area (ha)	Percent of KNP (%)
Montane Moist Forests	214,582	31%
Montane & Tableland Snow Gum Woodlands	130,393	19%
Subalpine Woodlands	107,153	16%
Alpine Herbfields / Grasslands & Bogs	80,415	12%
Lower Snowy Shrubby Woodlands	76,655	11%
Tablelands Dry Forests	52,757	8%
Eastern Tablelands Grasslands Woodland Mosaic	8,912	1.29%
Dry Shrubby Woodlands	4,093	0.59%
Eastern Tablelands Wet Forests	4,022	0.58%
Rain Shadow Woodland	345	0.05%
Montane Heath	298	0.04%
Cool Temperate Forest	106	0.02%
Tablelands & Slopes Box-Gum Woodlands	3.63	>0.01%
Tablelands Grasslands	2.63	>0.01%
Inholdings, disturbed areas, etc	10,687.74	1.55%
<b>Total</b>	<b>690,425</b>	<b>100%</b>

\*(after: Thomas, V. et al. (2002) Forest Ecosystem Classification and Mapping for the Southern CRA Region, A report undertaken for the NSW CRA/RFA Steering Committee)



**Figure 10.3** Idealised cross-section of vegetation ascending the Main Range of Kosciuszko National Park from the west (from Good 1992 after Costin 1979)



**Table 10.3** Diversity of Birds in relation in Kosciuszko National Park (after Good 1992)

Zone	Montane		Subalpine		Alpine		
Vegetation	Mixed woodland	Wet sclerophyll forest		Subalpine woodland		Alpine herbfields	
Altitude	1070-1225m	1225-1370m	1390-1530m	1530-1680m	1680-1840m	1840-1990m	1990-2140m
No. species	106	87	67	44	27	4	4

### Conservation status of fauna in Kosciuszko National Park

Compared to the fauna of both NSW and Victoria, the park contains a substantial number of species: about one-third of the terrestrial mammals, one-fifth of the amphibians and reptiles, and two-fifths of the bird species found in NSW (Table 10.4). If the marine and coastal avifauna were excluded, the birds would represent an even higher proportion. Of note is the relatively high percentage of threatened frogs compared to the total for NSW, and also the percentage of threatened mammals. The conservation status of the fauna of the Australian Alpine National Parks is summarised in tables in Attachment 10A. Coyne (2000) compiled detailed notes on each of the significant and threatened species.

In terms of condition, a threatened status at the national or state level suggests that there is evidence of the species' decline (as opposed to being naturally rare), and thus an adverse change in condition. Depending on the clarity of definition and extent of the threatening processes, populations of threatened species in the park may or may not be declining. For example, the large owls may be threatened across their broad range (by logging and land clearing), but populations in the park may not have (yet) changed in condition. For many threatened species the 'condition' of the park population remains, unfortunately, unknown.

About 75% of the vertebrate fauna of Kosciuszko National Park is regarded as common to uncommon. These species comprise the vast majority of the vertebrate biomass and would do most of the ecological 'work' of the vertebrates across the landscapes. The ecological "work" of invertebrates (and their interactions with vertebrates) should not be underestimated. The magnitude of the 'work' by the abundant and more common species in providing ecosystem services and keeping the overall ecosystems healthy cannot be over emphasised. Although this report highlights threatened vertebrate species, the common species are of critical importance to the health and resilience of the natural environment.

**Table 10.4** Number of species of vertebrate fauna in NSW, Kosciuszko National Park and Victoria at the time of European settlement (Sett.), and percentage (of original total) of extinct (Ext.) and threatened (Thr.) species (includes extinct)

	New South Wales <sup>1</sup>			Kosciuszko National Park <sup>2</sup>				Victoria <sup>3</sup>		
	Sett.	Ext. (%)	Thr. (%)	% of NSW total	Sett.	Ext. <sup>4</sup> (%)	Thr. (%)	Sett.	Ext. (%)	Thr. (%)
Frogs	70	0	12.9	21.4	15	0	33.3	33	0	30.3
Reptiles	209	0.04	12.4	19.6	41	0	7.3	133	0.8	21.1
Birds	474	3.2	20.7	41.4	196	0	4.1	450	0.2	16.7
Mammals (terrestrial)	139	20.7	38.5	29.5	41	4.8	29.3	110	18.2	39.1

<sup>1</sup> NSW EPA website, September 2002; data is from mid-1990's

<sup>2</sup> Green (1998)

<sup>3</sup> DNRE website, September 2002; data is for 2000

<sup>4</sup> Spotted tree frog, not included because of Upper Murray population

**Table 10.5** Numbers and conservation status of native vertebrate species in Kosciuszko National Park. Numbers from alpine-subalpine (above 1500m) are shown in square brackets (data derived from Green 1998)

Group	Common		Uncommon		Rare		Threatened Vulnerable		Endangered		Extinct		Total
Frogs	10	[2]			-		1	[1]	4	[2]	-		15 [5]
Reptiles <sup>1</sup>	35	[12]	3	-	-	-	2	[2]	1	[1]	-		41 [15]
Birds <sup>2</sup>	99	[53]	38	[4]	37	[2]	8	[4]	-		-		197 [61]
Mammals	25	[16]	3	[1]	2+	[-]	7	[3]	2	[1]	3	[-]	42 [21]
<b>Total</b>	<b>169</b>	<b>[83]</b>	<b>44</b>	<b>[5]</b>	<b>39</b>	<b>[2]</b>	<b>18</b>	<b>[8+]</b>	<b>7</b>	<b>[4]</b>	<b>3</b>	<b>[-]</b>	<b>295 [102]</b>

<sup>1</sup> Includes undescribed *Egernia* species

<sup>2</sup> Includes 15 bird species recorded in the park that are vagrants or live in suitable habitat close to the park

## Species of significance in the subalpine and alpine environments

### Introduction

The faunal attributes of this environment have been well described by Green and Osborne (1994). About 100 terrestrial native vertebrate species in Kosciuszko National Park occur in the subalpine and alpine environments as do all the cold-climate specialists. As the global climate has warmed, populations of low mobility alpine specialists (some invertebrates, small terrestrial mammals, reptiles and frogs) have 'retreated' up the mountain. Over time they have become genetically isolated at higher altitudes (see Figures 10.1, 10.2 and 10.3) and may now persist as a series of island (isolated) populations or, in some cases, as endemics to a particular area.

Of particular importance are the endemic vertebrates such as the southern corroboree frog *Pseudophryne corroboree* and the cold-climate specialists that are dependent on the park and adjacent alpine and subalpine environments (e.g. the alpine tree frog *Litoria verreauxii alpina*). Recent taxonomic advances have resulted in the identification of 'new' alpine species such as the alpine she-oak skink *Cyclodomorphus praealtus*, and the clarification of the genetic differences within others (e.g. mountain pygmy-possum).

The alpine zone is notable because in each broad environment there is at least one alpine-subalpine cold-climate vertebrate specialist that is threatened. Boulderfields and related heathlands (mountain pygmy-possum), grasslands and low heath (alpine she-oak skink), grasslands and sedgeland (broad-toothed rat *Mastacomys fuscus*); wetlands (alpine water skink *Eulamprus kosciuskoi*, southern corroboree frog, alpine tree frog), wet sedgeland (broad-toothed rat). There are no endemic birds in these environment and their diversity is low (Table 3), with few overwintering (Green and Osborne 1994).

### **Significant species and communities and some of their ecological functions**

The southern corroboree frog and mountain pygmy-possum are arguably the iconic fauna of the Australian Alps and the park; both are endangered and their populations are far from secure. Although the alpine–subalpine environments support populations of about 30% of the faunal complement of the park, a disproportionate number of species - about 55% - are threatened (Table 10.5).

Although the invertebrate fauna of the Australian Alps is not well understood, the park appears to fit the 'usual alpine model' of a low number of species but a high number of individuals, with the Orthoptera (grasshoppers) and Hymenoptera (ants, wasps and bees) being ecologically more important here than overseas (Green and Osborne 1994). Recent research in Kosciuszko National Park (Stock and Pickering 2002) has found higher abundance and diversity of these groups in alpine areas than montane, where they play a crucial role in pollination of alpine plants.

Significant and threatened species are listed in Tables A5 and A6 of Attachment 10A. The alpine thermocolour grasshopper *Kosciuscola tristis* is one of the few insects known to change colour in response to temperature change, and the genus is largely restricted to the snow country (Key and Day 1954). The case moth *Plutorectis caespitose* may be a periodically important grazer of alpine herbfields and could play a role in vegetation succession (Carr and Turner 1959). Victorian studies on the invertebrates (e.g. stoneflies, flatworms (St Clare et al. 1999) suggest high levels of speciation. More work on the invertebrates, particularly given their functional importance, is required.

The seasonal occurrence of bogong moths in the alpine region represents the spring–summer climax of an insect migration that is one of the longest in the world (Common 1954). The congregations of these aestivating moths in rock crevices provided an important food source for Aboriginal peoples (Flood 1980), and are the major food source of the mountain pygmy-possum. This rich food source is exploited by a range of birds and mammals and provides a major energy input into the alpine environment. This moth species and its ecology is of particular scientific, cultural and conservation significance.

In the subalpine and alpine zone, the variety of wetlands and streams are vitally important for all amphibians, freshwater invertebrates and fish. There has been worldwide concern about the conservation plight of amphibians, and this concern has been voiced in Australia (Gillespie et al. 1995). Of the five frogs known from the alpine–subalpine zone, four are threatened. The southern corroboree frog (endemic to the park) inhabits wet heathland, grassland and sphagnum bogs, and is disappearing from lower altitude sites (Osborne et al. 2001). The alpine tree frog, a once-widespread alpine endemic, has suffered recent large-scale population declines and range contractions. The cause(s) of the declines of these species remains unclear (Osborne et al. 2000).

These populations and long-term studies are important in resolving global conservation questions concerning amphibians. The alpine water skink is also restricted to alpine wetlands, and wetlands are the favoured habitats for the majority of migratory birds that are regular or occasional visitors to the park, such as Latham's snipe.

Somewhat counter-intuitively, recorded densities of some populations of reptiles in the Australian Alps are among the highest recorded anywhere in the world. All are heliotherms (requiring sunlight for warmth), but above 2000 m only one species, the mountain log skink *Pseudemoia entrecasteauxii*, persists (Green and Osborne 1994). The high species diversity of the reptiles is a distinctive feature of Kosciuszko National Park (Table 10.1). The reptilian diversity is dominated by skinks (10 species, three of which are threatened; see Table 10.5), with only two elapid snakes and a dragon. The Australian (Kosciuszko National Park) area is notable internationally for the large number of reptiles that occur above the snowline - 15 as against very few in other parts of the world examined to date (K Green, pers. comm., September 2002). Recent taxonomic work has erected several new species (e.g. alpine she-oak skink, snowy mountains rock skink, tan-backed rock skink), and there is regional endemism in the group. Three skink species (alpine she-oak skink, *Egernia guthega* and *E. montanum*) are all restricted to the alpine zone and the former two are threatened.

The most significant, internationally recognised feature of the mammalian fauna is the mountain pygmy-possum. It is the only marsupial alpine specialist and the longest lived small terrestrial mammal, with a life span of over 12 years. The species is a relict from a genus that was once widespread across Australia. Since its discovery as an extant species in 1966 it has been the subject of intensive study. Populations have been monitored continually since 1979 in Victoria (Mansergh et al. 1989) and since 1986 in Kosciuszko National Park (Broome 2001(b), which makes them zoologically significant in an Australian, and perhaps a world, context. There have been numerous papers published on this species (see references); the most pertinent to this discussion are:

- Heinze et al. (*in prep*) - a review of ecological studies;
- Broome (1992, 2001(a), (b)), Broome and Mansergh 1989, Smith and Broome (1992) - results of recent ecological work in Kosciuszko NP;
- Mansergh and Broome (1994) a monograph on the species;
- ISC Public Comments (2003);
- Osborne et al. (1999, 2000) – genetics; and
- Broome and Geiser 1995, Geiser and Broome 1991, 1993, Geiser et al. 1990, Körtner and Geiser 1996, Walter 1996, Walter and Broome 1998 – hibernation.

These studies, their longevity, and the inherent biological and zoological insights this species may provide (e.g. management and genetics of metapopulations) make the species of significant scientific interest.

The favoured habitat of the mountain pygmy-possum is alpine periglacial boulderfields frequently overlain by closed heathland of mountain plum-pine, which is limited and disjunct both in a bioregional sense and within the park. Bogong moths are a favoured food source. The species exhibits varying degrees of segregation between the sexes, depending on habitat availability, quality and population density. The species is endangered, with at least three, possibly five, genetically recognisable populations (Osborne et al. 1999, Heinze et al. *in prep*). The population in the park is currently being reassessed (Broome et al. *in prep*), with a best estimate of 250 breeding females (about 15% of the world population), spread across numerous small colonies (> 40) up to 3 km apart. Populations in resort areas are vital to the survival of the species in the park (Broome 2001a) and elsewhere (Mansergh and Scotts 1989).

The occurrence of the several vertebrate species are significant at the state level. The vulnerable broad-toothed rat, is an 'old endemic' cold-climate rodent with a vegetarian diet. Although it reaches the coast in southern Victoria, it is restricted to montane sites in NSW, where it inhabits dense wet grassland and sedgeland. There have been extensive studies of this species in the park by Happold, Bubela and others (Bubela and Happold 1993, Bubela et al. 1991, Carron et al. 1990, Happold 1978, 1989, Green and Osborne, *in press*).

The alpine–subalpine zone would be part of the annual foraging range of the vulnerable eastern false pipistrelle *Falsistrellus tasmaniensis* and migratory common bent-wing bat *Miniopterus schreibersii*. Cave and communal breeding sites would be important for the latter, and tree hollows for the former. It is likely that these species form part of a large bat complement that exploits the abundance of summer insects, including bogong moths.

As noted above there are no endemic or alpine specialist bird species, although over 60 species exploit the resources over summer either as international or altitude migrants. The only threatened bird species of the zone, the olive whistler, inhabits the denser scrub and woodlands, particularly at higher altitudes. The populations in the park are viewed as in stable and good condition (K Green, pers. comm., September 2002) Habitats and populations outside the park may be vulnerable to forestry activities. The spotted-tailed quoll is an occasional visitor to alpine environments, favouring treed areas at lower altitudes (see below).

### *Ecological function*

Although our knowledge remains imperfect, each species of the fauna has a separate role in ecosystem function, for example, through predation, nutrient recycling and capture, pollination, soil disturbance and aeration, seed dispersal and grazing. These happen at all scales of the landscape, both above and below ground, both vertebrate and invertebrate. Three examples indicate the 'scale' of some of this work. Ten species of megascolecid earthworms play a major role in the formation and continuing health of the humus soils of Kosciuszko National Park (Costin 1989). In essence they helped create and maintain the unique high altitude 'soil mountains' of the Australia Alps upon which much of the vascular plant communities depend. Tall alpine herbfield is largely absent from the Tasmania alpine zone and Bridle and Kirkpatrick (1998) attribute this absence to the lack of grazing pressure of marsupials. The extended periods of snowlie in Kosciuszko National Park prohibit macropods (Green and Osborne 1994) and tall herbfields can flourish in the absence of this grazing pressure. Over time, predation, by a variety of birds and mammals, of the bogong moths when they arrive in their millions, provides nutrient transfer from the plains environment to the alpine environment, which increases soil fertility (Mansergh 1989). This represents a major energy input to the alpine environment.

The bird species that migrate to the park to exploit the seasonally available food resources also recycle nutrients to the system – the predation of insects by birds may prove to be of major importance in nutrient recycling, given the absence of large herbivores typical of other alpine and grassland systems. Fungi are increasingly seen as having an important role in nutrient recycling in southeastern Australia (Claridge 1997), and the ubiquitous bush rat *Rattus fuscipes* may play a role in spore dispersal in the alpine environment (Carron et al. 1990, Mansergh et al. 1990).

Macropods are poorly adapted to movement in deep snow (Green and Osborne 1994), and the common wombat *Vombatus ursinus* may struggle to survive through heavy snow seasons. Thus, in contrast to alpine areas in the northern hemisphere, the Australia Alps are distinctive for evolving without major large herbivores and, perhaps consequently, without large carnivores (the dingo was a late arrival to the continent). The terrestrial mammalian fauna is relatively depauperate and the strong altitudinal species zonation exhibited elsewhere is absent (Happold 1989). Indeed, the bush rat and the dusky antechinus *Antechinus swainsonii* occur from high altitudes to the coast.

The ecological functionality of some groups of fauna may be more important in Australia than elsewhere: for example, case moths, seral stages of some vegetation, and the high diversity and density of skinks. At higher altitudes the major mammalian grazer is the broad-toothed rat, compared with deer and other ungulates on other continents. These differences, and the relatively small size and area-to-perimeter ratio of the park, make it vulnerable to introduced species of grazers (Rabbits, European hares *Lepus capensis*, deer) and predators (foxes and cats) that can constantly reinvade from lower altitudes, if they are not already resident. These species adversely effect the functioning of the natural system.



The flora and fauna also play a critical role in maintaining the natural water quality, both in the local environment and that which flows down the catchment. We have mentioned earlier that several of the threatened species that occur in the park are wetland-dependent.

### **Condition of populations**

'Condition' encompasses at least two concepts: how much has been destroyed (extent/depletion), and the state (compared with the natural state) of the remainder. In the alpine–subalpine zone, areas of some habitats have been destroyed by resort development and related infrastructure, so their extent has declined. The direct European impact across the park is not insubstantial (2.5% by area: see Table 10.2), and is concentrated higher in the alpine–subalpine zone because of the resorts and consequent infrastructure, and at lower altitudes by the Hydro-Electric Scheme.

There is no standard measure of condition for vegetation and/or habitats. Such a measure is required, and must be put into an ecological defensible policy framework, such as net gain in extent and condition. The broad condition is affected by the scale and effect of the threatening processes. Condition assessments are confounded because baseline data is generally not collected prior to the threatening processes operating. Further, Costin et al. (2000) have also shown how much time alpine vegetation communities need to recover (e.g. bogs from grazing) which is measured in decades. The alpine area was heavily grazed by sheep then cattle up to the 1960s.

The indirect effects of introduced species are most insidious and relentless on the terrestrial habitats: weed invasion, predation by foxes and cats, and trampling by ungulates (horses, potentially deer). Green (2002) has shown that the red fox selectively preys upon the broad-toothed rat in the subalpine environment, and fox predation is implicated in the species decline across its range. In fact, the prey of the red fox includes *all* threatened mammal species of this environment (Mansergh and Broom 1994, Green 2002). To the extent that this is a new (rather than replaced) predation pressure, the condition of the populations would have declined. Feral cats *Felix catus*, being more selective predators, have the potential to be much more destructive although definite empirical data are few in the alpine area. At present the distribution of cats appears to be most predominant around resorts and other high-use human areas (Sawpit tip). Cats appear to be having a severe impact on the mountain pygmy-possum populations around resorts (Broome, NSW NPWS, pers. comm.)

Entomologists in the 1920s and 1930s, including Waterhouse, recorded far greater populations of butterflies of several species than are presently observed in the alps (Good 1992). Good suggested that this 'gross' change may be cause for concern, but the reason remains unknown. Is this observed change due to changed grazing regimes? If so, this decline in abundance and diversity may be a result of improved management, but this remains unknown.

In the subalpine and alpine environments few species have been monitored, but for those that have the results are disturbing. Osborne et al. (2001) reported on the long-term monitoring of the alpine tree frog and the southern corroboree frog. Both species (and the other high-altitude species examined, e.g. the Victorian Baw Baw frog) and have undergone dramatic range and population declines over the last decade. Importantly, the authors provide evidence that these are not natural fluctuations. The causes remain obscure; they do not appear to be related to direct on-ground management, but may reflect global change, e.g. UV increase or changing climate. If trends continue, extinction of these species in the foreseeable future is possible (Osborne et al. 2001).

Broome 2001(a), (b) recently published the results of an 13-year (1986-98) study on the mountain pygmy-possum, concluding that 'there was no evidence that the ski resort at Mount Blue Cow had any significant impacts above the natural yearly variation in demographics.' Importantly, the development was influenced by knowledge of the species requirements and the capability to restore habitat (Mansergh and Scotts 1989). Previous habitat destruction and fragmentation have reduced the available habitat and its continuity.

Broome (NSW NPWS, submission) qualifies Broome (2001a) and states that data gathered since 1998 have shown a severe decline in the numbers of the species at Mt Blue Cow beginning in 2000 and continuing to 2003. At Charlottes Pass numbers declined from the 1987-2001, when a major fox control program began, but had recovered in 2002. It is not known whether these declines are attributable to low numbers of bogong moths in 2000, a series of low snow cover years and associated increased predation by cats, cumulative effects of resort usage or a combination of these factors. Parts of the habitat, previously skied, have been closed to ski activities by Mt Blue Cow and Perisher Blue Pty Ltd and monitoring of cat and fox numbers is to be undertaken as part of a control program.

The population is far from secure, with a total estimate of 250 breeding females (previous estimates have been around a 1000) and the highest quality habitats (population size and stability) within resort concessions. A total population of 250 breeding females is in the danger zone by any criteria.

Further, the movement and survival of the species between small areas of habitat, which is absolutely critical to long-term viability, is affected by predation by foxes and cats. The conclusions of Broome 2001(b) regarding management of this species as a metapopulation have wider applicability for all the alpine specialist species and consequently for land management. Habitat enhancement and creation should be a goal of management.

Recently, it has been discovered that Bogong Moths transport arsenic to the alpine regions, presumably from their 3–4 years as larvae in the self-mulching soils of western NSW (Green et al. 2001). The effect of this on the condition of the moth population and the effects up the food chain has yet to be determined, but is possibly significant.

There are critical ecological elements and processes that will affect the condition of the fauna populations in these environments (see also the section on threats below). These include:

- habitat protection (enhancement and continuity) - all development must be in context of net gain of habitat and inappropriate development should be avoided;
- management of populations as metapopulations;
- control of introduced predators and preferable restoration of natural predator regime;
- protection of wetlands and hydrology;
- increased research into invertebrates and their role in ecosystem function.

## Species of significance in the tall and wet forest habitats

### Introduction

Tall and wet forests comprise about 100,000 ha (Table 10.1) and generally occupy the altitudinal band below the subalpine woodland (*E. pauciflora*). These forests also spread down the valleys, where they may be limited to the riparian zone and surrounds. Tall and wet forests are broader on the western slopes (Figures 10.2 and 10.3). No species in these habitats is endemic to the park, but several species are significant. The invertebrate fauna remains little known. Attributes of maturity in all forest types (e.g. tree hollows that develop in mature trees older than 120 years of age) are critical for a wide range of threatened and more 'common' species, such as possums, gliders, cockatoos and parrots. Providing mature seral stages is a critical component of management for the park's biodiversity. This is also related to fire management. Many general aspects of this environment are shared with other treed environments.

### Significant species and communities and some of their ecological functions

The alpine ash (*E. delegatensis*) forests generally consist of pure stands, while the other forests are generally of mixed eucalypt species. In comparison to other forests, Alpine ash forests tend to have a low vertebrate species diversity (Norris et al. 1983), perhaps because of their propensity to grow as a monoculture following fire or logging. Fauna species mentioned below, particularly those with large home ranges, may also occur in alpine ash forests, but this is not the 'favoured habitat' of any of these species. Mature stands of alpine ash (and all tall wet forests), or those managed for maturity, are of significance given that these types are favoured for logging.

The mixed species tall open forests provide more diverse habitats than the alpine ash forests. Here, tree hollows and fallen logs provide breeding sites for a range of dependent species, many of which are threatened and/or depleted across their range; for example, the yellow-bellied glider *Petaurus australis*, powerful owl and spotted-tailed quoll. The latter two species and others require relatively large home ranges (e.g. 8–10 km<sup>2</sup> for the powerful owl) to support their prey base (e.g. gliders), which may also be dependent on hollows. Populations of such species in the park are vital to their long-term survival, and they must be managed in the park as part of a metapopulation that includes areas of habitat outside the park. The functionality of these medium-sized predators in the forest environment is important for ecosystem health.

The wetter, denser gullies are inhabited by the threatened pink robin, which has been recently recorded breeding in the park. A few montane streams were inhabited by the spotted tree frog *Litoria spenceri*, which is critically endangered nationally, but the most numerous population known in the park crashed in about 1997 and only a single male was found, which has now been taken from the wild for captive breeding. The reasons for the sudden decline to extinction remain unclear, but possibly relate to disease in the population (M Scroggie, pers. comm., September 2002). Introduced trout, which eat tadpoles but not adults, are not believed to be the proximate cause for the extinction of this population, although they are implicated in the endangerment of populations elsewhere (Gillespie 2001). The spotted tree frog might persist in the upper reaches of the Murray River in Kosciuszko National Park (M Scroggie, pers. comm., September 2002).

Some montane species (e.g. the spotted tree frog) require specific management of their habitats and catchments, and these areas can be progressively identified and managed accordingly. As a generality, it appears more prudent and practical to manage the broad habitats of the park at a landscape level (e.g. use of fire). However, it must be noted that some of the resident fauna and many of the threatened fauna (e.g. those that are reliant on mature seral stages, tree hollow dependent, or very large home ranges) rely for their long-term conservation on areas outside Kosciuszko National Park as well. It is a challenge for the future as to how much bias is given to the requirements of these species in the management of habitat. Although we would argue that a benchmark for vegetation condition is an imperative for the park (e.g. at European settlement) it is also important to ask whether it is prudent to bias the age structure of the park vegetation communities to allow for the proliferation of younger seral stages elsewhere. The management of Kosciuszko National Park must be cognisant of adjacent public land (Victorian National Parks and forestry).

## Ecological function

Over 240 vertebrate species have been recorded from the forested habitats of the park, and all would play a role in the health of the forests as pollinators, seed dispersers, predators or nutrient recyclers. The invertebrates remain little known although Recher and Majer (1996, quoted in Williams 2002) estimated that around 250 000 species of just one group of terrestrial invertebrates would be found in association with the *Eucalyptus* genus (700 species).

Further, May and Simpson (1997) estimated that eucalypts are likely to have 7000 species of associated fungi. All the species and communities which they form, both the generalists and the specialists, do the ecological work to keep the forests healthy and provide its resilience to disturbance.

Recent research into hypogean mycorrhizal fungi has indicated that they may prove to be a critical element in the nutrient recycling and nitrogen availability in the 'nutrient-deficient' soils of Australia and its forests. An overseas study in Oregon–Douglas Fir forest (Amaranthus et al. 1990) suggests that the biological productivity of sites that are cold and susceptible to drought or hot fires may decline because of the decrease in beneficial microorganisms. All of these factors operate in the park. These relationships may prove to be critical for fauna and forest health (Claridge and Lindenmayer 1998; Claridge et al. 2001). The importance of fungus species as food has been studied for some mammals, such as the long-footed potoroo *Potorous longipes*, swamp wallaby *Wallabia bicolor* and mountain brushtail *Trichosurus caninus*, but the role of mammals in dispersing the spores of these species may be equally as important (May et al. 1999). Fungi also forms part of the diet of the bush rat (Mansergh et al. 1990). Grazing and dispersal of spores may play a critical role in keeping the forest healthy. At a national level, many fungivore specialists are threatened or have declined in distribution underlining the importance of management of the system (Claridge 1997).

High-order predators perform a major function in all forests types and it is of some concern that this level appears to be disrupted and vulnerable; all large owls are threatened, and medium-sized predators (quolls) are either extinct or threatened. NSW NPWS has monitored the numbers and breeding success of the peregrine falcon *Falco peregrinus* (T Stubbs, pers. comm., September 2002). The dingo is 'controlled' and red foxes and feral cats are common. Predation by foxes and cats is a major problem in these environments and threatens several species. Their presence and replacement of natural predators would affect the abundance and distribution of prey, and cause consequent changes down the food chain. This is discussed further below. Similarly, the proliferation of ungulates (horses, deer, feral goats *Capra hirsus*) and other grazers is also a major threatening process in these environments (see below).

The lower levels of predation in the food chain are critical for the ecological health of the forests; for example, for controlling certain insect populations. A sugar glider *Petaurus brevipes* will consume up to 200 kg of insects each year (Suckling 1984), and a bat can eat more than its weight in nocturnal invertebrates during each night of activity.

## Condition of populations

In these environments there have been some positive discoveries (e.g. pink robin), although whether these represent changes or are artefacts of collection remains unclear. Some adverse changes (e.g. the spotted tree frog) have been recorded, but the condition of the vast majority of populations of species in these environments is not extensively monitored. The degree of threat to the species as reflected in 'listing' under legislation generally relates to their plight outside the park. In some instances it may be related in part to management (e.g. predator control, fire management). The condition of the populations in the park may also be related to land use elsewhere.

There are critical ecological elements and processes that will affect the condition of the fauna populations (see also threats discussed below). These include:

- the extent and condition of mature seral vegetation stages;
- the availability of the natural range of size and type of hollows;
- the maintenance or restoration of natural predator–prey relationships; and
- fire regimes.

## Species of significance in the drier more open forests and woodlands

### Introduction

Drier forests and woodlands comprise over half the area of Kosciuszko National Park (Figure 10.2). They support a fauna that is generally more widely distributed, although the elements of woodland bird and reptile fauna may be threatened as a group at the national scale (e.g. Robinson and Traill 1996, Brown 2002). Within this generalisation there are several populations of threatened species of vertebrates that are threatened. Some occupy specific habitats, such as the rocky outcrops of the brush-tailed rock-wallaby *Petrogale pencillata*, or were once widespread, for example, brush-tailed phascogale (*Phascogale tapoatafa*). Historically, it is in these environments of the park where most of the known past extinctions (all mammals) have occurred: the koala *Phascolarctos cinereus* (in 1960), eastern quoll *Dasyurus viverrinus* and brush-tailed rock-wallaby. The precise causes (e.g. disease, persecution, predation by foxes) of the declines across such large ranges remain imperfectly understood, but are at the sub continental scale, and do not appear to be a result of Park management regimes (e.g. Koala extinction was pre-Park).

### **Significant species and communities and some of their ecological functions**

These environments have the largest diversity of birds (Table 10.3) and mammals. Species perform ecological functions across a range of trophic levels and interact with other species (predator–prey) and the vegetation as grazers, pollinators, seed dispersers and decomposers (see above).

As for the wet forests, several of these threatened species are hollow dependent; such as brush-tailed phascogale and glossy black-cockatoo *Calyptorhynchus lathami*, Barking Owl *Ninox connivens* and several bat species. The extent of these environments, (over 3000km<sup>2</sup>) and their juxtaposition to adjacent protected areas of similar habitats makes them highly significant for long-term biodiversity conservation.

In Victoria, the koala has recovered from the population crash of early in the 20<sup>th</sup> century, and it is not inconceivable that the park may be recolonised from the south. Conversely, the brush-tailed phascogale is presumed extinct in adjacent Gippsland (Norris et al. 1983) and populations in the park are significant as a potential natural source. Recent research indicates that the brush-tailed phascogale, an insectivore, also plays an important role as a pollinator (Goldingay 2000), as does the eastern pygmy-possum. The decline or demise of such species may thus affect vegetation in the long term.

One threatened species, the smoky mouse *Pseudomys fumeus* is a seasonal seed and truffle (hypogeous fungi) eater, and is dependent upon appropriate fire regimes for the maintenance of suitable understorey and fungi within its habitat. Current records for the park suggest this species occurs in the karst areas, the Pilot and Ingebyra forest of south east Kosciuszko National Park, and it may be more widespread. The species' range is primarily in Victoria, but extends to dry forests of Eden hinterland, Kosciuszko National Park and adjacent state forest and the ACT. Most populations are in the reserve system (ie habitat that was not suitable for alienation and agriculture) with some in State forests, but all require active habitat management (fire, foxes, cats and habitat protection). This species is of state significance, as are populations of the square-tailed kite *Lophoictinia isura*, predominantly a low altitude species.

The red fox has been implicated in the demise of the brush-tailed rock-wallaby and the eastern quoll. If foxes and cats are controlled and the food sources and other habitat parameters remain present, these species may be able to be reintroduced which should be a long-term aim of the management of the park in these environments.

The endangered spotted-tailed quoll is the largest surviving marsupial carnivore on the mainland, and is of conservation concern. It is a close relative the eastern quoll, which once occurred in the park but is now presumed extinct throughout the mainland. A population of spotted-tailed quoll has recently been discovered in the Byadbo . Wilderness Area of the park at very high densities (22 animals in a 50 km<sup>2</sup> area), providing unprecedented home range information for a single population (Dawson et al. 2003) . This population is higher than any yet recorded in Victoria and possibly southeastern Australia, and is of high scientific significance and conservation interest. Predator management (e.g. fox control) needs to be very carefully considered in these areas (see discussions below of meso-predator release and the 2003 fires).

### **Condition of populations**

Historically, drier open forest and woodland environments in the park have suffered the most extinctions of vertebrate species. Mostly, declines of these species have been at a continental scale. A suite of woodland bird species are regarded as being threatened at the continental scale (Robinson and Traill 1996), as a result of changes in land use change, clearing, etc. Similar patterns may also be affecting reptiles (Brown 2002). Although the drier woodlands and forests of the park have received less attention biologically, they should not be neglected, because large segments of the fauna of these environments are threatened in southeastern Australia. In a scenario of continuing threats outside the reserve system, areas that are protected and appropriately managed in parks and reserves will become of increasing scientific and conservation importance. They should be managed as a national asset, in conjunction with similar areas outside the park.

The dramatic depletion of fallen wood debris (estimated to be now 16% of the pre-European amount) has recently been quantified for woodlands elsewhere, such as river red gum floodplains (MacNally et al. 2002). This depletes a wide range of habitats for fauna and changes the functional condition. Such data is disturbing, but emphasises the need for areas in conservation parks and reserves to be managed to achieve a closer surrogate of the pre-European habitats. Since other threatening processes (logging, fire wood collection) may be controlled, fire management is critical. As with other treed areas the availability of a range of different sized tree hollows is critical to a suite of birds and mammals. Use of hollows by feral European bees depletes availability to native fauna. Source populations for these ferals should be located distant from the park and eradication programs initiated within KNP.

The decline or extinction of native medium-sized predators is significant in these environments, as is the replacement by feral predators (dogs and foxes). There is a long-term opportunity for restoration of the predator hierarchy, which would restore the balance in the condition. This would involve the restoration of dingoes and quolls (presuming long-term reestablishment of the eastern quoll) and elimination of feral dogs, foxes and cats (see below). With the presence of foxes now (1990s) recorded in Tasmania, re-establishment of a viable eastern quoll population on the mainland will become imperative. Kosciuszko National Park would be a highly appropriate site in combination with others. There are critical ecological elements and processes that will effect the condition of the fauna populations (see also the section on threats below). These include:

- the maintenance or restoration of natural predator–prey relationships;

- the extent and condition of mature seral vegetation stages and availability of range of tree hollows;
- fire regimes for dependent fauna (e.g. smoky mouse) and habitat restoration.

## Species of significance in wetlands, bogs, streams and specialised habitats

### Introduction

The wetlands of Kosciuszko National Park have not been systematically mapped, and are therefore not shown in Figure 10.2. The alpine, subalpine and montane bogs and wetlands are a very significant conservation feature of the environment, not least because their hydrology may have direct effects lower down the catchments. The area of the wetlands has shrunk, and many bogs are degraded. These environments are still in a recovery phase following the removal of grazing several decades ago. Recovery in the condition of some bogs have been recorded (Costin et al. 2000), but there remains great scope for improvement. Unfortunately this far-sighted land management decision has not been replicated in Victoria, where substantial areas of bogs and wetlands are still open to cattle grazed under government licence, with deleterious effects (Williams et al. 2002). The situation in Victoria enhances the conservation and scientific significance of these habitats in Kosciuszko National Park.

### **Significant species and communities, some of their ecological functions and condition<sup>1</sup>**

Several alpine–subalpine endemic species that depend on the wetland and bogs (e.g. the alpine water skink, alpine tree frog, southern corroboree frog) have been discussed earlier. Under the JAMBA and CAMBA agreements, Australia is obligated to protect listed international migratory bird species and their habitat. The park's wetlands are used by some listed international migratory wetland species, such as Latham's Snipe. The park does not support large populations of these species, and the importance of its wetlands to the various species, either as a stopover or as a destination, is unknown.

The threatened northern corroboree frog *Pseudophryne pengilleyi*, formerly considered a northern form of *P. corroboree*, is found in the wetlands of the north of the park and in the Brindabellas. Osborne et al. (2001) has recorded a recent decline of this species in both abundance and range since 1989 in parts of its range, and the causes of this decline remain uncertain. The threatened booroolong frog *Litoria booroolongensis* also exists in the northern part of the park, but no monitoring has been done on the populations. The function of tadpoles (grazers/prey) and frogs (as smaller predators) in Kosciuszko National Park is not well understood.

Threats to these environments include changes in water quality and quantity and general degradation. Trampling by horses, deer, pigs and humans. At least two ungulate species appear to be expanding their ranges and abundance into the alpine–subalpine environment. If this expansion remains unchecked, the ecological and catchment improvements resulting from the removal of cattle in the 1950s and 1960s may be jeopardised.

Many areas of wetland and stream remain trout-free, primarily because of the 80 kilometres of aqueduct constructed by the Snowy Mountains Authority. Indeed, the most abundant spotted tree frog population was able to persist in a trout-free stream protected by an aqueduct and waterfall (K Green, pers. comm., September 2002). Trout are a known predator of spotted tree frog tadpoles (Gillespie 2001).

Other specialised habitats include caves, cliffs, and sites of communal roosting and breeding. The cave fauna is of particular interest, being largely confined to one or a few caves because movement in the open is difficult or impossible (Coyne 2000). Many troglobites (species which can live only in caves) are relicts of some antiquity and only distantly related to surface forms. They may be phylogenetic relicts, with no close living relatives, or they are distributional relicts, having survived in a geographic region in subterranean refugia. They provide valuable insights into the zoogeographic and evolutionary history of our faunas (e.g. Thurgate et al. 2001, also see Chapter 7).

Cliff and rock faces are important nesting sites for the peregrine falcon, a cosmopolitan species that has experienced historical declines across large parts of its range. Monitoring in the park suggests the population of about 30 pairs appears to be stable (K Green, pers. comm., September 2002). Conversely, brush-tailed rock-wallabies appear to be extinct in the park and have also become extinct in other areas. Fire appears to be the proximate cause in the park but the last colony to disappear was in a remote area apparently not subject to obvious threats (K Green, pers. comm., September 2002). Once the full gamut of threatening processes have been understood and ameliorated in the park (foxes, goats, rabbits, food availability), this species should be a candidate for reintroduction to its habitat at rocky outcrops, ravines and caves.

There are critical ecological elements and processes that will effect the condition of the fauna populations (see also threats below). These include:

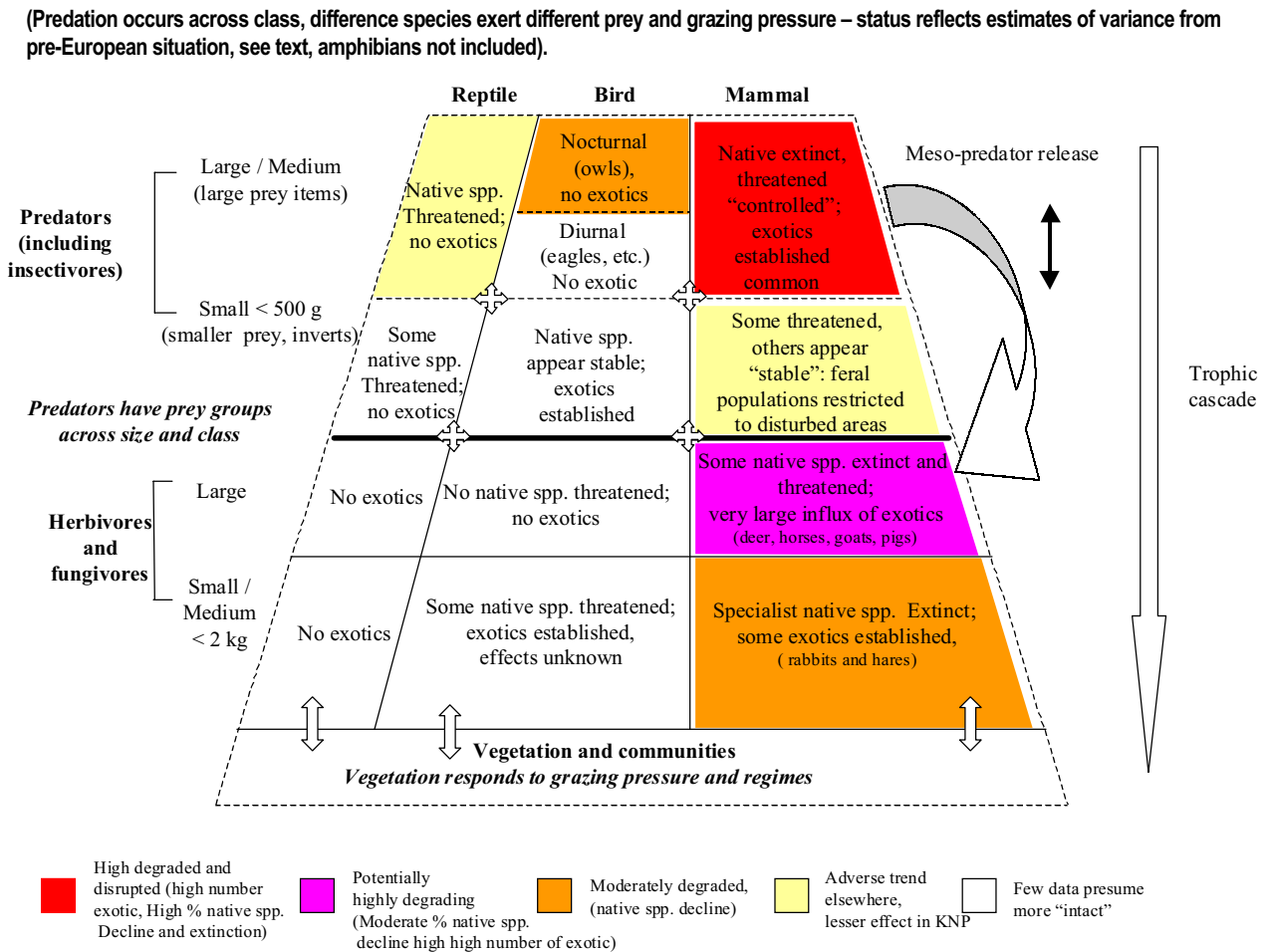
- maintaining or restoring the hydrological cycle and the health of wetlands and protection from ungulates;
- protecting and actively monitoring specialised habitats: caves, roosting and maternity sites for communally breeding species; and
- keeping existing trout-free areas free of trout, and expanding trout-free areas if practicable (see Chapter 8).

<sup>1</sup> The wetland habitats and their invertebrate and fish fauna are discussed more fully in Chapter 8.

## Condition of vertebrate fauna by trophic level

In order to get an overview of the condition of ecological functions that vertebrates perform, we can examine the fauna by trophic levels - predator and herbivore. Each faunal group is examined by the number (and percentage) of extinctions or declines and the number and abundance of invasive exotic species. This provides an approximate index of variation from the natural pre-European condition (Figure 10.4), although it should be remembered that all of these groups interact (e.g. Table 10.6). This allows us to conceptualise the 'balance' in the park and, importantly, what elements may drive undesirable change. The NL&WRA (2003) found that in the Australia Alpine bioregion (NSW) the key threatening process was feral animals (p 58) – this contrasted to all other bioregions (except for a small part of NW NSW) in Victoria and NSW.

**Figure 10.4** Gross simplified estimates of condition of trophic levels of vertebrate fauna in Kosciuszko National Park, by class.



Gross or even subtle changes at one level may affect a 'trophic cascade' of changes. A study in Yellowstone National Park in the United States found that wolf reintroduction has affected the behaviour of their prey (elks), which consequently modified aspen regrowth and distribution (Ripple et al. 2001). In Kosciuszko National Park the pre-European medium-sized predators are extinct (eastern quoll and dingo) or threatened, with a decline in abundance and distribution (spotted-tailed quoll). The introduced red fox is now common and is implicated in the decline (to extinction in some cases) of quolls, potoroos, bettongs and many small mammals of the forests and woodlands. The latter grazing species spread the spores of hypogaeal fungi, which provide nutrient cycling in the phosphorus- and nitrogen-poor Australian soils (Claridge 2001). Thus, the effect of the red fox is spread across its trophic level and down through its prey levels, some of which it has apparently eliminated, to the producer level (vegetation).

Our empirical and theoretical understanding of these concepts continues to evolve (e.g. Este 2001). However, even a simple view of the park from this perspective (Figure 10.4) is sobering. Many nocturnal predators (e.g. large owls and bats) are threatened, and declines in their abundance would effect the abundance of insects either directly or indirectly through abundance of prey. The park has a suite of introduced large herbivores (horses, goats, deer, pigs), populations of which are well established and are capable or likely of expansion. Sustained grazing by introduced herbivores (or changed distribution of native herbivores) will initiate vegetation change (e.g. Bridle and Kirkpatrick 1998, Williams et al. *in prep*), and there is a huge potential for adversely effecting vegetation.

Most of the medium–large native species still appear common (wombats, kangaroos and wallabies), the declines being predominantly in habitat specialists such as rock-wallabies. The effect of rabbits on native vegetation, and in some cases soil stability, in the Australian landscape is well documented.

Figure 10.4 suggests that priority areas should be managed in priority order: first the exotic mammalian predators, then the exotic grazing regimes and large owl/bat predator roles. The latter may prove to be more intact in the park than in adjacent forests, although there is little data. The ecological changes initiated by the introduced grazers remain unknown and are probably underestimated (e.g. Pulsford 1991). To date there has been insufficient research in this broad area for the park. Other land managers should also be involved (e.g. forestry managers in the case of forest species), and the park should form strategic alliances with other partners, such as forestry, Victorian Department of Sustainability Environment (DSE) and Cooperative Research Centres (CRCs), since the alpine–subalpine region of the park has a particular, indeed unique responsibility, in the context of NSW.

Management and research should be focused on areas where adverse changes to the natural ecology have the capacity to be most profound. In the longer term, changes that affect a 'trophic cascade' may fundamentally change the vegetation and habitat available within the park. From this perspective we now examine the concept of meso-predator release within the most disrupted trophic level: the medium–large predators.

**Table 10.6 Prey identified in scat collections from Brindabella and northern Kosciuszko National Parks (Triggs and Story 1998–2001), Tinderry Nature Reserve (Triggs and Story 1997–2001) and Tin Mines (Newsome et al. 1983)**

Prey	Brindabella and northern Kosciuszko		Tinderry Nature Reserve		Tin Mines
	Feral dog	Red fox	Feral dog	Red fox	Dingo
Swamp wallaby	29%	18%	28%	15%	5.7%
Eastern grey kangaroo			6%	3%	2.9%
Red-necked wallaby			0.6%		1.9%
Brushtail possum	8%	14%	6%	12%	2.9%
Ringtail possum		7%	5%	9%	9.2%
Eastern pygmy-possum				0.4%	
Yellow-bellied Glider <sup>a</sup>	1%				
Greater glider	1%	3.5%			
Sugar glider	1%		2%	3%	
Dusky antechinus	2%	7%	1%	4%	2.2%
Bush rat	2%	3.5%	0.6%	3%	2.5%
Broad-toothed rat <sup>a</sup>		3.5%			0.2%
Short-beaked echidna	29%		10%	1%	
Insects	2%		3%	7%	
Vegetation	6%	3.5%	3%	2%	
Common wombat			2%	6%	51.3%
Reptiles	2%	3.5%	1%	1.5%	
Birds	5%	18%	6%	5%	
Fish	1%				
European rabbit <sup>b</sup>	5%	11%	3%	14%	17.8%
Brown hare <sup>b</sup>			2%	1%	
Cat <sup>b</sup>	1%	7%		0.8%	
Black rat <sup>b</sup>	1%				
Sheep <sup>b</sup>	3%		3%	4%	
Cattle <sup>b</sup>	1%		3%	1%	
Pig <sup>b</sup>	1%		10%	5%	
Goat <sup>b</sup>			3%		
Red fox <sup>b</sup>			0.6%		
Horse <sup>b</sup>					1.3%
<b>Total sample size</b>	<b>111</b>	<b>28</b>	<b>173</b>	<b>252</b>	<b>314</b>

Note: Multiple species may be identified within a single scat

<sup>a</sup> Threatened species

<sup>b</sup> Introduced species

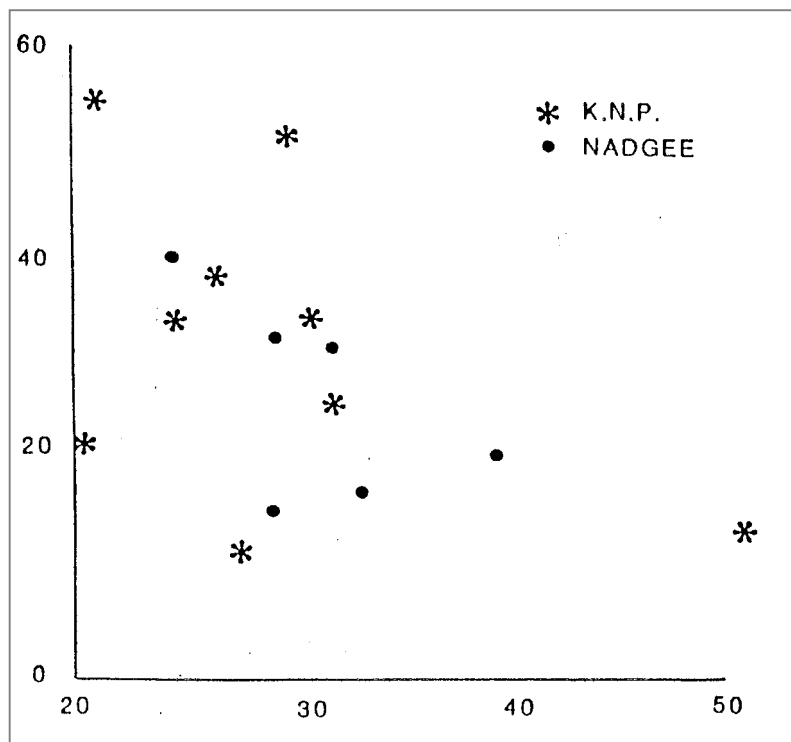
## Ecological processes: meso-predator release

### Introduction

Predators can exist in a hierarchy where the dominant predator influences (suppresses) the abundance of subdominants. Removal of a higher predator releases the subdominant to become dominant. This is termed meso-predator release (Crooks and Soule 1999, Estes 1996, Soule et al. 1988). The control of dingoes/wild dogs is one of the most contentious Kosciuszko National Park management issues with adjacent landholders and is currently given first priority by NPWS in pest management. This section endeavours to explain the value of encouraging restoration of a natural predator hierarchy that, if achieved, could assist land managers and landowners alike. It would also assist a suite of threatened species in the park, by removing the pressure of fox predation, at least at altitudes below the subalpine.

There has been a major change in the high order predator–prey relationship since European settlement. The dingo/dog–fox–cat dynamic, has replaced the dingo–eastern quoll–spotted-tailed quoll hierarchy (Figure 10.4). Elimination of the dingo in other areas has led to the increase in foxes and increase in abundance of dingo prey (emu *Dromaius novaehollandiae*, kangaroos) (Newsome et al. 1998). The larger species (dingo) can naturally suppress numbers of the smaller introduced predator species in a hierarchy of dingo–dog–fox–cat. Results (Figure 10.5) from research in Kosciuszko National Park where red fox and dingo population competition was studied demonstrate this meso-predator release (Newsome et al. 1983). Parallels have been demonstrated in the United States with the coyote–fox–skunk–cat relationships and in several environments (chaparral, grasslands) (Estes 1996). The change in the abundance and type of predators produces a different predation regime and abundance of prey and, consequently, differing grazing regimes in a trophic cascade (Ripple et al. 2001, Estes 1996). The apparent increase in cat numbers in areas of KNP subject of fox control measures may prove to be another example of this phenomenon.

**Figure 10.5** Two examples of meso-predator release between dingoes and red foxes, from the Tin Mine Region in Kosciuszko National Park down to the coast at Nadgee Nature Reserve (Newsome et al. 1983)





### **Basis for management**

Under the *National Parks and Wildlife Act 1974*, NPWS has a legislative duty to protect native species and control feral animals. Control and management of introduced animals is primarily governed by the provisions of this Act and the *Rural Lands Protection Act 1998*. Control programs within the park need to be consistent with NPWS's state-wide field management policies and the provisions of the current management plan for the park. Currently, priorities and approaches for introduced animal control in the park are contained within pest management strategies for the two NPWS regions covering the park.

### **Significance and condition**

The natural large and meso-predator regime in Kosciuszko National Park is highly significant and potentially more so. Kosciuszko National Park contains one of the few remaining dingo populations in southeast Australia, which plays a key role within the meso-predator relationship (Newsome 1988). There are large pressures and effects outside the park from dogs and foxes, and impacts on the relative abundance of native fauna populations, which are also highly significant (Newsome et al. 1983). Predation by the red fox is a nationally listed threatening process under the EPBC Act and listed as a threatening process in the park under the *Threatened Species Conservation Act 1995* - a process exacerbated by meso-predator release. The park also has one of the largest known spotted-tailed quoll populations in southeastern Australia (NPWS 2002). Over the last two decades there have been major efforts in Europe and North America to restore large predators (e.g. bears and wolves) to the landscape (a costly and controversial exercise)<sup>2</sup>. It is suggested that efforts by Kosciuszko National Park to restore the natural predator regime would achieve international recognition.

The condition of the large predator hierarchy in Kosciuszko National Park is very poor and highly degraded, and one species in the hierarchy, the eastern quoll, is already extinct in the park. Although a significant population of the spot-tailed quoll persists the condition across its range in KNP remains unknown. It is presumed to have suffered some decline as noted for the other parts of its Australian range (Mansergh 1983). There also needs to be active management of the spotted-tailed quoll population in order that it can be restored to numbers where its ecological function and its place in the predator hierarchy can be expressed at the landscape level. Currently, dingoes are removed from the park and, perhaps, even more significantly, this species is subject to a genetic dilution from introduced dogs. This trend of genetic dilution is magnified by the comparative disparity in breeding cycles; dogs breed twice a year, while dingoes breed once a year (Catling et al. 1992). This trend is expected to continue if the dingo is actively pursued as a pest. The nexus of the problem is it that is very difficult to scientifically distinguish in the field between a dingo and a wild dog that looks like a dingo. Indeed a clear understanding of the distribution and abundance of the Dingo is required (presuming techniques to practically differentiate. Dingo and dogs is developed). Positively, there have been recordings of the spotted-tailed quoll where a change in baiting practices from aerial to ground has occurred.

The pressures on restoration of a balanced predator relationship are: management practices that do not specifically target dogs and foxes, and disadvantage the dingo; increased opportunities for foxes and cats over winter because of the presence of ski resorts and other developments; a lack of research and funding; and the increase in domestic dog incursions (e.g. by pig dogs; Green, K, pers. comm., September 2002) in the park. Even with restoration of the pre-European predator relationship there will remain a problem above the snowline and around resorts where cats and foxes are the major predators. For the cat, it is likely that a cat-specific toxin will be available for field use in the foreseeable future (Marks, C, DNRE, pers. comm., September 2002), and fox-baiting techniques will probably improve to allow broadscale control (see *Southern Ark*, DSE, 2003).

In this context it is highly probable that efforts to control the dingo/dog in the park exacerbate the fox and cat problems, and may be counter-productive to improved ecological outcomes. An alternative is to restore a stable dingo population, which would control the populations of the smaller fox and probably cat. This might also provide some 'natural' predation pressure to overcome problems with feral horses and deer. Such a strategy would have to be implemented in concert with the restoration / protection of the spotted-tailed quoll population and in the context of adaptive experimental management.

### **Opportunities**

There is an obvious opportunity for research and funding to increase the knowledge of the dynamics of this relationship, so that the meso-predator process can be manipulated to benefit both graziers and conservationists. In the long term the reestablishment of the eastern quoll would be an opportunity for the alps and also a safeguard against its potential demise in Tasmania where the fox has been a recent introduction. At present there is an opportunity to restore the place of the dingo and the natural meso-predators in the natural system of the park. Todd (2002) describes a method and an example for building community consensus on a similar issue in Alaska, which may be a useful guide for Australian policy makers. The problem of exotic predators is Australia wide but KNP, because of its size and ecological significance does become a suitable area to begin resolution of the complexities of this major threatening process.

### **Indicators and monitoring**

The most obvious indicators to monitor this meso-predator relationship are dingo and spotted-tailed quoll numbers. It would be necessary to have an index of the numbers of all predators in the park, and thus form a picture of the relative structure of the predator community.

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<sup>2</sup> A bibliography on this issue can be viewed at [www.lib.uwo.edu/](http://www.lib.uwo.edu/)

Monitoring of sheep kills could also be considered in conjunction with the Rural Lands Protection Board (RLPB). The latter data should be linked to the positive identity of the predator dog–dingo hybrid. Pest management programs should be cognisant of the predator hierarchy dynamic and land tenure, preferably tenure blind. Such a program may have multiple target species both for control and enhancement. The current Cooperative Wild Dog/Fox Control Plan for the Brindabella and Wee Jasper Valleys provides a current example (Hunt et al. 2002).

A major policy objective must be to restore the natural (pre-European) meso-predator regime in the park, in order to reduce fox and dog populations. This will decrease the exotic predator pressure on native species in the park, hopefully to a point where they do not play a major role in meso-predator relationship. This would also have associated positive effects on fauna populations, including the maintenance of a stable dingo population and increased quoll populations. Estimation of dingo population, genetic integrity and practical measures to distinguish in the field are priorities for research and underpin the vision to restore a natural predator hierarchy.

## **Ecological processes - grazing herbivores**

We noted earlier that, in Tasmania, grazing by marsupials influences the distribution and abundance of tall herbfields (Bridle and Kirkpatrick 1998), and the major grazers in the alpine area of Kosciuszko National Park are insects. There are, however, a large number of introduced vertebrate herbivores in Kosciuszko National Park, some having a major effect, others localised or at present seen as having low impact (hares, deer). The licensed grazing of cattle ceased many years ago (although there remain three 'stock routes'), but the individual and combined grazing pressure of introduced species (rabbits, hares, horses, pigs, deer) is substantial. Populations of these herbivores are affecting vegetation and sensitive areas like bogs. The populations of some, such as horses, are increasing; some, such as pigs, may increase in the future; and others are still expanding their range (for example, sambar deer are now commonly recorded above 1600 m in Victoria). The altitude at which habitat becomes marginal for rabbit populations appears to be substantially higher at present than several decades ago. Species, such as horses, that can persist at higher elevations (Green and Osborne 1994) are of particular concern. From a nature conservation perspective, horses should be eliminated. Control measures that only 'harvest' the natural increase or less will not decrease the population. The use of feral horses for recreation, if allowed, requires strict monitoring and consequent adaptive management so as to minimise their ecological effect.

At present, the alpine area may well be protected by the seasonal snow cover and is not presently overly effected, except in the case of bogs. However, it is highly vulnerable, particularly under changing population sizes and climate change. Unchecked invasion by some of these herbivores is likely to change the structure of the alpine vegetation and move it away from the present insect-dominated system. In the absence of natural enemies (predators, parasites) or control, these species represent a major threat to the natural integrity of the park. It is also probable that exotic plants (clovers in alpine mix etc.) may assist the establishment and or persistence of rabbits (and other grazers) at higher altitudes – native species should be used in all soil stabilisation works. Re-establishment of the pre-European predator system should be incorporated into control measures.

According to the ecological concept of 'trophic cascades,' the suite of exotic herbivores current present in the park may represent a major problem that is not perceived at present. Control of introduced herbivores within an adaptive experimental management framework should be a major management program of the park.

## **Ecological processes - fire**

NSW NPWS and Kosciuszko National Park management have obligations to protect assets from the impacts of wildfires, as well as use fire in ecological management. Fire in Kosciuszko National Park and its implications for management (e.g. risk) are discussed elsewhere (Chapter 12), however, fire is such an important determinant of habitat that it requires some discussion in relation to fauna. Apart from the alpine area, where wildfire is a very rare 'catastrophic' event, most environments within the park have evolved under a regime of relatively frequent fire. Kosciuszko National Park has been subject of several major and extensive bushfires (e.g. 1939) and Banks (1989) records 18 fires in the Brindabella Range between 1820 and 1973. The recent 2003 fire is discussed below.

Fire (or lack of it) is a major determinant of vegetation and its seral stages across the Australian landscapes – this affects the spatial and temporal availability of habitat for fauna. Present vegetation distribution is an expression of past fire regimes. Nevertheless, pre-European (Aboriginal) fire regimes are imperfectly understood. Banks, (1989), through dendrochronology (tree ring dating, fire scars) and historical records, found that fires in Kosciuszko National Park were more frequent following settlement and less frequent from the 1960s. He qualified this generalisation, observing that the magnitude of this increase was site dependent, and that fires were probably patchy in the intensity of their effect. Certainly, fire regimes have changed and may have affected faunal distributions.

Management using fire (both naturally and purposely ignited) is important for habitat manipulation and vegetation condition and fires may contribute to tree hollow production. Some species are reliant on specific fire regimes for maintaining attributes of habitat (e.g. Smoky Mouse, seed plants and fungi) whilst others may be more tolerant of broader fire regimes. Species requirements, particularly threatened species, need to be incorporated into the management of the fire regime in Kosciuszko National Park.

Recently, fire management for ecological purposes has developed the concept of using the life history characteristics (vital attributes) of constituent flora and fauna and ecologically tolerable intervals to determine appropriate fire regimes (Fire Ecology Working Group 2002). Fire history (controlled burns and wildfires) is mapped to vegetation class and compared to an 'idealised' age class distribution – thus active management can be targeted (exclusion and controlled burning). To be operational, this process requires a GIS system that incorporates layers of vegetation condition (see below). Within this framework management decisions regarding any bias for maturity, catchment and wildlife protection, etc, can be transparently embedded.

In order to improve management of fauna and its habitat, while recognising the need to protect property inside and outside the park, fire management should be driven by ecologically-based fire regimes using life history characteristics, and spatially address needs of fire dependent threatened species, and vegetation age class and maturity.

## Fires in 2003

In January – February, 2003 KNP and adjacent areas of NSW, Victoria and ACT were subject of a series of fires, several of which converged: Over 1.2M ha was within the fire perimeter in Victoria and 465,000 ha of KNP (67%) and 27,000 of adjacent private property. Full assessment of the fire (eg. fire intensity mapping) and consequent management actions (fire trails) has yet to be made but it is probable that the fire intensity, thus effects, will prove to be patchy across KNP. Patchiness implies refugia for populations. Apart from extensive forested areas, some alpine habitats were burnt, and it is these areas where fires are much less frequent. The impact of the fires will be evident across the landscape for several decades and their ecological significance should be seen in the longer term – for example, the fires may have destroyed existing many tree hollows but also created the conditions for the formulation of others. It is important that KNP takes this opportunity to correlate the fire intensity with vegetation condition (see habitat hectare discussion above) and track this through time as this is an excellent opportunity to quantify vegetation and habitat condition with catchment condition both within KNP and the down stream ecological services. Overall, the distribution and abundance of species will spatially change across KNP as populations exploit seral stages post-fire – the fires are not necessarily bad for fauna. The sensitive species are those that require components of "old growth" (depleted through fire) or in habitats where fire is a rarer natural event (alpine areas). For at least two species detailed information is being collected. Certain sites require protection from fire (rock-wallaby, see p. 88)

Some of the threatened species and their habitats mentioned above warranted monitoring post fire. Initial responses (post-fire survival) should be viewed in the context of longer term population and habitat recovery. Some initial data following the fires has been collected but all conclusions as to the medium and longer term implications remain necessarily tentative. All the habitat of the Mountain Pygmy-possum (except Mt Buller, Vic) was within the fire perimeter – but the effect on habitat and population appears patchy. In KNP, Mt Blue Cow appears the habitat where the fire was most intense (80% severely burnt) and the comparison of population pre-fire (8 ad. Fem/ 2 ad male) and post fire (2 ad fem. 1 juv. male) suggests a marked decline (Broome, L, NSW NPWS, pers. comm.). This is similar to intensely burnt areas in Victoria (Mt Mc Kay) but less intensely burnt areas did not show such declines (Heinze, La Trobe Uni, pers. comm., March 2003). Long term monitoring of both population and habitat will be required as recovery of the long-lived Mountain Plum-pine (for food and shelter) remains unknown.

Habitats at Mt. Paralyser, Charlottes Pass, Summit Road, South Ramshead and Gungartan and Mt. Kosciuszko were not affected by the fires; however, Dicky Cooper Bogong was burned (Green, NSW NPWS, pers. comm., February 2003). Overall the fires may represent a population bottleneck but at this stage a tentative conclusion is that the meta populations will survive - recovery is dependent on habitat recovery and any changed susceptibility to predation.

Dawson (NPWS NSW, pers. comm.) provides the following observations on the fires in KNP 2002 - 03 and work on the Spotted-tailed Quolls. Extensive surveys undertaken during 2002 revealed many records of the species, particularly in the Byadbo Wilderness Area in the south of the park. In late January 2003 a very high intensity wildfire went through this area. The fire completely removed the understorey and resulted in the loss of large numbers of large, hollow bearing trees across the entire study area. The intensity of the fire, and the loss of both understorey and hollow resource, was expected to result in the death of individual quolls and large numbers of key prey species such as Brushtail Possum, rabbits, native rats and bandicoots. Evidence of death of large numbers of prey was apparent throughout the area.

The study area was re-trapped in early May 2003. This survey revealed that quolls were still present in the area, with numbers of animals captured being slightly greater than 50% of the numbers from 2002. This included both male and females that were present in 2002, juveniles (likely survivors from litters of females present in the area in 2002), and new adults. From this preliminary work it can be seen that individual Spotted-tailed Quolls are able to survive the immediate impacts of even the most severe wildfire events. It is likely the numerous large rock outcrops that occur through the study area provided refuge sites for quolls, and perhaps some prey as well. Monitoring of the population will be ongoing to assess the longer term impacts of the fires, and the effect of the fire on diet, home range, breeding and latrine use will be further investigated.

As with other species, initial survival may be positive, however, long-term survival is dependent on the seral stages providing habitat, food and predator response. Fires burnt the entire range of the Southern Corroboree Frog and populations of this species have yet to be assessed. Given the bog habitats change markedly after fire, are subject to erosion and take decades to recover the prognosis for this endangered species is not good at this stage.

## Overall condition and trend in condition - interpretation

The condition of the fauna in the park is difficult to assess and has been made more complex by the recent fires. The condition of some populations and trophic levels has been discussed earlier. For the vast majority of species no routine monitoring is undertaken to determine trends. Indeed, *there is no long-term contextual framework within which such studies can be conducted*. Peregrine falcon breeding success is monitored annually and, as part of monitoring for global warming, bird migrations are monitored weekly in relation to snow depth and cover, emergent vegetation and flowering (Green, K, pers. comm., September 2002). For some groups, such as birds, there is a system of informal 'surveillance' monitoring (by birdwatchers and others).

For other faunal groups, most notably frogs (e.g. Osborne et al. 2000) and mammals (Broome 2001a,b), more detailed species accounts are available from the park and elsewhere. The broad-toothed rat has the longest monitoring history in the park - since 1978 at Smiggin Holes (Green, K, pers. comm., September 2002). Relevant studies of species and communities outside the park can help to guide management. Even some of these must be seen in the context of long-term cyclical change (e.g. El Niño droughts) and the recovery of habitats from major disturbances (grazing, bushfires, etc), the effects of which are not fully understood but have a recovery period measured in decades.

Newsome and Catling (1979) proposed a simple measure of habitat complexity for small mammals, however, there is no model that even purports to include all faunal groups. Such theoretical work, to produce a simple metric is required and it should be harmonised with the vegetation condition. There has been no general measure of condition of the vegetation in KNP which could assist assessment and long-term monitoring indeed until recently such a metric has been notably absent from the national agenda (DNRE 2002). A measure such as habitat hectare (Parkes et al. 2003) is vital for the ongoing measurement of vegetation condition. In order to accomplish this, some point in time (a benchmark date) against which to measure changes needs to be established. The arrival of Europeans would appear to be the most appropriate, even though absolute knowledge of the condition then is impossible and must be intelligently surmised. All benchmarks have disadvantages, but this point would also recognise the Aboriginal knowledge embedded in their land management, and encourage investigations of this knowledge.

Notwithstanding their limitations, general observations gleaned from the literature about the condition of specific species, habitats and communities, the ecosystem services that are provided by the fauna, and the condition of their habitats, have been discussed above. Figure 10.4 indicates that faunal assemblages of some of the trophic levels of the park are in a disrupted and poor condition. The natural predator-prey balance has been markedly disturbed: all large owls are threatened (declined across their range); large and medium-sized mammalian predators are either extinct (eastern quoll), have declined in abundance (spotted-tailed quoll) or have been 'controlled' (dingo). Populations of foxes and cats are prevalent, frequently around important biological areas (e.g. mountain pygmy-possum habitat) and have introduced selective predation pressures (e.g. on the broad-toothed rat, Green 2002). Changes in predation (increase or decrease) will cause consequent changes in prey species and the extent or magnitude of their ecological function.

Grazing and trampling pressures are evident from a suite of introduced species, including rabbits, horses, deer and pigs. These populations cause a general decline in habitats (at variance from the 'natural' condition) and may destroy some components, such as bogs, if left unchecked. Other elements adversely affecting the condition are discussed below.

There are critical elements that will improve our understanding of condition. These include:

- The establishment and implementation of systematic framework for monitoring vegetation condition; This should be part of a state-wide or perhaps national framework, and should evolve to encompass habitat condition (e.g. wetlands) (see Parkes et al. 2003). This should be integrated with the post fire intensity mapping;
- Current monitoring of some key and focal species and communities is relatively good for the alpine-subalpine areas and should continue. It is relatively poor for the forests, particularly the drier woodlands;
- The effect of introduced species on basic ecological functions, roles and processes should be used to prioritise management, e.g. predator-prey relationships, grazing. Restoration of natural systems should be the goal.

## The assets - taxonomy and genetics

Since the original Plan of Management for Kosciuszko National Park (1982) there have been many advances in taxonomy and the scientific tools derived from the study of genetics. Genetics offers a most valuable new tool for park management and should be incorporated into future research plans. New taxa (species and subspecies) have been erected, several of which are alpine endemics (e.g. alpine she-oak skink and alpine tree frog). In Victoria, a field investigation of an alpine flatworm *Spatula tyrssa* found several new species that are endemic to various mountain areas (St Clair et al. 1999), and these findings could well be 'typical' of the alpine environment. In the case of the mountain pygmy-possum, arguably the most studied species of fauna in the park, it has only been found recently that the small population (500, inc. males and females) consists of two genetically identifiable haplotypes (Osborne et al. 1999). Further, the global population (only 2000 adults) consists of three or four genetically distinct subpopulations (Osborne et al. 2000). Observations such as these should have profound effect on fauna population management into the future. Recent work has identified 18 micro-satellites for the mountain pygmy-possum (Mitrovski and Hoffmann, CESAR, pers. comm). This will enable some of the basic conservation management questions to be answered (eg.  $N_e$ ) and provide knowledge into the broader issues of managing fragmented populations in KNP and elsewhere.

These examples highlight our imperfect knowledge of the fauna (particularly invertebrates), and suggests the prudent use of the precautionary principle in park management activities. We do not know the extent and diversity of many of our assets. Genetic studies are being undertaken for the spotted tree frog, northern corroboree frog, mountain pygmy-possum, spotted-tailed quoll, broad-toothed rat, brush-tailed rock-wallaby and smoky mouse (NSW NPWS 2000). Such studies of the fauna of the park are to be encouraged. These advances at the species and subspecies level should be complemented by studies that provide insights into how the ecosystem works.

### **Some additional threatening processes**

Some of the key threatening processes have been discussed earlier, or elsewhere by the ISC (e.g. weeds), and are not discussed below. Although the causes of the threatening processes discussed here are beyond local park management, an adaptive management response is required.

#### **Climate change**

The potential consequences of the enhanced greenhouse effect for the global climate (ie global warming) and for the climate of southeastern Australia are profound. Bennett et al. (1992) and Brereton et al. (1995) provided future scenarios for selected fauna of southeast Australia. Green and Pickering (2002) examined the reduction of the area of snowline for mammals and birds in the Snowy Mountains. Distributions will change drastically, and alpine species appear to be among the most vulnerable, with many 'climatic envelopes' likely to be extinguished. However, for some other species, the mountains, which provide altitudinal gradients, will become increasingly important as refugia (see also Howden et al. 2003).

The snowline is predicted to rise, causing a dramatically reduced snow season, possibly as early as 2030 (Whetton et al. 1996). If the period and extent of snowline declines then this will cease to be a limiting factor in the distribution of some species. Green and Pickering (2002) suggest that altitudinal increases in distribution are already observable at Kosciuszko National Park (e.g. swamp wallaby). Other fauna (e.g. macropods) may exploit the expanded snow free area and thus induce novel grazing pressures that may initiate vegetation change (Bridle and Kirkpatrick 1998). A further implication is the loss of competitive advantage for species that have behavioural or physiological adaptations for the present alpine climate (e.g. hibernation), and they may be exposed to increased competition from species presently confined to lower altitudes. Over a long period, the vegetation communities (habitats) shown in Figure 10.3 would shift in their altitudinal extent, and the treeline would move upward as conditions for the germination and persistence of Snow Gums became available. Fauna are predicted to follow these trends, and more mobile generalist species may be able to persist in the larger snow-free areas.

It is likely that invertebrates will initially be the most sensitive to climate change. This has potentially profound effects on the alpine vegetation, where insects are major native grazers and influence the seral succession of some vegetation types. A major research proposal - part of an international system, ITEX - is in train (Bergman, Melbourne University, pers. comm., June 2003) and the park has an important role. This research should illuminate the 'robustness' of the alpine and montane vegetation to climate change.

Some broad implications for faunal conservation and 'greenhouse-proofing' in the park are:

- Alpine environments are a key area for research and monitoring;
- A better understanding of the ecological functions at the systems level is needed;
- The present habitats must be as robust and healthy as possible (Bennett et al. 1992) in order to maximise resilience. This includes the control of introduced predators;
- Registration of the importance of the park as a refugium and the integration of adjacent land uses to maximise biodiversity conservation. This suggests, for example, the need for planning of regional-scale corridors across landscapes outside the park.

#### **Increased UV-B radiation**

There has been much scientific debate concerning the biological effects of elevated solar UV-B radiation, particularly at higher latitudes and altitudes, because of ozone depletion. Alpine amphibians (frogs and tadpoles) are seen as particularly vulnerable because this radiation can penetrate several metres into water (Blaustein et al. 1994). Current research suggests that a declining species (the alpine tree frog) is significantly more sensitive to ambient UV-B than a non-declining species (*Crinia signifera*) (Broomhall, quoted in Osborne et al. 2001). The global problem of ozone depletion has been addressed through the Montreal Protocol (for the control of CFCs), and recent reports suggest that ozone levels may be stabilising, and could return to normal levels by 2050 (Macey 2002). However, this may be too late for some species if increased UV-B radiation is indeed the primary cause of decline.

#### **Exotic diseases and pathogens**

The wildlife populations of the park may be vulnerable to exotic diseases and pathogens. Disease (e.g. toxoplasmosis) has been suggested as a cause of the rapid declines of marsupials early in the 20<sup>th</sup> century (quolls, koala). Diseases such as canid mange in wombats and chytridiomycosis in frogs have been recorded in the park.

The latter disease, caused by a fungus-like organism, has been recorded in both wild and captive spotted tree frogs, and many other species (M Scroggie, pers. comm., December 2002), although there is still debate as to whether it constitutes a primary cause of observed population declines (see Alford and Richards 1997, Berger et al. 1998, Bosch et al. 2001).

Exotic diseases have the potential to have long-term detriment to the parks fauna. It is a difficult problem to counteract. In the national sense, the Australian Quarantine Inspection Service is the first line of defence, and park managers have powers to stop deliberate release. However, parks staff must remain vigilant in their surveillance and reporting of unusual events, and at least several staff should be keeping abreast of the literature.

## Gaps in the knowledge required for management

Some of the gaps in our understanding have been discussed above. In this section we discuss some of the generic gaps and the specific studies required. There is a need to establish an overall framework for strategic research. Incorporating many of the research projects into a program of adaptive experimental management is arguably the most rewarding. In the recent past, threatened species have attracted a substantial research effort. This has been worthwhile, but a more holistic landscape approach may prove more productive. The research within Kosciuszko National Park should be linked to other areas, and for some topics (e.g. large owls, predation, health of system, subterranean biodiversity, and nutrient cycling) the major drivers could well be outside the park system.

Recommended studies include the following:

- Systematically evaluate the condition of the vegetation (and progressively habitat) of the park (linked to surrounds). This should be GIS-based and would assist in the resolution of questions concerning seral stages and area of mature vegetation. It is also linked to fire regimes;
- Examine the meso-predator system in the park, with the aim of restoring the dingo–quoll predator system. In the foreseeable future, when techniques are available, landscape control of both foxes and cats should be possible;
- Within the above framework, knowledge is required on the processes of the system. This is particularly important regarding the role of insects and invertebrates as major grazers, in the alpine area in particular and should include subterranean biodiversity and nutrient availability;
- Increase knowledge of several key species/groups to assist in their management:
  - spotted-tailed quolls and meso-predators,
  - Smoky Mouse: role of fire and fungi,
  - a suite of alpine species, e.g. alpine tree frog, three ‘new’ reptiles: some of these will prove suitable for long-term monitoring and indicators of health (e.g. mountain pygmy-possum),
  - Bogong Moths, which provide a major energy input to the alpine environment: the recent discovery of arsenic should be investigated, as should the breeding grounds response to greenhouse warming; and
  - other species, e.g. brush-tailed rock-wallaby, that have legal requirements for recovery;
- Grazing animals. The suite of feral grazers (e.g. horse, deer, pig and rabbit) in the park are altering the natural ecological grazing regime. The extent of the grazing pressure may also be related to predator management. The effect of this on the natural capital of the park is more than likely profound. Research to thwart the expansion of the range of these animals into the alpine areas should be initiated, with efficient and effective control or elimination being the aim; and
- Enhanced greenhouse climate change. As biodiversity assets are among the most vulnerable, and alpine environments the most vulnerable of these, we need to understand the specific changes in the context of global changes. This understanding must be related to feasible management options for the park. ‘Robustness’ or ecological health are important attributes in the alpine environments. Within this framework, the role of the park as a refugia for species outside the park must be included.

## Indicators

The NSW NPWS indicated that a series of indicators for the condition of fauna in Kosciuszko National Park were required for management. A preliminary contribution is illustrated in Chapter 22. The range of these indicators includes some focal species (several of which are icon species), keystone species indicative of the condition of a process (predator hierarchy), and surrogates for the condition of habitat (vegetation condition). As noted elsewhere, these indicators and the research and monitoring they imply should all be done within an adaptive management framework, and thus remain capable of refinement over time.

Much of the trend to use indicators derives from the need to measure progress and many derive from the condition–pressure–response model made popular by the OECD and used in state of the environment reporting. The indicators below are put forward as suggestions for the long-term, perhaps reporting on every 5 years with frameworks and intellectual infrastructure in place as early as possible. Others use indicators for a multitude of purposes. The indicators are not necessarily amenable to ‘annual targets’ or other such more immediate management requirements.

## **Some results of faunal management – ‘Vision for 2020’**

In the year 2020, Kosciuszko National Park is viewed as a national asset for biodiversity conservation. In conjunction with alpine parks in Victoria and ACT, it has achieved World Heritage Area status, in recognition of the parks’ outstanding and increasingly important biodiversity assets. The conservation value of the park has been internalised to become a “sacred site” for all Australians and most young people have been exposed to deeper understanding of the nature of our continent, in part through the ecological and inter-relationship studies conducted in KNP.

The park makes a highly significant contribution to the economy, as its faunal values are most valued by visitors and contribute to the attractiveness of the park. The Park is recognised as a key feature as the economy increasingly adopts ESD principles. The economic value of the park is also recognised by local communities who benefit from its proximity. Indeed components of activities that were deemed incompatible with ecological sustainable development (ESD) of the park (eg. inappropriate accommodation) have promoted appropriate private development adjacent to the park.

The condition of all the vegetation and habitats is demonstrably improving relative to the benchmarks of pre-European settlement and from the 2003 fires. Having adopted the goal of net gain in condition and extent of native habitats, governments and the community have adequately funded management to achieve these tangible goals. As a consequence, viable representative populations of all fauna species in the park are conserved and are able to perform their ecological function. Land management lessons from the park are increasingly being adopted in other areas across the landscape. KNP becomes increasingly ecologically reconnected to its surrounds.

Several species have recovered sufficiently to be removed from the threatened species list, although the alpine endemics remain threatened because of the restricted nature of the habitats. The condition of several of these populations has, however, improved due to habitat enhancements and a decrease in predation pressure from introduced carnivores. It is acknowledged that species that are threatened in NSW and occur in the park, have their most secure populations in the park. Populations in the park provide an invaluable biodiversity reservoir and refugium. Brush-tailed rock-wallabies have been reintroduced into the park, while Koalas re-established without assistance.

The pre-European meso-predator hierarchy is in the final stages of restoration, with healthy dingo and spotted-tailed quoll populations. The eastern quoll has been successfully reintroduced, and in the drier habitats is once again taking up its place in the ecology. These species are common enough to be an obvious feature of the park and can be readily seen by many visitors. Importantly, this has also allowed some natural control of the indigenous grazers such as kangaroos. Fox and cat populations have declined to very low levels in the park, and in adjacent areas.

The emphasis on protecting mature vegetation has enabled many fauna species to persist in the park and, importantly, the increasing availability of tree hollows has seen a gradual restoration of populations of hollow-dependent species.

By 2020, the effects of enhanced greenhouse climate change are occurring, and subtle yet sure changes in the distribution of some species of fauna are evident at the continental scale. The park (as part of the Australian Alpine Park) has become one of the central pillars in ‘greenhouse-proofing’ the natural landscapes of southeast Australia. The alpine and subalpine environments have been progressively made more healthy and robust, and are now more resilient to changes that are wrought by disturbance, such as invasion by weeds.

## **Acknowledgements**

Submissions were received from fourteen people and/or organisations and the time and effort put into comments and constructive criticism of the original chapter is gratefully acknowledged. We trust all can see their efforts reflected, although not all comments were included. Michael Scroggie and Greg Hollis (DNRE) provided information on frogs, and Clive Marks and Gordon Friend (DNRE) commented on aspects of predation and fire. Ken Green, Linda Broome and Mark Adams (NSW NPWS) provided valuable guidance on structure and content, while Andy Spate provided advice on an early draft. Further thanks to Dean Heinze, Paul Mitrovski and Ary Hoffmann all from La Trobe University who provided recent information on the mountain pygmy-possum. Thanks are also due to the NSW NPWS staff who assisted the ISC and to Heather Anderson for assistance with the graphics and David Meagher who provided editorial support.

Attachment 10A

Table 10A.1 Mammal species of the Australian Alps national parks considered significant as rare, vulnerable or threatened

Common name	Scientific name	IUCN	EPBC Act	ANZECC list	NSW TSC Act	Vic FFG Act	VROTS	ACT NC Act
Mountain pygmy-possum	<i>Burrhamys parvus</i>	E	EO	E	v	2A	v	
Leadbeater's Possum	<i>Gymnobelideus leadbeteri</i>	E	EP	E		2A	e	
Long-footed potoroo	<i>Potorous longipes</i>	E	E	E	eP	2A	e	
Smoky mouse	<i>Psuedomys fumeus</i>	V	EO	E	eP		r	eA
Spot-tailed quoll/Tiger quoll	<i>Dasyurus maculatus</i>	V	VO	V	v	2A	v	
Brush-tailed rock wallaby	<i>Petrogale penicillata</i>	V	VO	V	v	2A	e	eA
Yellow-bellied glider	<i>Petaurus australis</i>	L	S		v			
Squirrel glider	<i>Petaurus norfolcensis</i>	L	S		v			
Brush-tailed phascogale	<i>Phascogale tapoatafa</i>	L	S		vP	2A		
Koala	<i>Phascolarctos cinereus</i>	L	S		v			
Great Pipistrelle	<i>Falsistrellus tasmaniensis</i>				v			
Broad toothed Rat	<i>Mastacomys fuscus</i>				v			
Common Bent wing Bat	<i>Miniopterus schreibersii</i>	L			v	2	c	
Greater long eared bat	<i>Nyctophilus timoriensis</i>	V			v			
Eastern horseshoe bat	<i>Rhinolophus megaphyllus</i>					2	c	
Dingo	<i>Canis familiaris dingo</i>						ins	
Eastern broad nosed bat	<i>Scotorepens orion</i>						ins	

IUCN = World Conservation Union  
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E = endangered; L = lower risk, near threatened; V = vulnerable  
 E = endangered; O = recovery outline completed; P = recovery plan completed; S = taxon summary completed; V = vulnerable  
 Cr = critically endangered; E = endangered; V = vulnerable  
 e = endangered; P = threatened species profile completed v = vulnerable;  
 2 = listed on Schedule 2 as threatened; A = action statement completed  
 c = restricted colonial breeding or roosting sites; e = endangered; ins = insufficiently known (suspected of being e, r or v); r = rare v = vulnerable  
 A = action plan completed e = endangered; v = vulnerable



**Table 10A.2 Bird species of the Australian Alps national parks considered significant as rare, vulnerable or threatened, or as migratory species**

Common name	Scientific name	IUCN	EPBC Act	ANZECC list	NSW TSC Act	Vic FFG Act	VROTS	ACT NC Act
Regent honeyeater	<i>Xanthomyza phrygia</i>	E	E	E	e	2A	e	eA
Swift parrot	<i>Lathamus discolor</i>	V	E	V	v	2	e	vA
Glossy black cockatoo	<i>Calyptorhynchus lathamii</i>	V			v	2	v	
Grey falcon	<i>Falco hypoleucus</i>	V			v	2A		
Square-tailed kite	<i>Lophoictinia isura</i>	V			v		v	
Barking owl	<i>Ninox connivens</i>				v	2		
Powerful owl	<i>Ninox strenua</i>	V			v	2	r	
Olive whistler	<i>Pachycephala olivacea</i>				v			
Pink robin	<i>Petroica rodinogaster</i>				v			
Masked owl	<i>Tyto novaehollandiae</i>				v	2	r	
Sooty owl	<i>Tyto tenebricosa</i>				v	2	r	
White-bellied sea eagle	<i>Haliaeetus leucogaster</i>					2A	r	
Turquoise parrot	<i>Neophema pulchella</i>					2	r	
Peregrine falcon	<i>Falco peregrinus</i>							
Latham's snipe	<i>Gallinago hardwickii</i>							

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 e = endangered; P = threatened species profile completed v = vulnerable;  
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 A = action plan completed e = endangered; v = vulnerable

**Table 10A.3 Reptile species of the Australian Alps national parks considered significant as rare, vulnerable or threatened**

Common name	Scientific name	EPBC Act	ANZECC list	NSW TSC Act	Vic FFG Act	VROTS	ACT NC Act
Alpine she-oak skink	<i>Cyclodomorphus praealtus/ Tiliqua casuarinae</i>				2	v	
Alpine water skink	<i>Eulamprus kosciuskoi/ Sphenomorphus kosciuskoi</i>				2	v	
High Plains/ alpine bog skink	<i>Pseudemoia cryodroma</i>				2		
Mountain dragon	<i>Amphibolurus diemensis/ Tympanocryptus diemensis</i>					ins	
Glossy grass skink	<i>Pseudemoia rawlinsoni</i>					ins	
Tree goanna	<i>Varanus varius</i>					ins	
Snowy Mountains skink	<i>Egernia sp</i>						
Skink	<i>Egernia sp. 1</i>						
Skink	<i>Egernia sp. 2</i>						

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Cr = critically endangered; E = endangered; V = vulnerable

e = endangered; v = vulnerable; P = threatened species profile completed  
 2 = listed on Schedule 2 as threatened; A = action statement completed

e = endangered; c = restricted colonial breeding or roosting sites; ins = insufficiently known (suspected of being e, r or v); r = rare v = vulnerable;

A = action plan completed e = endangered; v = vulnerable;

**Table 10A.4 Amphibian species of the Australian Alps national parks considered significant as rare, vulnerable or threatened**

Common name	Scientific name	IUCN	EPBC Act	ANZECC list	NSW TSC Act	Vic FFG Act	VROTS	ACT NC Act
Spotted tree frog	<i>Litoria spenceri</i>	V	E	Cr	e	2	e	
Baw Baw frog	<i>Philoria frosti</i>	E	E	Cr		2A		
Southern corroboree frog	<i>Pseudophryne corroboree</i>	E	E	Cr	e			
Giant burrowing frog	<i>Heleioporus australiacus</i>		V	V	v	2A	r	
Alpine tree frog	<i>Litoria verreauxii alpina</i>	V	V	V				
Northern corroboree frog	<i>Pseudophryne pengilleyi</i>		V	V	v			vA
Booroolong frog	<i>Litoria booroolongensis</i>				e			
Blue Mountains tree frog	<i>Litoria citropa</i>						r	
Eastern banjo frog (montane form)	<i>Limnodynastes dumereli fryii</i>							

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 A = action plan completed e = endangered; v = vulnerable

**Table 10A.5 Fish species of the Australian Alps national parks considered significant as rare, vulnerable or threatened**

Common name	Scientific name	IUCN	EPBC Act	ANZECC list	NSW FIM Act	Vic FFG Act	VROTS	ACT NC Act
Trout Cod	<i>Maccullochella macquariensis</i>	E	EO	Cr	e	2A	e/v	eA
Macquarie perch	<i>Macquaria australasica</i>	D	EO	E	v	2	v	eA
Australian grayling	<i>Prototroctes maraena</i>	V	VO	V		2	v	
Murray Cod	<i>Maccullochella peeli</i>	Cr				2	v	
Two-spined blackfish	<i>Gadopsis bispinosus</i>							vA
Australian bass	<i>Macquaria novemaculeata</i>						r	
Climbing Galaxias	<i>Galaxias brevipinnis</i>						r	
Flat-headed Galaxias	<i>Galaxias rostratus</i>	V					r	
Freshwater Blackfish	<i>Gadopsis marmoratus</i>						ind	
Mountain Galaxiid	<i>Galaxias olidus</i>						ins	
Dwarf flat-headed gudgeon	<i>Philypnodon sp. nov.</i>						ins	

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A = action plan completed e = endangered; v = vulnerable

**Table 10A.6 Insect species of the Australian Alps national parks considered significant**

Common name	Scientific name	IUCN	EPBC Act	ANZECC list	NSW TSC Act	Vic FFG Act	VROTS	ACT NC Act
Alpine stonefly	<i>Thaumatoperla flaveola</i>					2		
Bogong Moth	<i>Agrotis infusa</i>							
Alpine mayflies	<i>Ameletoides lacusalbinae</i>							
Stonefly	<i>Austrocerella hynesi</i>							
Stonefly	<i>Austrocerella verna</i>							
Caddisfly	<i>Austropsyche bifurcata</i>							
Rayed Blue Butterfly	<i>Candalides heathi alpinus</i>							
Caddisfly	<i>Chimarra monticola</i>							
Mayfly	<i>Coloburiscoides munionga</i>							
Reduced-wing Stonefly	<i>Eusthenia venosa</i>							
Caddisfly	<i>Helicopsyche tillyardi</i>							
Kosciuszko Mtn Grasshopper	<i>Kosciuscola tristis tristis</i>							
Stonefly	<i>Leptoperla cacuminis</i>	V						
Stonefly	<i>Leptoperla rieki</i>							
Stonefly	<i>Leptoperla sp. nr. tasmanica</i>							
Spotted grasshopper	<i>Monistria concinna</i>							
Ground beetle	<i>Notonomus carteri</i>							
Ground beetle	<i>Notonomus kosciuskianus</i>							
Moth	<i>Oenochroma alpina</i>							
Alpine Silver Xenica	<i>Oreixenica latalis theddora</i>							
Caddisfly	<i>Polypsectropus lacusalbinae</i>							
Metallic Cockroach	<i>Polyzosteria viridissima</i>							
Stonefly	<i>Riekoperia intermedia</i>					2		
Ground beetle	<i>Scopodes splendens</i>							
Moth	<i>Synemon sp.</i>							
Caddisfly	<i>Tasimia atra</i>							
Mayfly	<i>Tasmanophlebia lacuscoerulei</i>							
Mayfly	<i>Tasmanophlebia nigrescens</i>							
Ground beetle	<i>Teraphis crenulata</i>							
Hairy cicada	<i>Tettigarcta crinita</i>							

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**Table 10A.7 Invertebrate species of the Australian Alps national parks, other than insects and cave fauna, considered significant**

Common name	Scientific name	IUCN	EPBC Act	ANZECC list	NSW/TSC Act	Vic FFG Act	VROTS	ACT NC Act
Murray River crayfish	<i>Euastacus armatus</i>	V						vA
Freshwater crayfish	<i>Euastacus crassus</i>	E						
Freshwater crayfish	<i>Euastacus woiwuru</i>							
Spider	<i>Sternodes castaneus</i>							
Mountain Earthworm	<i>Graliophilus montkosciuskoii</i>							
Mountain Earthworm	<i>Graliophilus woodi</i>							
Kosciuszko Funnel Web Spider	<i>Hadronyche sp</i>							
Wolf Spider	<i>Lycosa kosciuskoensis</i>							
Wolf Spider	<i>Lycosa musgravei</i>							
Wolf Spider	<i>Lycosa summa</i>							
Peripatus, Velvet worms	<i>Onychopora - Peripatoides leuckartii</i>							

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**Table 10A.8 Fauna confined to the caves of Kosciuszko National Park, or there and very few other localities**

<b>INSECTS</b>		
Family Blephariceridae	After a survey of 130 caves in NSW and literature review, this family was recorded only at Yarrangobilly.	1 (see below)
<i>Cavernotettix montanus</i>	In a survey of 130 caves in NSW and literature review, this species was recorded only in two caves at Cooleman Plain and four caves at Yarrangobilly.	1
Family Ptiliidae	After a survey of 130 caves in NSW and literature review, this family was recorded only at Yarrangobilly.	1
<i>Pseudonemadus</i> sp.	After a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<i>Teraphis cavicola</i>	Occurs at Yarrangobilly; draft nomination prepared for listing as Vulnerable in NSW.	2
<i>Teraphis</i> sp. Nov.	After a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<b>OTHER INVERTEBRATES</b>		
? <i>Heterias</i> sp.	After a survey of 130 caves in NSW and literature review, this species was recorded only in two caves at Cooleman Plain and one other cave.	1
<i>Achaeranea extrilidum</i>	After a survey of 130 caves in NSW and literature review, this species was recorded only in two caves at Yarrangobilly and one other cave.	1
Class Symphyla	After a survey of 130 caves in NSW and literature review, this class was recorded only in two caves at Cooleman Plain, three caves at Yarrangobilly and three other caves.	1
<i>Engaeus cymus</i>	In a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<i>Ferrisia</i> sp.	In a survey of 130 caves in NSW and literature review, this species was recorded only at Cooleman Plain.	1
Genus nov. near <i>Laetesia</i> sp. Nov.	After a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<i>Glacidorbis hedleyi</i>	In a survey of 130 caves in NSW and literature review, this species was recorded only at Cooleman Plain and Yarrangobilly.	1
<i>Holonuncia recta</i>	After a survey of 130 caves in NSW and literature review, this species was recorded only at Cooleman Plain and Yarrangobilly.	1
<i>Icona</i> sp nov	A spider troglobite known only from one juvenile specimen from River Cave (Yarrangobilly). No other troglobitic spiders are known from caves in the Australian Alps despite their apparent suitability as glacial refuge areas.	2
<i>Icona</i> sp.	This troglobitic species is confined to one cave at Yarrangobilly and has been proposed for listing under the Threatened Species Conservation Act	JV
<i>Ixodes</i> sp.	After a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<i>Neoniphargus</i> sp.	In a survey of 130 caves in NSW and literature review, this species was recorded only at Cooleman Plain.	1
<i>Olois pictus</i>	After a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<i>Paralaoma</i> sp.	In a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<i>Textricella</i> sp.	In a survey of 130 caves in NSW and literature review, this species was recorded only at Cooleman Plain.	1
<i>Thasyrea lepida</i>	After a survey of 130 caves in NSW and literature review, this species was recorded only at Yarrangobilly.	1
<b>Note:</b>	Bats and their resultant guano are a very important determinant of the type and abundance of cave fauna. The decline in numbers and distribution of bats in NSW caves has had far reaching, but completely unquantifiable, effects on invertebrate communities.	<b>1</b>

1 Eberhard, S and Spate A, 1995, Cave Invertebrate Survey: Toward an Atlas of NSW Cave Fauna, Copyright Dept Urban Affairs and Planning and the Australian Heritage Commission

2 NSW NPWS, 2000b, Yarrangobilly Management Unit Kosciuszko National Park Karst Area Management Plan (draft), NSW NPWS

JV Jo Vincent pers.comm.

Attachment 10B Fauna of Victoria and New South Wales

Table 10B.1 Number of threatened fauna taxa in the Victorian alpine bioregion

Number of taxa		VROTS								Threatened (c,e,v)	
Flora or fauna	Division name	x	c	e	v	l	i	k	r	Total	
Fauna	Mammals		2	5	2	1	1			11	9
	Birds		1	7	8	1	2			19	16
	Reptiles		2		3	1				6	5
	Amphibians		2		1					3	3
	Fish		1	1				1		3	2
	Invertebrates					5		4	5	14	5
<b>Fauna total</b>			<b>8</b>	<b>13</b>	<b>19</b>	<b>3</b>	<b>8</b>		<b>5</b>	<b>56</b>	<b>40</b>

VROTS = Victorian Rare or Threatened Species list

c = restricted colonial breeding or roosting sites; e = endangered; v = vulnerable

Table 10B.2 Number of taxa in each IUCN category and vertebrate class that are included on the Advisory List of Threatened Vertebrate Fauna in Victoria, 2002 version (% of listed taxa).

IUCN Category	Fish	Amphibians	Reptiles	Birds	Mammals
Number of taxa assessed	28	17	49	165	63
XT	0	0	0	0	10 (22)
RX	3 (12)	0	1 (3)	1 (1)	10 (22)
CR	7 (28)	6 (40)	9 (26)	10 (12)	5 (11)
EN	5 (20)	2 (13.3)	11 (31)	25 (30)	11 (24)
VU	5 (20)	2 (13.3)	6 (17)	48 (57)	8 (18)
DD	5 (20)	5 (33.3)	8 (23)	0	1 (2)
NT	3	1	12	41	14
Total listed on advisory list (excluding NT)	25	15	35	84	45
<b>Number of taxa listed under FFG Act</b>	<b>23</b>	<b>9</b>	<b>26</b>	<b>63</b>	<b>33</b>

CR = critically endangered; DD = data deficient; EN = endangered; NT = near threatened; RX = regionally extinct; VU = vulnerable; XT = extinct.





# Chapter 11

# landscape values

*Prof Jamie Kirkpatrick AM*

This section of the scientific report pertains to those natural values that express themselves at the landscape scale, with the exception of geological ecosystem processes, which are covered in Chapter 5, and of biological ecosystem processes, which are covered in section Chapters 6–10. Physical ecosystem processes, relating to fire, air and water, in its many different states, form the central part of this consideration. These can be described in scientific terms. The other natural landscape values addressed in this section are cultural constructs of nature: wilderness and natural beauty.

People are obviously part of nature, but it is convenient in discussing natural landscape values to regard as unnatural the impacts and scale of human activities that postdate gathering and hunting societies, while regarding those of the gatherers and hunters as natural. This convention is adopted below. It must also be recognised that there is no ecosystem in Kosciuszko National Park that is totally natural in the above sense. At one extreme there are ecosystems like ski villages that bear little resemblance to the natural. At the other extreme there are some parts of the park that are dominated by the same trees that grew there in gathering and hunting times, have few or no changes in biotic and edaphic conditions since these times, but have an atmospheric composition and radioactive particles in the soils that are clearly unnatural.

In the continuum from unnatural to natural, it is convenient to classify as natural those areas that have ecosystems that are predominantly similar to those found in the mid eighteenth century, and to leave in the unnatural class villages, dams, roads, powerlines and cultivated land, while recognising that it is possible to improve the naturalness of much land that is classified as natural.

## Physical ecosystem processes - fire, air and water

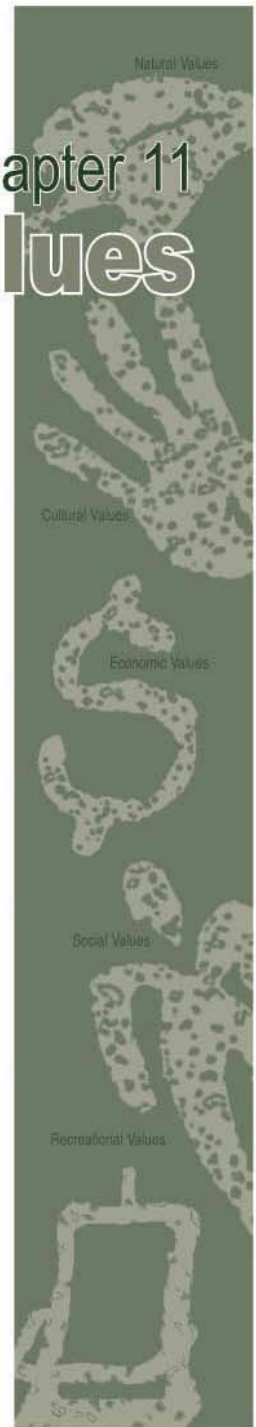
### Introduction

Before people invaded Australia, the biota, landforms, soils and waterforms of Kosciuszko National Park largely evolved in response to physical ecosystem processes, and their variations through time. The exact degree and kind of impacts of gathering and hunting *Homo sapiens* on the expressions of these ecosystem processes in the environment is currently a matter of some debate, especially in relation to the role of *H. sapiens* in the extinction of the Pleistocene megafauna. However, the palynological evidence suggests that the influences of people on Australian ecosystems were subdued, in comparison to the influences of climatic change, until the invasion of agricultural *H. sapiens* in the late eighteenth century (Kershaw et al. 2002).

Temperature, precipitation and fire regimes still strongly influence the biota, landforms, soils and waterforms of Kosciuszko National Park. They are thus critical in the maintenance of other values. They are also, to some degree, values in themselves, as with the importance of snow and cloud in the beauty of the park.

### Basis for management

In section 2A(1)(a) of the *National Parks and Wildlife Act 1974* (1974), the conservation of nature is made an object of the Act. Section 30E (2)(a) makes the conservation of natural phenomena and landscapes a principle in national park management. Section 72A(1)(g) makes the maintenance of natural processes one of the matters that needs to be considered in the drafting of a management plan. Fire and weather are both natural phenomena and natural processes. However, the legal and administrative constraints on fire management in national parks in New South Wales (NSW) relate more to a misperception of the utility of planned burning in preventing the loss of human life and property than to the maintenance of natural processes and the conservation of natural phenomena.



*“Old trees are generally regarded as more beautiful than young, in contrast to the convention with humans.”*

At the national and international levels, the mitigation of climatic change induced by human activity is a widely accepted goal, implying a positive valuation of natural climatic systems.

### Significance

The significance of physical ecosystem processes in Kosciuszko National Park lies largely in their importance in maintaining and creating other values. These, of course, include much of the water supply of Adelaide, most of the irrigation industry of the Murray-Darling basin, and the ski industry of NSW. More importantly, in the context of the present discourse, they are necessary for the perpetuation of almost all of the other natural values of Kosciuszko National Park.

The processes of snow fall, accumulation and melt are particularly critical in maintaining many of the most significant biological and aesthetic values of the park. The park contains the largest contiguous area of snow country in NSW and in Australia, making it of both state and national significance for this phenomenon.

Natural fire regimes, which are partly a function of climate, have created subalpine, montane and lowland landscapes covered with a catena of eucalypts, interspersed with small patches of less fire-adapted vegetation, such as *Atherosperma moschatum* closed-forest, *Callitris* woodland and *Acacia sylvestris* closed-forest. The role of fire regimes is therefore indirectly of potential international significance, as discussed in Chapter 12, related to the eucalypt theme. The fire regimes of the park could not be regarded as natural, even though some evidence from nearby mountains suggests that they more closely approximate the natural than the regimes between European occupation and 1970 (Banks 1982, 1997). The fire regimes thus have no significance in themselves.

### Dependence

Kosciuszko National Park contains almost all of the area in NSW that is covered by snow for more than 30 days a year (Whetton 1998). It contains most of the country in Australia that is covered by snow for more than 60 days a year (Whetton 1998). In Australia, outside the Main Range, there are very few snow patches that last into summer (Galloway et al. 1998).

### Condition and trend in condition

Several tendencies, putatively largely related to human activities at a global scale, have been recognised in the climate of Kosciuszko National Park and adjacent areas since 1900 (Broomhall 1998; Davis 1998; Osborne et al. 1998; Whetton 1998; Hennessy et al. 2003). These tendencies are:

- a decrease in winter rainfall;
- a decrease in snow incidence;
- an increase in temperatures; and
- an increase in ultraviolet radiation.

In most cases the data are not overwhelmingly convincing for the region, but seem highly credible in the context of national climatic change. A striking feature of graphs showing changes in temperature, one major determinant of snow cover, is a rapid rise from 1950 and relatively constancy since 1980. Interpolation of global climatic tendencies to regions is not appropriate, and the best models that have been used are relatively coarse (Whetton 1998). Nevertheless, the balance of the evidence suggests that the proportion of years with low snow cover and duration are likely to increase during this century as a result of global greenhouse warming (Whetton 1998; Hennessy et al. 2003).

Ultraviolet (UV) radiation inputs are sensitive to lower atmospheric conditions as well as to the condition of the ozone layer. The present condition is poor, with UV-B circumstantially, and experimentally, implicated in the decline of frog species in Kosciuszko National Park (Broomhall 1998; Osborne et al. 2002). The medium and longer term prognosis is for improvement, as a result of international success in reducing the release of ozone-depleting substances.

Fire regimes in Kosciuszko National Park over the last forty years probably approximate the natural in alpine vegetation and closed-forest, in that fire has been largely absent from these ecosystems. Elsewhere in the park there are some areas, frequently burned for hazard reduction, that are probably burned more often than in the natural condition, and large areas probably burned less often than in the natural condition. These regimes are taking place in vegetation modified from that which covered the country when occupied by gatherers and hunters. The combination of burning and stock grazing that took place over most of the area occupied by dry and subalpine eucalypt forest and woodland for more than one hundred years has dramatically changed vegetation structure over much of the present park. In some cases this unnatural management resulted in the elimination of trees. In others it resulted in dense stands of regrowth trees where previously woodland with old growth trees predominated. The wet eucalypt forest seems likely to have been burned more frequently than in the natural condition. In recent decades, there have been some extensive landscape fires that have replaced older trees with younger ones.

The desired outcome with physical ecosystem processes is an increase in the degree of their naturalness.

## Pressures

Global warming, and concomitant change in other climatic factors, appears likely to continue even if greenhouse gas inputs were to be dramatically reduced immediately. As there seems little or no prospect that the release of greenhouse gases will be controlled on a global basis, it seems precautionary to plan with the assumption of increasing temperatures and decreasing snow. The expectation of poor snow years, in itself, is likely to increase the pressures to establish more snow-making infrastructure, to engage in cloud seeding and to extend skiing infrastructure to higher altitudes. All of these activities are likely to have substantial negative impacts on natural values and naturalness, as are the climatic changes themselves (see chapter 19, this volume, Scherrer and Pickering (2001); and Hill and Pickering (2002) for a discussion of some of these impacts).

Interim recovery actions may be necessary for species susceptible to morbidity and mortality from UV-B, until natural levels of radiation are achieved.

The major pressure in relation to fire regimes is an inappropriate legal and administrative framework, combined with a wide social and political misperception of appropriate solutions to fire hazard problems. The major misperception is that widespread hazard reduction burning in parks is necessary to prevent loss of property and life outside parks, when CSIRO research has shown that the critical variables are fuel conditions in close proximity to buildings, simple fire protection measures for buildings, and human behaviour as a fire approaches are the critical variables. Hazard reduction burning was of no use in the 2003 fire, when flames moved unhindered through recently burned areas. The other major problem is a reluctance to engage in ecological burns: those burns necessary to maintain or improve naturalness. Given the legal and physical hazards, it is much easier to not burn than burn.

## Opportunities

As down hill skiing becomes more and more dependent on snow-making, serious consideration should be given to investigating the potential for establishment of ski slopes in subalpine and montane valleys outside the park, in places where minimum temperatures are lower than in the alpine zone, thereby facilitating snow-making, and the weather generally better during the daytime.

## Knowledge gaps

There is a strong need for research directed towards developing techniques for unbounded patch burning within the dry eucalypt and lowland grassland ecosystems of the park.

## Indicators and monitoring

Climatic data need to continue to be collected within the park. Best guess ranges of appropriate fire frequencies should be established for the ecosystems of the park and data on actual fire frequency should be compared with these using spatial information system technology. The indicator would be the proportion of area of the park that has had fire regimes within the appropriate range. On ground monitoring of biotic responses to fire will also be necessary to allow adaptive management (ie shifting of the ranges of appropriate fire frequencies in response to increasing knowledge).

## Wilderness

### Introduction

Wilderness constitutes an important recreational resource, and is also highly important for the conservation of nature and natural aesthetic value (Helman et al. 1976; Kirkpatrick 1994a).

Wilderness is land in a natural condition that is remote from mechanised access (Helman et al. 1976; Kirkpatrick and Haney 1980). Remoteness from mechanised access is generally taken to be equivalent to distance from roads, while naturalness is generally taken to be the degree to which the ecosystems, view fields and aural fields resemble those in the mid eighteenth century.

Boundaries between wilderness and non-wilderness are, to some degree, arbitrary. There are several reasons for this: there is a continuum from the natural to the unnatural; the nature of 'natural' is debatable; susceptibility to mechanised access is often more a matter of regulation, and its enforcement, than of infrastructural availability. However, all ways of defining wilderness areas require a core area that is in a close to natural condition and that is remote from roads that are available for general use.

### Basis for management

Wilderness areas are legally defined in NSW by declaration under the *Wilderness Act 1987*. Section 2A(1)(a)(iv) of the *National Parks and Wildlife Act 1974* makes the protection of wilderness and wild rivers objectives of the Act. Under section 72AA(1)(f), the protection of wilderness values is defined as one of the objectives of management plans for national parks.

At the national level, protection of at least 90% of forested wilderness was one of the objectives of the Regional Forest Agreement Process, but is not mentioned directly in the criteria for nationally significant heritage values developed under the *Environmental Protection and Biodiversity Conservation Act 1999*. This act recognises and protects world heritage values.

Therefore, if the Kosciuszko National Park were part of a successful world heritage area nomination in which the maintenance of wilderness would be necessary to maintain world heritage values, national significance would be recognised. The world heritage criteria do not directly mention wilderness. However, the concept of natural aesthetic value present in the world heritage criteria is logically related to wilderness, in that wilderness requires a high degree of naturalness, as does natural aesthetic value.

### **Significance**

In the Kosciuszko National Park there are nine legally recognised wilderness areas, which constitute 346,257ha, or 50.15% of the park (See Map 11.1):

- Byadbo (80,725 ha) - The Byadbo wilderness includes extensive areas of cypress pine and white box woodland in the rain shadow of the alps, as well as some dry montane forest and woodland.
- Pilot (80,168 ha) - This wilderness area contains subalpine grassland and woodland, montane forests, and dry forest and woodland. The Murray River rises within this area, which is contiguous with legally defined wilderness in Victoria.
- Jagungal (67,188 ha) - This wilderness area includes subalpine grasslands and woodland in the snow country, and montane forest in areas of high relative relief.
- Bogong Peaks (28,797 ha) - The Bogong Peaks wilderness ranges from cypress pine woodlands on the lower slopes to subalpine woodlands and heath on the plateau, with rugged country occupied by montane forest in between.
- Goobaragandra (33,666 ha) - This highly rugged wilderness area in the north of the park and consists largely of montane forest and woodland.
- Bimberi (18,004 ha in Kosciuszko National Park, 56,088 ha in total) - The Bimberi wilderness extends from Kosciuszko National Park to other reserves, including Namadgi National Park in the Australian Capital Territory. In the Kosciuszko National Park it covers steep slopes ranging from the alpine environment of Mount Bimberi to dry forest in lowland river valleys.
- Indi (11,636 ha) - This small wilderness area extends from near the Murray River to the Alpine Way, south of Khancoban, on the western slopes of the park. Most of the area is steep and heavily forested, with some areas of old growth.
- Western Fall (15,174 ha) - The Western Fall wilderness encompasses much of the steep western fall of the Main Range. Its steep slopes support much wet eucalypt forest, some of which is old growth.
- Bramina (10,899 ha) – This area at the northern end of KNP is centred on Bramina Hill (1400m), cascading via Cooleman and Bull Flat Creek's deep gullies, to the Goodradigbee River at 700m. Moist montane forests dominate with Alpine Ash and Snow Gum communities at higher elevations.

These wilderness areas do not include some areas of Kosciuszko National Park that are regarded by wilderness users as wilderness, nor are they consistent with any particular threshold for wilderness definition. The official and unofficial wilderness areas have a high degree of significance at a regional and state level. State significance has been recognised legislatively for the wildernesses listed above.

At national and international levels, the wilderness areas of Kosciuszko National Park could be significant on a legal basis if their natural aesthetic values were recognised as part of a successful case for world heritage listing (see natural aesthetic values section below). Nationally, most of the types of wilderness country found in the Kosciuszko National Park are also found in wilderness in Victoria and the Australian Capital Territory. However, this increases, rather than decreases, their potential national and international value as part of a potential Australian Alps nomination (Kirkpatrick 1994b).

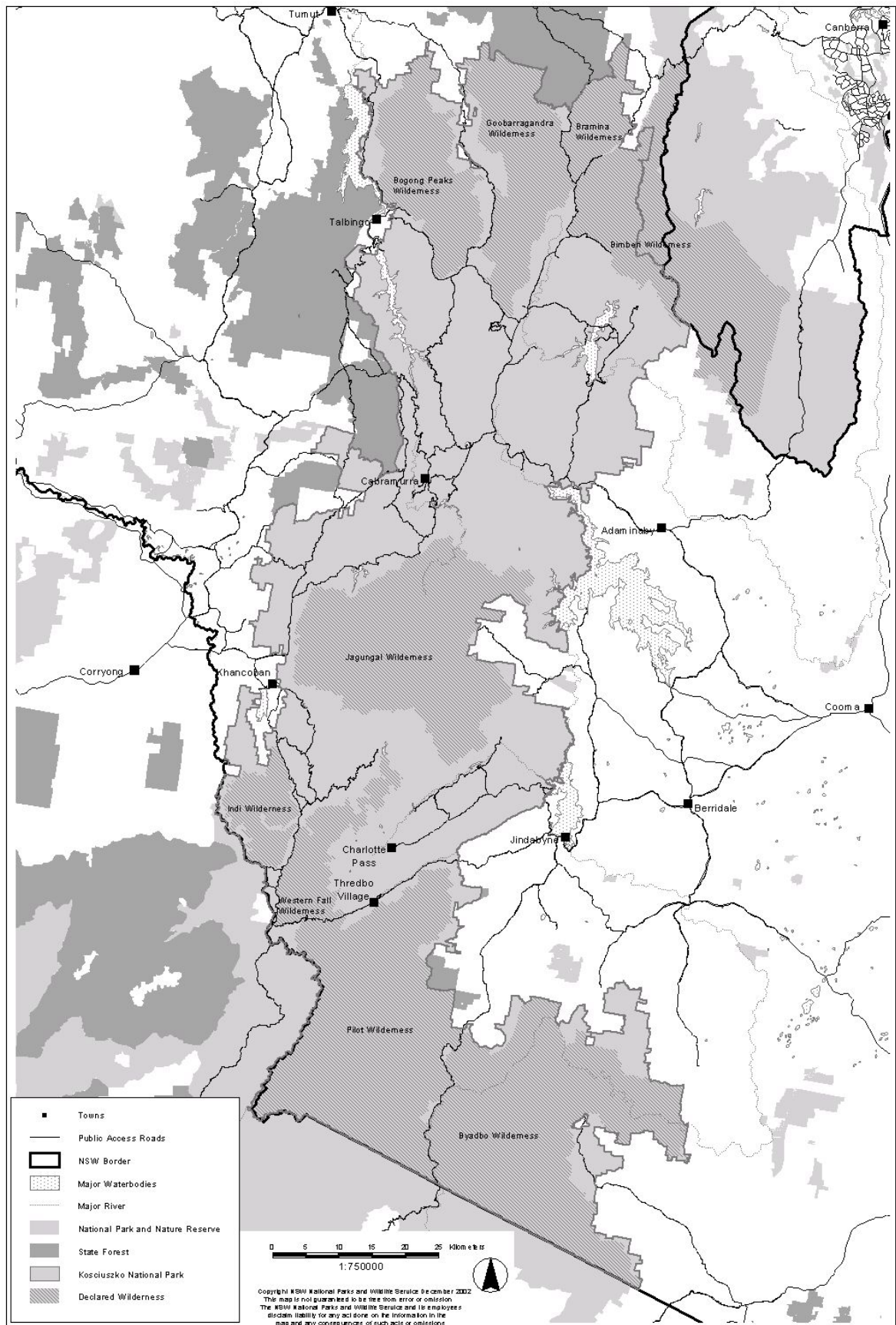
### **Dependence**

Kosciuszko National Park contains 18.6% of the declared wilderness of NSW, while constituting 0.86% of the total land area of the state. The landscapes and ecosystems contained within the Kosciuszko National Park wilderness areas are, with few, and minor, exceptions, absent from the other wilderness areas of NSW. Therefore, these types of wilderness are largely dependent on Kosciuszko National Park for their future in NSW. The dependence is less extreme nationally (see above).

### **Condition and trend in condition**

The National Wilderness Inventory (NWI) provides a technique for measuring the components of the wilderness resource. The results of initial mapping using this technique indicates variable quality in the Kosciuszko wildernesses.

The wilderness areas of Kosciuszko National Park are traversed by vehicle tracks, contain a wide variety of human artefacts, have substantial populations of introduced organisms, and have large areas of soil and vegetation modified by human use since the European invasion of Australia. On the positive side of the ledger, the tracks are not available to recreational vehicles; the artefacts, with a few exceptions, including huts, are no longer functional; the introduced organisms form a small component of the biomass; and the modifications have largely ceased.



The removal of the post-Aboriginal cultural disturbances, such as stock grazing, that changed the soils and vegetation of much of the wilderness areas has placed these areas on a trajectory of recovery to naturalness. Limited data from snow gum woodlands in the nearby Australian Capital Territory (Banks 1982, 1997) suggest that the post 1970 incidence of fire was similar to that in the eighteenth century, after an intervening period of massively increased incidence. This, if maintained, would also tend to result in a return towards naturalness. There is therefore a general trend of improvement in wilderness condition.

The desired outcome with wilderness is maintenance or improvement of National Wilderness Inventory values.

### **Pressures**

The pressures on wilderness values relate largely to the maintenance of naturalness. Unless active management prevents it, there will be continuing growth in the populations of many exotic plants and animals. There is also, in some wilderness areas, some pressure to impose fire regimes designed to reduce so-called 'hazard', rather than to maintain naturalness, and an embarrassing lack of data on the fire regimes that are appropriate to maintain naturalness in some ecosystems. A tendency to exclude fire if there is no evidence to suggest that it is needed can result in a drift from naturalness, as much as the past propensity to burn frequently in the same circumstances.

Potential increased recreational use could result in localised damage in the form of pads, tracks and degraded camp sites, although the resistance and resilience of the ecosystems of the Kosciuszko National Park to these forms of degradation is generally high.

A loss of the feeling of remoteness in some parts of some wilderness areas could result from developments within, and outside, the park that disrupt the naturalness of the view and aural fields.

### **Opportunities**

The major opportunity for improvement of the Kosciuszko National Park wilderness resource lies in vehicle track closure and restoration.

### **Knowledge gaps**

A critical review is needed of the economic, social and environmental benefits and costs of fire trails and other management access roads in wilderness.

### **Indicators and monitoring**

The national wilderness inventory will be updated every five years and changes in values quantified and mapped.

## **Natural aesthetics**

### **Introduction**

Natural aesthetic value is the beauty that people perceive in nature. This beauty may relate to any of the senses. The sounds, smells and feelings of nature are important in the total aesthetic experience. For example, the sound of chainsaws can destroy contemplation of nature, even if no chainsaws are visible. At a landscape scale the non-indigenous cultural perception of visual natural beauty has long related positively to the presence of water and high relative relief (Mendel and Kirkpatrick 1999). Early painters of the Australian Alps, such as Nicholas Chevalier and Eugene von Guerard, imposed their Gothic vision of natural beauty by creating precipitousness where gentleness prevailed (Kirkpatrick 1994b). In contemporary celebrations of beautiful natural landscapes the Gothic is selected, rather than enhanced. For example, there are two landscape scale photographs of the Australian Alps in the 2002 Wilderness Diary (Australian Conservation Foundation 2001). One, not in Kosciuszko National Park, contains a waterfall and cliff. The other shows the steep western escarpment of the Main Range in the background of a magnificent alpine wildflower display. The persistence of wilderness romanticism (Bonyhady 1991) is exemplified.

Natural aesthetic value does not only occur at the landscape scale. It also occurs at the individual and community scales, as in the examples of the Corroboree Frog and tall alpine herbfield in the 2002 Wilderness Diary. Colour substitutes for cliffs.

Natural aesthetic value is not necessarily constant. In a continent in which snow is a rarity, this ephemeral solid state of water imparts considerable natural aesthetic value. Some ephemeral qualities of light and sky are considered beautiful, while others are not. Old trees are generally regarded as more beautiful than young, in contrast to the convention with humans.

### **Basis for management**

In section 2A(1)(a) of the *National Parks and Wildlife Act 1974* the conservation of nature is made an object of the Act. As natural aesthetic values are partly contingent on human perceptions, this object does not necessarily make the conservation of aesthetic qualities an object. For example, a forest recently burned for ecological reasons may not be perceived as being as attractive as one not burned recently. However, by definition, natural aesthetic values cannot persist in the face of artifact, so the conservation of nature provides one prerequisite for the conservation of natural aesthetic value.



In section 2A(1)(b) the Act also makes conservation of cultural values of the landscape an object, firmly placing the maintenance of natural aesthetic values as an implied objective. The principles for National Park management in section 30E reiterate the importance of nature conservation and landscape cultural values. In section 72A(1)(d) the protection of scenic features is required to be taken into consideration in the preparation of a plan of management. These, of course, may be artefactual, natural, or a mixture thereof, but are likely to be natural in a national park.

It is envisaged that the criteria for national significance under the *Environmental Protection and Biodiversity Conservation Act 1999* will include the importance of a place 'in exhibiting particular aesthetic characteristics valued by a community or cultural group'.

Article 2 of the World Heritage Convention makes outstanding natural beauty a component in two of its three clauses that define natural heritage. The criteria developed by the World Heritage Committee to determine suitability for listing include: 'iii. contain superlative natural phenomena or areas of superlative natural beauty and aesthetic importance'.

### **Significance**

There is much steep country, sometimes juxtaposed to water, within the Kosciuszko National Park, but the natural aesthetic qualities that make it an exceptionally beautiful place for many people lie in the pastel pastiche of eucalypts, cypress pines, scleromorphic shrubs and tussock grasses that clothes gently undulating hills and flat-floored valleys, and the mosaic brightness of flowering daisies on the rounded slopes within the alpine plateau, not in cliffs, lakes or torrents, which are in shorter supply, and less extreme manifestation here, than in most mountainous regions of the world.

Many of the invading Europeans found the typical Australian bush harsh and ugly (Taylor 1992). This is not the current perception of most inhabitants of Australia. The Heidelberg School first captured the beauty of the texture, mood and form of the dry eucalypt forest, an untidy, pastel beauty well divorced from that of the, still much-admired, emerald green rainforest. Kosciuszko National Park has 106 ha of rainforest, 0.02% of its area. It has 604, 935 ha of forest and woodland dominated by eucalypts or cypress pines, or 87.62% of its area. Of this, 466,302 ha, or 67.54% of the park, is the dry forest and woodland celebrated by the Heidelberg School. Variations in tree species dominance produce subtle changes in canopy colour melded into topography, while variations in the understorey substitute different sets of flowering grasses, herbs and shrubs, depending on moistness, soil type and disturbance history. In recently burned forest, delicate native orchids and lilies flower abundantly among blackened stems.

Most of the 80,363 ha (11.64%) of the park covered by herbfield and grassland produces outstanding wildflower displays in late spring and throughout summer (Costin et al. 2000). Even before the peak of flowering there is a wondrous variation in foliage cover in the vegetation mosaics of the alpine country and limestone plains. There are even a few lower altitude valley grasslands where grey kangaroos emerge from the red heads of the dominant kangaroo grass. Such scenes were once common in much of south-eastern Australia, but are now rare (McDougall and Kirkpatrick 1994).

The Main Range in the Kosciuszko National Park is one of the few areas of Australia where snow can still be relied upon to sit through winter and persist, in small patches, until early summer. Snow, at its peak, submerges the treeless areas and decorates the twisted subalpine trees. In its recession it highlights both the geomorphological complexities of the landscapes and the fresh life that emerges as it melts.

The natural scenery of Kosciuszko National Park is definitely of state and national significance. Both its wildflower displays and its snow-garnished slopes and forests exhibit aesthetic characteristics highly valued by a large proportion of the population, as is evidenced by the high frequency of their depiction in popular publications, and the popularity of the park for tourists.

Kirkpatrick (1994b) argued that the Australian Alps as a whole had outstanding universal significance for natural aesthetics in that they presented an 'unique combination of gently rounded slopes, highly floriferous alpine vegetation and the pastel untidiness of the eucalypt forest'. The fact that this combination of qualities is not one that conforms with the Eurocentric romantic vision of mountains as places of steep, crumbling, icy grandeur should not detract from its international significance, given that there is wide intercultural and intracultural variation in aesthetic perception (Dearden 1984). The presence of persistent snow is not a great selling point at the international level. The Kosciuszko National Park provides the core of the natural aesthetic qualities of the Australian Alps that may have international significance.

### **Dependence**

The only other large area of persistent snow country in Australia lies in Victoria, where its wildflower displays are destroyed by cattle; and roads, dams and ski villages markedly reduce naturalness. Therefore, the persistence of the natural aesthetic values associated with the snow country and adjacent eucalypt clad slopes depends largely on the maintenance of naturalness in the Kosciuszko National Park.

### **Condition and trend in condition**

View fields are the critical variable in gauging the natural scenic condition. Kirkpatrick (1979) developed a technique that allowed disturbance to the view field to be calculated. This visibility disturbance score was the percentage of the arc of visibility from the highest point in a grid square that contained roads, quarries, artificial impoundments, cleared land, buildings or forestry activity.



In deriving an ultimate score the types of disturbance were weighted with roads, quarries and human artefacts weighted more heavily than less visually disruptive disturbances.

The present visual natural aesthetic condition of Kosciuszko National Park varies from extremely poor in the vicinity of ski resorts, hydroelectric infrastructure and roads in open country; to poor where impoundments, cleared land and forestry activities are visible; to excellent in the heart of much of the wilderness country. Unfortunately, the areas that have the least natural views are among those most visited.

Most of the park is remote enough from settlement and mechanized human activity to allow the sounds, smells and feelings of the bush to dominate. However, unnatural sounds can penetrate large distances in particular weather conditions, even where there is no visual disturbance. No noise mapping or monitoring has been undertaken.

The trend in condition is negative as a result of the ongoing development of skiing facilities, increasing traffic on the roads and ongoing development outside the park that is visible within it.

A desired outcome is to reduce the total visibility disturbance score by 2010.

### **Pressures**

The tendency towards declining snow incidence (Green 1998), if continued, may create pressure for a movement of ski infrastructure to higher altitudes and for more snow-making, an activity that requires water, and, therefore, dams. Even if snow cover does not decrease we can expect pressure for further expansion of ski infrastructure. Further development could also be expected to occur around the margins of the park, particularly holiday home construction, with potential visual and aural effects.

### **Opportunities**

It is possible to increase natural visual amenity in a variety of ways. Hard features, such as quarries, roads, buildings, sewage ponds, dams and transmission lines can be muted or screened. Inappropriate developments of lesser visual impact, such as golf courses, can be restored to natural vegetation. Natural visual and noise management can be incorporated into all planning processes, including those in the adjacent local government areas. It will be important to concentrate on those screening, restorative and preventative activities that impact most on the greatest number of people. This does not necessarily relate solely to their numbers. For example, the old road to Mount Kosciuszko disrupts the natural scene from the highest elevation on continental Australia. Given that a large number of people walk a substantial distance, for most, to attain this icon, its disruption is more severe than if it were visible from a roadside viewpoint.

### **Knowledge gaps**

Viewfield analyses are needed as a basis for decision-making. Social research may be necessary to determine natural aesthetic usage throughout the park and the nature of people's perceptions of gradations of naturalness. The above research will be able to be used to develop priorities for action that will minimise cost while maximising social and environmental benefit. There are no data on the penetration of unnatural noise into the undeveloped parts of the park.

### **Indicators and monitoring**

Visibility disturbance could be scored and mapped in the year of the commencement of the plan, and at least every five years thereafter, including 2010. Noise monitoring at selected critical sites is needed.

# Chapter 12

## fire values

Bruce Leaver<sup>1</sup>

### Introduction

Fire management is an integral part of the management of other features and values within Kosciuszko National Park. Fire has influenced, and will continue to influence, the occurrence and distribution of vegetation communities and some species. Similarly, fire can have deleterious impacts on the soils of Kosciuszko National Park, particularly the organic soils of the alpine and subalpine zones.

Fire management in Kosciuszko National Park has always been, and remains, controversial, even though considerable research has been undertaken over the past 30 years on fuel accumulation, fire behaviour, fire effects and impacts. In the late 1940s, wildfire was recognised as a major threat to mountain catchment stability and the operations of the Snowy Mountains Hydro Electric Scheme. In 1951, the Hume-Snowy Bushfire Council was established to coordinate wildfire suppression and to plan and coordinate prescribed burning programs. The council operated until 1985, when its role and functions were passed to the National Parks and Wildlife Service (NPWS).

Fire management in the park has developed since that time, from a very simplistic approach of attempting to suppress all wildfire ignitions together with an annual program of fuel reduction, to an approach based on ecological principles that provide for sound nature conservation, catchment stability and the maintenance of an acceptable level of risk from wildfire impacts on infrastructure, neighbours and park users (Good 1986).

### Vegetation type and fire risk

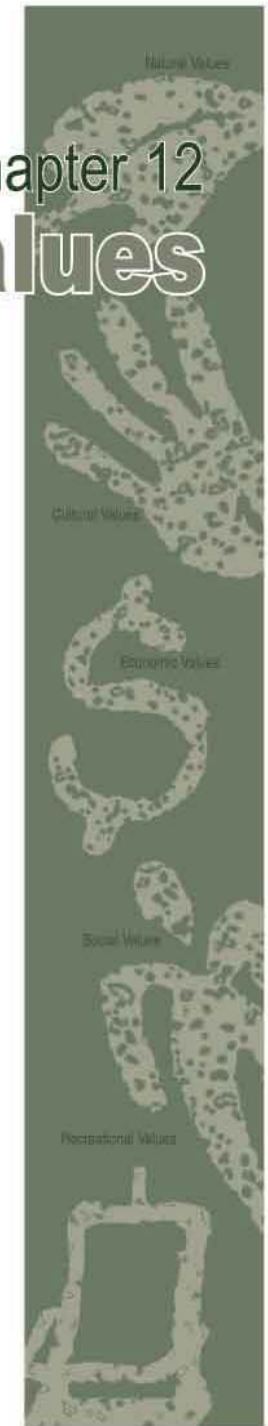
The boundaries of Kosciuszko National Park are generally arbitrary land tenure boundaries. Vegetation and fuel patterns are often contiguous across the landscape, paying no regard to land ownership or reserve status.

The vegetation of Kosciuszko National Park is a complex of vegetation types that vary with altitude, aspect, rainfall and fire history. Each type produces fuel of different rates, levels of accumulation and different presentations of combustible fuel to fire. Bushfire hazard depends largely on the likelihood that high-intensity wildfire will adversely impact on natural or economic assets, and on the capacity to contain potential wildfire in conditions of fuel availability and adverse meteorological conditions across fire-dangerous topography and wind direction.

The complexity of fire in Kosciuszko National Park compounds when the nature of different potentially serious fire seasons is taken into account. A hot dry summer following a high-precipitation winter produces copious grass fuels at lower altitudes, posing a fire intensity hazard in those eastern sections of the park that abut natural or economic assets. However, the high-fuel montane forests and subalpine areas then show green uncured grassland-woodlands or moist compacted fuel beds, forming a barrier to the ignition or spread of high-intensity wildfire.

On the other hand, a summer season that has been preceded by a period of protracted low rainfall presents a quite different hazard regime. The lowland forests and adjacent grasslands have little cured grass fuel and thus have little potential to carry a high-intensity wildfire. In contrast, the higher-altitude forests have beds of deep dry fuel and thus have a capacity to carry high-intensity wildfire under suitable conditions.

<sup>1</sup> Roger Good (NSW NPWS) coauthored this paper at the request of the Independent Scientific Committee



*“Fire management is an integral part of the management of other features and values within Kosciuszko National Park.”*

Managing fire in Kosciuszko National Park thus presents the challenge of bringing together a complex amalgam of park and regional assessments of vegetation type (and thus fuel accumulation characteristics), topography, asset distribution and potential fire suppression influences.

Other management objectives have to be woven into this complex equation, particularly catchment management elements and nature conservation objectives. The biggest problem facing the management of fire in Kosciuszko National Park is oversimplification. Simplistic solutions to complex biophysical problems rarely work and may produce unjustified and potentially dangerous overconfidence. The first step facing fire management planning is to gain an understanding of the vegetation–fuel relationship. A description of this relationship is presented in Attachment 12A.

## **Evolution of fire management in Kosciuszko National Park**

### **Aboriginal use of fire**

Fire ‘management’ could be considered to have commenced with Aboriginal occupation of the tablelands and foothills of the Snowy Mountains, when annual summer pilgrimages to the high country for ‘bogong feasts’ and other intertribal ceremonies became part of their summer seasonal activities.

The Aboriginal tribes of the alps areas did light fires in the high country during their summer tribal gatherings, to smoke out the bogong moths and to cook them. No documentary evidence exists on whether wildfires occurred directly as a result of this Aboriginal use of fire but it can be accepted that infrequent fire escapes may have occurred and burnt over small areas of the mountains. Only small areas would have been burnt, as the feasts were predominantly held at or above the tree line where a ‘summer green’ growing season would have prevailed in all but very infrequent drought years.

### **The European settlement and grazing era**

The introduction of domestic sheep and cattle grazing into the mountains by the early European settlers also introduced a major change in the occurrence, frequency, extent and distribution of fire, producing a very different fire regime to that under which the greater part of the high-mountain vegetation had evolved. This was particularly so in the upper subalpine and alpine zones where much of the summer ‘snow lease’ grazing was carried out.

The graziers burnt their lease areas toward the end of each summer grazing period, if and when seasonal conditions were suitable. This annual burning aimed to encourage a greater growth of the grasses and herbs (a ‘green-pick’) in the following spring and summer, and to suppress the growth of ‘useless’ shrubs. Grazing had a physical impact on the herbaceous grasses and inter-tussock herbs, leading to the degradation of the vegetative cover and subsequent erosion. Unfortunately, however, the regular burning increased the rates of drying of the remnant herbaceous and litter cover, actually increasing the capacity to burn each year and so leading to a greater risk of wildfire. The impact of grazing and burning was most noticeable in the Mount Kosciuszko summit area, where very severe and widespread erosion was evident. The regular and frequent burning of subalpine and montane forests and woodlands to suppress shrub understoreys only exacerbated the snow lessees’ shrub ‘problem’ (Good 1980, 1982, 1998).

The regular low-intensity burning favoured many shrub species, particularly the leguminous species such as *Bossiaea foliosa*, *Daviesia latifolia*, *Oxylobium alpestre*, *Hovea purpurea* and several wattle (*Acacia* spp). These species all produce a high percentage of hard seed that remains viable in the soil for many years as soil-borne seed reserves. The regular burning favoured the regrowth of these species through the heat scarification of the hard seed and through the continual provision of a disturbed or denuded seed-bed suitable to the rapid regeneration of shrub species. This regrowth was at the expense of grasses and inter-tussock herbs. As more and more shrubs established, the graziers had to undertake more burning, the end result being that they were tied into an irreversible cycle of burning and grazing (Good 1982, 1998).

In the 1890s, Helms (1893) and Maiden (1898) both noted the impacts of grazing and burning, but it was a report by Byles (1932) on the condition of the forested areas of the mountains that alerted the scientific community to the detrimental impacts of regular and frequent low-intensity burning on the upper catchments of the Murray, Murrumbidgee and Snowy rivers.

Unfortunately, the concerns of Maiden, Helms, Byles and the scientific community were not heeded and the burning practices continued unabated for another 20 years. This meant that when the removal of domestic stock from the mountain catchments commenced, the catchments were very unstable in terms of vegetative cover and were actively eroding over large areas and dominated by shrubs in other areas. Ironically, a very hazardous fire situation existed at this time, in terms of fire ignition potential, shrub and fine litter fuel levels - a situation created by prevailing burning practices.

### **The Hume–Snowy Bushfire Prevention Scheme and Bushfire Council**

The Snowy Mountains were gazetted as an area of erosion under the Soil Conservation Act 1938, but it was only when the proposals for, and the planning, development and construction of, the Snowy Mountains Hydro Electric Scheme commenced that there was ‘formal’ recognition to the need for better catchment management. Effective wildfire control and suppression were seen as an essential component of this catchment management.

The Hume–Snowy Bushfire Council (HSBC) and the Hume–Snowy Bushfire Prevention Scheme (HSBPS) were established in 1951 to coordinate the cooperative fire prevention activities of the HSBC's constituent members - local government, the Forestry Commission, the Soil Conservation Service, the Kosciuszko State Park Trust (later the NPWS), the Snowy Mountains Hydro-Electric Authority and the rural community. Other interested agencies and organisations joined the HSBC in later years.

The HSBC's fire prevention programs were based on the following (HSBC Fire Management Plan, circa 1970):

*Experience in eastern Australia shows that the control of major forest fires and mitigation of damage in dangerous fire seasons can only be accomplished by burning back from, or steering fires into natural barriers, or fuel reduced areas of sufficient size to moderate extreme fire behaviour and give suppression a chance of achieving its objective .*

In the early years of the HSBPS, the Bushfire Council developed proposals for fuel reduction burning over more 70% of the park (later up to 93% with the inclusion of the Byadbo lands, previously managed by the Monaro Bushfire Prevention Association). The only area excluded from the planned burning program was the alpine area above the treeline. Prescribed burning blocks of 6000–10 000 acres (2500–4200 hectares) were identified across the park and burning was arbitrarily implemented in several blocks each year, so that all blocks would be burnt on a 7–15 year cycle, with the aim of reducing the fuel loads on each block to below 10 tonnes per hectare. This program took no cognisance of the probability of wildfire ignition and there was no assessment of the relative potential for impact on park infrastructure, natural values, conservation objectives and the lives and property of neighbours and park users.

The annual burning program continued through the 1950s, 1960s and early 1970s; all but a few blocks were burnt at least once, with many burnt two, three or more times. This program continued until it was questioned by fire managers and ecologists from the NPWS and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The NPWS subsequently took a greater role and responsibility in the planning of fire mitigation (including prescribed burning) programs.

While the objectives of the HSBPS may have been based on acceptable premises, the three decades of fuel reduction burning had as great a detrimental impact on the forest and woodland vegetation, and the soil stability of the park, as the many years of grazing. Ecologists from the NPWS and CSIRO argued that the very regime that was being implemented by the HSBC to 'protect' the catchments was resulting in catchment degradation, not in catchment stability. This was due to a lack of understanding of the complexities of fire physics in mountain environments; in particular, the relationship between fire behaviour, fuel types and fuel structure, fuel accumulation rates, flammability and the range of ground vegetation cover needed to prevent soil instability and erosion. Many individual burning blocks covered a wide elevation range and included varied topographic features, so that acceptable prescribed burn fire behaviour (rate of spread and intensity) could not be achieved across a block. Instead, areas of no burn and areas of crown scorch usually resulted (Good 1986). A number of major wildfire events also occurred as a result of burns in blocks of widely varied elevations and micro-climatic and topographic environments.

In 1981, a review of the management arrangements was undertaken. An assessment of the HSBC's fuel reduction records indicated that the council's objectives for fuel reduction burning had been achieved on less than 10% of the total block area and that no assessment of the success or otherwise of any year's program had been undertaken to form a basis for planning of further burning in following years. There was no instance where the burning program had any influence on the outcome of subsequent wildfire suppression operations. In 1982, the HSBC agreed to a timetable for the transfer of responsibilities to the NPWS. This transfer was completed in 1986 and the HSBC was subsequently dissolved. The NPWS significantly upgraded its fire management capacity to facilitate the transfer. This included the hiring of professional fire management and support staff and equipment, supplemented by a program of fire management training. A fire management plan was subsequently prepared within the framework of the park management plan in 1998. The plan was prepared in consultation with communities around the park. NPWS is also a member of the bushfire management committees that cover the shires around and including Kosciuszko National Park, and has cooperative arrangements with Victoria and the Australian Capital Territory for cross-border management of fire.

## **Fire management objectives, planning and programs**

The main objectives of the Kosciuszko National Park Fire Management Plan are to protect human life and property; and to conserve the park's natural and cultural features, catchment values and recreational opportunities.

The fire management plan identifies, and contains management strategies for, areas of bushfire risk and areas requiring protection from fire because of their natural and cultural values. It includes strategies to reduce the risk that bushfires will damage residential areas, recreational areas and assets within Kosciuszko National Park, or spread from the park to neighbouring townships and property. Examples of strategies to reduce risk include:

- prescribed fire or slashing to reduce or modify fuels
- maintenance of trails for fire access
- active fire investigation of illegal fire events
- training and education programs to increase awareness of issues related to fire.

The plan identifies environments, vegetation communities and animal habitats where a lower fire frequency is needed to protect biodiversity and catchment values. Fire management within the park is ecologically based, with a basic objective of excluding fire from most vegetation communities for between 15 and 50-plus years.

### **Subalpine woodlands**

A very high level of protection from fire is desirable in alpine, subalpine and frost hollow areas, moist forests and river valleys of the park. This is a very specific objective for the subalpine woodlands. The structure of the subalpine woodlands was dramatically changed over the many years of grazing and as a response of the vegetation to the poorly planned and implemented 'prescribed burning programs' of the HSBPS. At the time of writing, the greater part of this snow gum woodland remains in a young-age condition, existing as a dense mallee form of woodland (Good 1980, 1986, 1998). This is in contrast with the very small remnant areas of old-age snow gums that are still in very open woodland communities, with large-diameter single-trunk trees at a density of less than 50 per hectare. Research by Barker (1989), Banks (1982, 1989) and Good (1982) indicates that the number of trunks per tree has increased in regularly burned areas, from one to three trunks per tree to up to 40, with the number of trees per hectare having increased from under 50 to 6000–7000 per hectare.

The young-aged woodlands (about 50 years) provide little opportunity at this time for any planned ecological burning for vegetation and habitat manipulation. Until the majority of the snow gum community reaches an old-age class (> 100 years), it will not be possible to plan fire regimes that are appropriate to its long-term conservation. An appropriate fire regime would allow the creation and maintenance within the community of the age, species and structural diversity that would provide optimal habitat for the suite of fauna species which use the subalpine woodlands (Parks 1975; Good 1982, 1986).

Similarly, a long period without fire is necessary to allow the dense understorey shrub communities to senesce and to be replaced by a stable grass understorey. Research indicates that this cycle of shrub growth and senescence will occur over a period of 50–70 years, so a further fire-free period of at least 20–30 years is still required for this to take place.

A subalpine woodland with a grassy understorey provides for a greater decomposition rate of the annual litter fall and higher fuel moisture conditions, resulting in a low fire ignition potential in all but the driest years. In this situation the fuel levels may well be above the perceived hazardous level of 10 tonnes per hectare, but are not in a flammable condition. Fuel levels as such in the subalpine woodlands and upper montane forests do not equate with high fire danger or high fire ignition potential or probability. This low fire ignition probability is enhanced by the fact that the growth season in the high country is summer; hence a 'summer green' exists in most years, which itself reduces the chance of fire ignition and occurrence (Good 1982).

### **Alpine ash communities**

A number of other specific ecological fire management issues have been identified and need to be effectively addressed in any fire management planning. One of these is the specific fire regime required for the fire-sensitive alpine ash (*Eucalyptus delegatensis*) communities. This species requires a high-intensity fire once in its lifecycle, at a frequency of about 100–150 years. Such a fire kills the adult standing trees but provides a disturbed and litter-free seedbed for the germination and growth of the large soil-borne seed reserves and for the seeds released from seed capsules during the passage of the fire. The exclusion of fire from these forests for many years, to allow the species to mature and set seed, is an objective of current fire management, even if it demands the loss of some conservation values in small areas of other communities surrounding the alpine ash forests (Good 1980).

### **Cypress pine and white box woodlands**

Other issues are the cypress pine (*Callitris* spp) and white box (*E. albens*) woodlands of the lower Snowy River, the black scrubs (*Acacia sylvestris* - *Eriostemon* spp) of the Byadbo area, and the cold-air drainage grasslands valleys in the north of the park. Also, in that part of the park, fire management has to take account of the potential impacts of any fires on the limestone cave systems at Yarrangobilly, where smoke and ash may discolour the cave formations and impact on cave hydrology (A Spate, Optimal Karst Management, pers. comm., 1996 and 1998).

### **Catchment issues**

Catchment issues, particularly catchment hydrology and stability, also require specific consideration. During the many years of fuel reduction by the HSBPS, catchment soils were regularly exposed to potential erosion as a result of the reduction of fuels (litter and herbaceous cover) below a level that provided for soil protection and stability. Catchment research in the 1970s and 1980s (Costin 1970; Good 1982, 1986) indicated that most soils on moderate to steep slopes required from 10 to 25 tonnes per hectare of organic matter (litter etc) to provide for stability, so there is an obvious conflict between fuel reduction programs and catchment management over much of Kosciuszko National Park.

This 'conflict' in objectives can be noted from Table 1 where data for three major soil groups in the Snowy Mountains indicate that, on slopes in excess of 15 degrees, fuel loads in excess of 10 tonnes per hectare are required to reduce post-fire soil erosion. As prescribed burning for hazard fuel reduction is generally based on reducing fuel loads to below 10 tonnes per hectare, an obvious catchment management and fire management conflict has to be resolved as part of the planning and implementation of prescribed burning in these significant mountain catchments (Good 1982, 1986).

While the need for, and application of, fuel reduction burning in the montane and subalpine zones has been questioned and is now not widely applied, prescribed burning in the lower elevation forests and woodlands has not been challenged in the same way.

It should be challenged, as these woodlands, particularly the white box woodlands, yield very little litter with the maximum fuel loads seldom accumulating above 9–10 tonnes per hectare. Hence the maximum levels of fuel in these woodlands are below the 10 tonnes per hectare quoted as necessary for fuel reduction programs.

**Table 12.1 Fuel loads required to reduce post-fire soil erosion, for three soil types on slopes up to 30 degrees**

Slope class (degrees)	Soil type				
	Podsollic		Solodics		Solodised
	Red	Yellow	Red	Yellow	Solonetz
	Litter loads (tonnes per hectare)				
< 2	2	2	3	3	3
2–5	2	3	4	4	4
6–10	3	4	5	5	6
11–15	4	5	6	7	8
16–20	8	10	10	12	12
21–25	12	12	14	14	16
26–30	16	16	18	18	20
> 30	> 20 tonnes per hectare				

Source: Based on data from Good (1986)

Fire management planning must also identify:

- the risk of certain wildfire scenarios occurring
- the 'life and property' under threat of impact from fires that may occur regularly in any one area /site
- the impact of these fires on the native vegetation
- the potential of regularly burnt areas to impact on catchment stability and to favour alien plant establishment.

The potential sources of high-intensity fire ignitions, and their potential and history of spread into and out of the park, also need to be identified and quantified through a hazard risk assessment process that the NPWS has developed (Good 1982, 1986). These areas are or will be the sites and areas where fuel reduction burning should be undertaken for the protection of life and property. This currently amounts to an area of approximately 30 000–40 000 hectares, or approximately 7% of the park. This contrasts with the area that the HSBPS regularly attempted to burn for fuel reduction: an area in excess of 500 000 hectares, or about 80% of the park.

Other areas within the park have been identified for prescribed burning but the proposed burning is for ecological purposes (vegetation and habitat manipulation), not for fuel reduction. The integration of weed and exotic plant management is an essential part of this fire management.

### **Prescribed burning - a social as well as a management issue**

All land management agencies have an obligation to undertake ecologically sound fire management planning and to implement effective wildfire mitigation programs. The greater part of fire management is based on the management of fine litter ground fuels, this largely being achieved through the application of prescribed burning (planned application of low intensity fire). Prescribed burning, also referred to as hazard fuel reduction burning, protection burning and controlled burning, is the planned application of fire under a prescribed set of weather conditions; the prescribed or defined outcome is an effective measure of protection against the adverse impact of high-intensity wildfire.

The principles of prescribed burning are well founded but unfortunately the application of such burning is often poorly planned and executed. This has resulted in many fire escapes, resulting in uncontrolled wildfire, excessive scorch height of the overstorey vegetation, and many cases of unacceptable impacts on native flora and fauna and catchment stability.

As a result, the increasingly widespread application of prescribed burning, particularly in nature reserves, national parks and other protected natural areas, has been criticised and is of continuing concern to many professional and community interest groups alike. These concerns arise mainly from the lack of detailed data on the impacts of prescribed burning on the native biota.

A greater concern is that prescribed burning is often implemented for 'fuel reduction' with little or no quantification of the actual fuel loads at the time; nor of the fuel structure or the rates of decomposition of litter and hence the rates of fuel accumulation following a prescribed fire.

Similarly, little or no quantification of the hazardous nature of various fuel complexes is evident in most prescribed burning plans, the assumption being that fuel loads exceeding 10 tonnes per hectare all pose a high fire hazard. Even where such fuels pose a high hazard in terms of their potential high intensity if they were to burn in a wildfire, the risk of such a fire occurring is seldom assessed.

Therefore, the natural area land management program that is potentially most significant continues to be implemented with little or no knowledge of the very component of the environment that managers are endeavouring to manipulate, modify or reduce.

One of the unfortunate social consequences of the debate on prescribed burning is that it tends to overshadow and thus negate discussion on the development and implementation of other effective fire protection policies and measures (Leaver 1988). Specific areas prone to high-intensity wildfire can be accurately predicted, so it is possible to preclude developments and investments in these lands, by using restrictions similar to those applied in areas subject to other natural hazards such as flooding and landslip. As long as the community is diverted by the seemingly effective panacea offered by prescribed burning, the need for effective measures is ignored. Such measures could include:

- strategic fuel reduction (including prescribed burning) in areas where it can be effective;
- exclusion of residential and other asset development in fire prone lands;
- making assets fire resistant;
- ensuring that those involved in fire management have a basic understanding of fuel dynamics and fire physics.

Ignorance about fuel dynamics and fire physics can have tragic consequences.

One of the most dangerous misconceptions about the impact of reduced fuel loads on fire behaviour is that rate of spread of wildfire is reduced in extreme conditions. This is not the case.

Often too many eggs are placed in the prescribed burning basket. If the program is designed to reduce remote forest fuel loads then the practical reality is that in many years, a burning program is not practicably achievable because of weather conditions and, when achievable, the impacts are often as bad as the wildfire that was to be excluded by the practice.

### **A new consideration for fire management planning - prescribed burning and predicted global warming**

An expanded 'commitment' to prescribed burning is also being carried out across New South Wales with little or no assessment for smoke management and public health. For example, almost every year extensive prescribed burning along the New South Wales south coast and escarpment results in a smoke pall extending over the coastal plain with a consequent potential impact on asthmatics and allergy sufferers. Of concern is the more long-term impact of the contribution to greenhouse gas emissions of these regular and extensive fires together with the infrequent wildfires (Good 1998). These contributions have never been assessed or quantified but some guide can be gained from studies of a fire of approximately 40 square kilometres, where some 20 000 tonnes of carbon dioxide were calculated to be released to the atmosphere along with 3000 tonnes of particulate matter. For wildfires and prescribed burning in an average fire year, this would equate to some 5 million tonnes of carbon dioxide, 1.5 million tonnes of methane and 750 000 tonnes of particulate matter being dissipated into the atmosphere.

In comparison to the total emission of greenhouse gases by primary and secondary industries, the contribution of these gases from the burning of biomass during wildfires and prescribed burning is very small: approximately 2% of the total. However, it is important to note that these figures relate only to the burning of the fine fuel components of the fuel complex, and do not include the large fuels (logs etc) that may burn and smoulder long after the passage of a fire front. These fuels could increase the contribution of carbon dioxide by a factor of four or five.

The release of greenhouse gases from biomass burning may not all be detrimental but certainly will require a rethink in terms of prescribed burning and fire management. Carbon dioxide concentrations in the atmosphere are currently around 370 ppm, some 20% higher than they have been in the last 150 000 years (Spate 1994). Research by Gifford (1991) suggests that if the carbon dioxide concentrations in the atmosphere were to double to 700 ppm in the next 20 years, plant growth and yield could be increased by as much as 30–40%.

Other climate models (Pittock and Nix 1986) indicate a possible 0–40% change from north to south of the continent as a response to the gradual movement poleward of the general climatic zones. This would provide for wetter summers and drier winters over central and south-eastern Australia. Another modelled scenario (Wright 1992) indicates a general 20% increase in windiness and a 20% decrease in humidity. If this were to be the case, the measure of possible wildfire occurrence (the fire danger index) would increase dramatically over southern Australia by about 38% and in the south-west by 13–17%. This scenario indicates a possible increase in the occurrence of high-intensity wildfire, while that proposed by Gifford and by Pittock and Nix suggests that the occurrence of wildfires would decline in southern Australia as summer rainfall increases.

Depending on which scenario eventually arises, the contribution of biomass burning could dramatically increase or decrease with the predicted increase in global warming. If the incidence of wildfires decreased, the need for extensive prescribed burning for hazard fuel reduction purposes would be similarly reduced and the total contribution to greenhouse gas emissions would decline. The alternative is an increase in wildfire occurrences and, if current practices are followed, a consequent increased demand for prescribed burning and further increases in greenhouse gas emissions from fire management programs (Good 1998).

Fire management planning and skills in implementation will have to improve greatly if the latter scenario eventually arises. A sound knowledge of fuel complexes, an appreciation of fire behaviour and an understanding of ecosystem processes relative to fire will be essential skills for natural area and fire management personnel, if we are to meet the challenge of fire management and at the same time make a worthwhile contribution to a reduction in greenhouse gas emissions.

### **The significance of fire management - implications for the plan of management**

Fire management is an integral part of the management of other features and values within Kosciuszko National Park and influences the capacity to implement other management strategies and to achieve planned management outcomes. Fire influences the occurrence and distribution of vegetation communities and of some species. The native vegetation in Kosciuszko National Park has evolved over thousands of years, under the direct influence of fire regimes, and all plant species have developed adaptations (survival traits) to enable them to complete their life-cycles and to survive the impacts of high-intensity fire. Many species depend on fire to some degree to assist the release of seed stored in capsules, the scarification of hard seed and the clearing or disturbance of a seedbed suitable for the germination of seed and the growth of young seedlings such as alpine ash (*E. delegatensis*) and leguminous shrubs, *Daviesia*, *Oxylobium*, *Pultenaea*, *Bossiaea* and *Acacia* spp.

Similarly, fire can have deleterious impacts on the soils of Kosciuszko National Park, particularly the organic soils of the alpine and subalpine zones (alpine humus and transitional alpine humus soils). The combination of wildfire and prescribed burning over these soil types reduces the vegetative cover, exposing the underlying soils to drying, breakdown and eventual soil erosion by wind and water run-off. Soil, vegetation and natural wildfire occurrence are intricately linked in a functional ecological system.

Wildfires can enter the park from adjoining lands and escape from the park to neighbouring farmland. The entry and exit sites of fires have been identified and are recognised as points in historical fire paths. These boundary fire sites necessitate intensive park boundary fire management through the implementation of planned burning for fuel level reduction (hazard reduction), but encompass a very small total percentage area of the park. Infrastructure and tourist or recreational facilities should not be developed in these areas.

Fire, weed and exotic animal management programs need to be effectively linked and implemented to achieve the greatest environmental benefits and to ensure weed and exotic animal control programs are successful.

The fire management elements of the plan of management for Kosciuszko National Park should therefore be based on:

- an understanding that inevitable recurrent wildfire has been a feature of the development of the region's vegetation structure for millennia;
- outcomes that are derived from an assessment of vegetation systems and fuel structures, with the principles of combustion physics applied to ensure that these outcomes are valid and achievable;
- a principle that a focus of fire management should be effective measures to minimise the impact of high-intensity fire on natural and human assets
- an understanding that vegetation in large tracts of the park is skewed to a primary state of succession as a consequence of past fire history and a recognition that the dominant vegetation management objective should be to achieve a more representative range of succession, including areas of old growth vegetation (representing the end result of environmental stability);
- a principle that achieving catchment protection and stability is a vital conservation function for the alpine areas on both conservation and economic grounds, and recognition that fire management practices should not be undertaken if, on balance, they detract from an objective of catchment protection.



## Attachment 12A

### Kosciuszko National Park fuel complexes and accumulation rates

Extensive fuel sampling across major vegetation associations in Kosciuszko National Park has been undertaken over the past 25 years and the fuel loads depicted in Table 12A1 indicate the sampling results. The fuel load data can be used to generate fuel accumulation curves and generalised fuel models, which can provide a guide to expected fuel loads in the various dominant vegetation communities at other sites.

**Table 12A.1 Fuel loads for some forest and woodland communities in Kosciuszko National Park where time since last fire exceeds 25 years**

Vegetation association	Fuel weight (tonnes per hectare)			Altitude range (metres)
	Lowest	Mean	Highest	
<i>Eucalyptus delegatensis</i>	28.5	43.5	69.8	1200–1400
<i>E. delegatensis/E. viminalis</i>	24.2	37.1	42.4	1100–1220
<i>E. pauciflora</i>	18.4	28.4	38.2	1000–1400
<i>E. pauciflora/E. dalrympleana</i>	16.5	24.8	35.1	950–1500
<i>E. pauciflora/E. rubida</i>	14.8	24.0	31.2	900–1420
<i>E. dalrympleana/E. radiata</i>	22.0	26.2	30.4	1000–1100
<i>E. dalrympleana/E. fastigata</i>	23.7	27.4	31.0	1000–1150
<i>E. radiata/E. bicostata/E. viminalis</i>	18.8	28.5	37.3	550–900
<i>E. albens</i>	9.0	11.8	14.7	300–450
<i>E. macrorhynca/E. dives</i>	6.4	10.0	16.1	500–900
<i>E. dives/E. mannifera</i>	8.5	12.6	18.2	450–950

Source: Based on data from Good (1982, 1986)

Fuel curves are generated using the modified Olsen model (Walker 1980) which expresses the relationship between litter production and decomposition, and hence the accumulation of dead litter ( $X$ , in tonnes per hectare) at time  $t$  (in years) as:

$$X_t = L/K(1 - e^{-Kt}) \text{ where } L = KX_{\max}$$

where  $L$  is the litter production rate (tonnes per hectare per year),  $X_{\max}$  is the maximum litter standing crop at equilibrium,  $K$  is the independent decomposition constant (the ratio of  $L$  to  $X_{\max}$ ), and  $e$  is the base of the natural logarithm. The constants  $L$  and  $K$  (and therefore  $X_{\max}$ ) are functions of vegetation community type. This equation yields zero fuel at time 0 and allows the amount of fuel ( $X_t$ ) to approach equilibrium value  $X_{\max}$  as time ( $t$ ) proceeds to infinity. The values of  $L$  and  $X_{\max}$  determine the maximum fuel level reached and the rate at which this level is reached.

Caution must be exercised when using this equation to generate fuel accumulation curves for use in planning and implementing fuel management and fuel reduction/prescribed burning programs. The equation makes three unrealistic assumptions that need to be accounted for; it assumes that:

- fine dead litter at time 0 immediately after a fire is always zero; ie all fires effect total reduction;
- decomposition and litter fall are constant over time;
- fine dead fuel load is the only fuel input.

The first of the above points may be correct for high-intensity fires where there may be a lag period of 1–3 years during which there is little fuel accumulation. On the other hand, fuel accumulations after low intensity fires (prescribed burns) are generally rapid and reach maximum levels again within 3–5 years of such a fire. More importantly, the 8–10 tonnes per hectare fuel load identified in many fire management plans (as the level below which fuels should be maintained in fuel management programs) will in most situations be exceeded in 2–3 years. This can be modelled if the amount of fuel remaining after any fire is known, as it simply decays as a function of the decomposition constant:

$$X_{rt} = XRe^{-Kt}$$

where  $X_{rt}$  is the amount (tonnes per hectare) of this residual fuel remaining at time  $t$  and  $XR$  is the amount of residual fuel immediately after the last fire. The fine fuel load is thus the sum of  $X_t$  and  $X_{rt}$  (Kessell et al. 1980).

From the above, the following very general fuel accumulation models can be generated.

### **Closed forest communities**

Mean litter fall rate	2.8–3.6 tonnes per hectare per year
Mean decomposition rate	0.12 kilograms per year
Maximum fine fuel accumulation	23–30 tonnes per hectare

### **Open forest communities**

Mean litter fall rate	2.2–2.8 tonnes per hectare per year
Mean decomposition rate	0.8–1.0 kilograms per year
Maximum fine fuel accumulation	27–28.5 tonnes per hectare

### **Woodland (dry to moist)**

Mean litter fall rate	0.6–2.8 tonnes per hectare per year
Mean decomposition rate	0.1 kilograms per year
Maximum fine fuel accumulation	6–28 tonnes per hectare

### **Use of fuels data**

Generalised fine fuels data can provide an overview of the status of the potential hazardous fire situation existing in a locality, a vegetation community or across a park or region. These data can also be an input into the quantification of hazard (Good 1986) in terms of potential wildfire behaviour and fire impacts on life and property, or of valuable biophysical features on the lands over which wildfires may burn. It must be recognised that fuel load is not the only factor that contributes to fire behaviour; flammability of the fuels is influenced by the depth and density of the fuel bed (the packing ratio,) and the distribution and groundcover of the fuel bed.

The packing ratio (PR) is the actual weight of fuel per unit volume and can be calculated as:

$$PR = \text{bulk density (kg/m}^3\text{)}/\text{average fuel particle size (mm)}$$

The bulk density (BD) is calculated from the total fuel loading and its average depth.

$$BD \text{ (kg/m}^3\text{)} = \text{total fuel load (t.ha}^{-1}\text{)}/\text{depth (m)} \times 10.$$

While the approach above gives a methodology and guide to fuel management and the planning of prescribed burning, the relationships among fine fuel load, surface groundcover, slope and soil stability also need to be considered. A fire frequency (or frequencies) appropriate to the vegetation communities must be identified and considered in terms of maximum post-fire fuel accumulation loads (Good 1980). The relationships among the local weather, microclimate and fuel accumulation rates and fuel flammability must also be considered. For Kosciuszko National Park, the local weather allows planned burning to be carried out effectively on only a very few days per year (between 5 and 20). As these occur infrequently, fuel loads are generally at a maximum and if such a fuel load was in the order of 35 tonnes per hectare a single effective fuel reduction burn would or should only reduce the fuel load by no more than 15 tonnes, if implemented within 'prescribed' intensity and rate of spread behaviour. If fuel loads in this situation were to be reduced down to 10 tonnes per hectare, which is the stated objective of hazard fuel reduction, higher intensity fires would be needed, or would result. The lack of understanding of this basic fire physics and fire behaviour continues to lead to many fuel reduction burns becoming wildfires.

To avoid wildfire intensities would require an area to be burnt two or three times in a short time span (3–5 years) which for all but a few small vegetation communities in Kosciuszko National Park would be unacceptable in terms of vegetation management (Good 1986). It would only be acceptable in the areas or sites designated for the maintenance of continuous low fuel loads, e.g. near or around infrastructure under threat of impact, or in boundary areas with a quantified history of regular occurrence of fire leaving the park. On the other hand, if only one low intensity fuel reduction burn was to be implemented effectively, only a proportion of the fuel bed would be removed (as noted above), this being the drier upper layer of the fuel complex. This would result in the lower layers of the fuel bed being exposed and these would then dry out (Good 1982, 1986). Hence the fire ignition potential would remain and the heavy fuel load would mean that the potential for a high-intensity wildfire would similarly still exist. One-off fuel reduction burns in these situations therefore do not achieve satisfactory fuel reduction, or if they do, they result in high fire intensities and higher than acceptable impact on the native vegetation and catchment soil conditions.

Where the HSBPS carried out fuel reduction burning in the higher elevation forests and woodlands, a justification for burning was the desire to create a mosaic of vegetation age, species and structure, a justification used particularly post-fire, when planned (prescribed) fire intensities had been exceeded (Good 1986). Unfortunately, where this 'mosaic' was created it was one of areas continually burned, or not burnt at all due to the burning being done in the same season each year (autumn) when only the low dry fuel load areas would burn, leaving the moist heavy fuel areas unburnt.

These unburnt areas were to become the sites of fire ignition in several of the prolonged drought years in the 1950s and 1960s, adequately indicating that the fuel reduction programs carried out by the HSBPS were either poorly planned or that the fuel complex, weather and fire behaviour were poorly understood, if recognised or even considered. The actual fire hazard situation was never quantified and hence the fuel reduction program never reduced the fire hazard if one ever existed. Future fire management must be based on and implemented with this understanding.

## **Supplemental Report**

The fire chapter was finalised in October 2002 in the expectation that the forests of south eastern Australia were facing a potentially extreme severe fire season due to the combination of protracted drought and persistence of El Nino related weather patterns. It however was difficult to contemplate the occurrence of the multiple lightning caused ignitions of early January 2003 and the subsequent extent of widespread wildfire in NSW, Victoria and ACT and the catastrophic impact of fire on urban Canberra on 18 January 2003. The distribution of this fire event is shown in Map 12.1.

The bushfire events of the 2002-03 fire season are already the subject intense public debate, seminars and a number of formal inquiries at the federal, state and territory level. It is anticipated that the issues relating to fire management and suppression will be exhaustively canvassed in the various inquiries and this supplement will not attempt to anticipate inquiries outcomes.

Notwithstanding the juxtaposition of the release of the Interim Report and the onset of major fires, including in Kosciuszko National Park, the authors were surprised at limited response to the fire Chapter compared to other sections of the Report. Twenty one comments were received of which eight supported the views expressed in the chapter, seven were critical of those views and six submissions offered general comments.

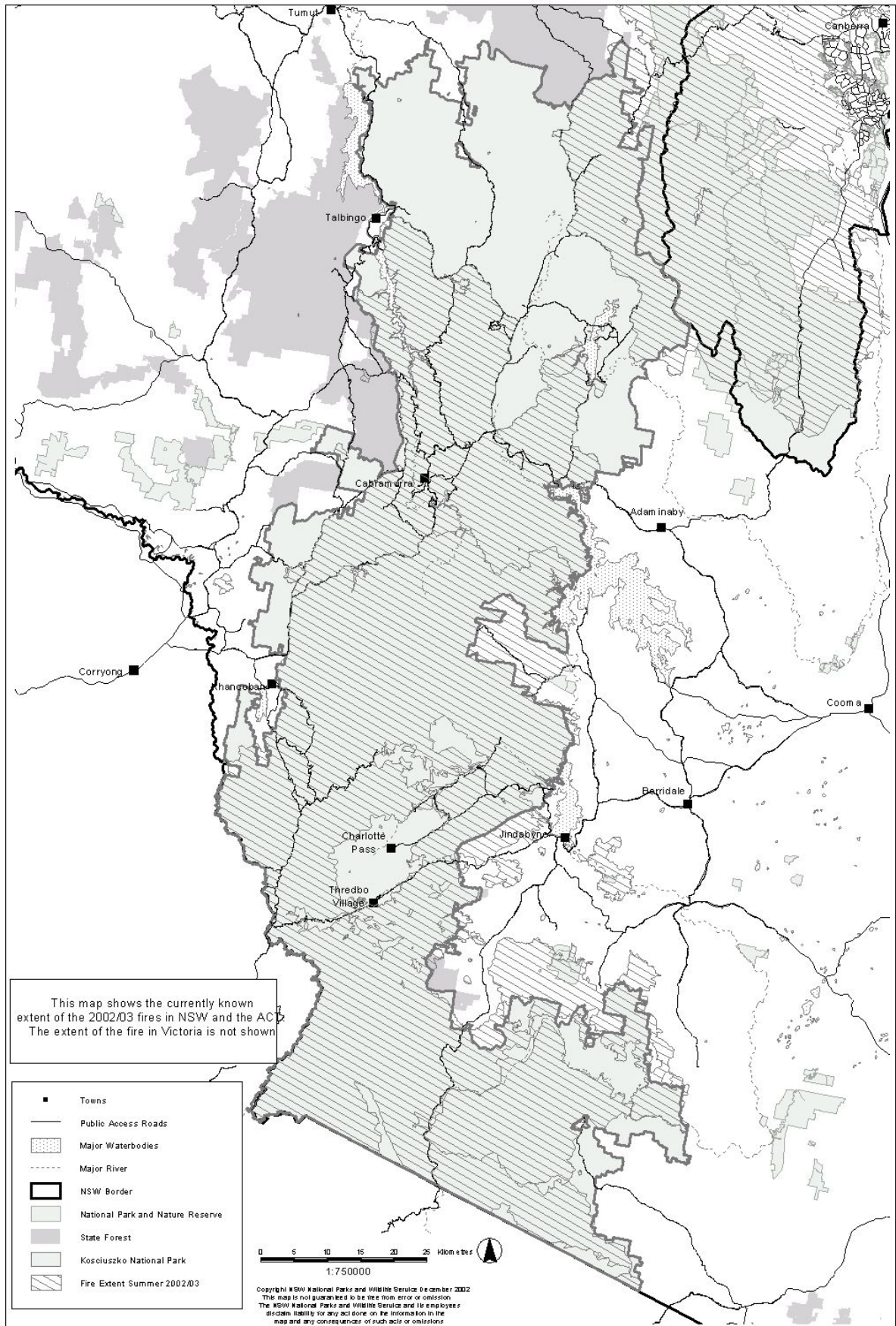
There minor corrections and a number of useful comments about fire protection priorities which should be considered in the preparation of the Management Plan.

The need for broad area fuel reduction programs was raised in six submissions however no submission addressed the detailed points raised in the chapter that discussed the management problems and outcomes associated with fuel reduction programs in the mountain environment. The authors expect that these issues will receive detailed attention in the bushfire inquiries.

The content of some of the submissions reflected the social and cultural aspects of fire management issues described in the Chapter. The heritage links to the mountains and the life style and practices of ancestors remains a powerful and motivating force to many people in the region. The cataclysmic bushfire events provided a ready forum for many people to express anger and frustration at what they saw as the loss of historic land use practices that they believed provided far better protection against the extent and intensity of the wildfires that burnt through the region in the 2002-2003 season. Apart from the observation that the spread and severity of the 1906 and 1939 fires occurred when these historic land use practices were in vogue, it is considered that no useful purpose is served by entering into debate on what are feelings of historic connection and perceptions. These views should be acknowledged and respected as important heritage linkages associated with the history of the area.

One significant fire policy development that occurred since the publication of the Interim Report should be acknowledged. On 23 May 2003 the federal, state and territory Ministers responsible for the cooperative management of the Australian Alps adopted common fire management principles for application in the Alps. The authors commend these principles to form the basis of fire management in the Kosciuszko Management Plan. The principles are attached to this supplement.

**Map 12.1 Distribution of 2003 fires in ACT and NSW**



## Principles Of Fire Management In The Australian Alps Protected Area System

### Preamble

Fire is a natural and recurring factor shaping the environment of the Australian Alps protected area system. Fire behaviour in the Alps is complex, primarily because of the immense variety of vegetation communities, the mountainous topography and the wide range of climatic conditions. Many fires in the Alps are natural lightning fires as opposed to other areas which have a higher incidence of human caused fire.

The distribution and abundance of many species and communities are greatly affected by the frequency, intensity and seasonality of fire. Some fire regimes can pose a threat to human life and property, as well as to natural and cultural assets. Inappropriate fire regimes can and have had a serious adverse impact on the important catchment values of the Alps. Fire also has implications for other conservation management priorities in the Alps such as weeds, feral animals, endangered species and visitation. Recent fires have highlighted the fact that many communities are now dependent on tourism based on the Alps protected area system, and have concerns about the implications of fire management for the tourism industry.

Since European settlement there have been a steadily increasing number of physical assets created in and around the protected area system of the Australian Alps which require protection from fire. The number of physical assets, such as people's homes and ski resorts, has grown markedly in recent years. Many private land interfaces are fenced and abut agricultural production areas. The very substantial investment of governments and the community in fire management is largely driven by the need to minimize the risk of fire impacting on these assets.

The fire management responsibilities of conservation agencies are undertaken within a broader landscape and planning context. They need to be underpinned by a land use planning and development control system and building codes which minimise the creation of fire risks (e.g. by minimising the potential for assets to be placed in areas of significant fire hazard). Effective fire management also requires that those who own assets share a responsibility to ensure they are prepared for the likelihood of fire.

The weight of scientific opinion indicates that climate change is leading to hotter and drier conditions in the Australian Alps, with more extreme weather events. This trend is expected to continue and probably accelerate. This has significant implications for the management of fire and the likelihood of major landscape-scale unplanned fires in the future. For all of these reasons fire management is one of the most important and challenging tasks facing conservation managers in the Alps. All jurisdictions have in place comprehensive systems of fire management policies and procedures, consistent with their particular legislative requirements. However, all jurisdictions are also committed to continuous improvement and working together.

### Principles

There are a number of key principles which should govern fire management throughout the Australian Alps protected area system:

- 1) Firefighter safety and the protection of life and property are fundamental issues of concern to all fire authorities and land managers and will underpin every strategy.
- 2) Fire management strategies should be consistent with the primary objective of the protected area system, which is to conserve the natural and cultural heritage values of the Australian Alps.
- 3) Fire management should be broadly based involving an integration of fire prevention, preparedness, response and recovery strategies. It should make strategic use of all appropriate tools which are available, such as:
  - fuel reduction through burning or by mechanical means in areas of high potential fire intensity hazard;
  - early detection and rapid suppression of wild fire;
  - a strategically located fire trail network;
  - a properly trained and equipped workforce, including volunteers, to undertake fire management; and
  - education to help communities and individuals to be prepared for the likelihood of fire.
- 4) Fire management strategies, including hazard reduction, should:
  - be practical, achievable and cost effective;
  - be based on a strategic analysis of risk to the assets (natural, cultural and physical) that may be affected by fire;
  - be focused on the protection of significant assets and values at risk from wildfire;
  - be based on sound science, in particular a clear understanding of the factors which influence fire behaviour; and
  - take full account of the known and likely implications of climate change.
- 5) There should be a total landscape approach to fire management, including suppression activities, involving cooperation and collaboration both within jurisdictions and across State/Territory borders.
- 6) Community engagement and support in the development, implementation and review of fire management strategies should be sought to both ensure that local knowledge, values and resources are effectively utilised and to raise awareness, understanding and appreciation of fire management issues in the community.



# Chapter 13

## cultural values

Prof Sharon Sullivan  
and Jane Lennon

### Introduction

This chapter presents the cultural heritage values of Kosciuszko National Park organised under a series of themes. The historical content of each theme is briefly covered, and its manifestations within the park summarised. This is followed, for the items described under each theme, by a general assessment of their current dependencies, condition, pressures, knowledge gaps, opportunities for enhancement, desired outcomes and monitoring requirements.

The chapter is based on research already carried out. No new research work has been conducted for this study, but major gaps requiring more primary research or analysis have been identified. The chapter has been specifically written for the preparation of the Kosciuszko National Park Plan of Management.

An effective assessment of significance, and of management resources and measures required to sustain this significance, depends on the quality and consistency of the data available. We are fortunate that a range of researchers have done significant work on some of these cultural values, especially in preparation for, and as a result of, the 1992 conference on the cultural heritage of the Australian Alps. However, the work has been patchy and has not been done in a systematic fashion, using a consistent set of criteria. National Parks and Wildlife Service (NPWS) staff have also done some excellent work but there are still significant gaps in many areas. Studies for the comprehensive regional assessment for the Southern NSW Regional Forest identified places and values of indicative national estate significance within Kosciuszko National Park, and many others in adjoining areas (Commonwealth of Australia 1999).


This means that any overall assessment of significance will necessarily be similarly somewhat unsystematic. In particular, certain themes and areas have received little attention. The cultural heritage management strategies for 2001–06 for the Snowy Mountains region (NPWS 2001a) and for the south-western slopes region (NPWS 2001b) contain assessments of the major elements of the physical cultural heritage items within the park, but this work is brief and preliminary; indeed, the reports recommend further identification, recording and analysis of such items. For example, most of the items identified have not yet been assessed in terms of state heritage criteria. This chapter does not incorporate additional identification or analysis, because of time limitations. It has therefore been possible to assess significance only in general terms, using the overarching criteria of historic, aesthetic, scientific and social values. There is no doubt that some elements of the park's cultural heritage significance have been overlooked or perhaps misunderstood.

Lack of precise knowledge and data has also meant that in most cases it has been possible to assess dependence, condition, trends etc in only a very general way.

### What is cultural heritage?

The New South Wales (NSW) National Parks and Wildlife Service (NPWS) defines cultural heritage as follows (NPWS 2002ac):

- Cultural Heritage is the value people have given to items through their associations with those items.
- 'Items' are manifestations of cultural heritage values. These may be non-physical and/or physical and include, but are not limited to, cultural practices, knowledge, songs, stories, art, buildings, paths, and human remains. When natural elements of the landscape acquire meaning for a particular group, they may become cultural heritage. These may include landforms, flora, fauna and minerals.



*“These values may be seen in places and physical features, but can also be associated with intangible qualities such as people’s associations with or feelings for an item, or in cultural practices, knowledge, songs and stories.”*

- **Historic Heritage:** Items that contain physical and non-physical manifestations of cultural heritage values of human occupation and settlement after the arrival of non-indigenous people in Australia. Historic heritage includes both non-indigenous and Aboriginal cultural heritage values and can also be referred to as post-contact heritage.
- **Pre-contact Aboriginal Heritage:** Items that retain physical and non-physical manifestations of cultural heritage values of Aboriginal occupation and settlement prior to the arrival of non-indigenous people in Australia.

The criteria for assessing cultural heritage values are based on those used in the *Australian Heritage Commission Act 1975* and the Burra Charter of Australia ICOMOS (Australia ICOMOS 2000) to refer to qualities and attributes possessed by items that have aesthetic, historic, scientific or social value for past, present and future generations. These values may be seen in places and physical features, but can also be associated with intangible qualities such as people's associations with or feelings for an item, or in other items described above such as cultural practices, knowledge, songs and stories.

Cultural significance is a concept that helps in estimating the value of items. The items that are likely to be of significance are those that help to provide an understanding of the past or that enrich the present, and that will be of value to future generations. The criteria used to address the values of cultural significance, and the meanings of these values, are described below (derived from Lennon 1999).

### **Aesthetic value**

This comes from people experiencing the environment. It includes all aspects of sensory perception, visual and non-visual, and may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the item and its use; the emotional response; and any other factors having a strong impact on human feelings and attitudes.

### **Historic value**

An item may have historical value because it has influenced, or been influenced by, an historical figure, event, phase, period or activity. It may also have historical value as the site of an important event. For any given item the significance will be greater where evidence of the association or event survives in situ, or where the settings are intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment (e.g. massacre sites or explorers' landing sites).

### **Scientific value**

The scientific or research value of an item will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the item may contribute further substantial information about environmental, cultural, technological and historical processes.

### **Social value**

Social value embraces the qualities for which an item has become the focus of spiritual, political, national or other cultural sentiment to a majority or minority group. The item has a special meaning important to a community's identity, perhaps through their use of the item or association with it. Items that are associated with events that have had a great impact on a community often have high social value.

Aboriginal values are embodied in the cultural, spiritual, religious, social or other importance an item may have for Aboriginal communities. Aboriginal items may have other layers of significance as well as those mentioned here; these meanings are defined by the Aboriginal communities themselves

This analysis in this chapter, while using the well documented term 'social value' as defined above, recognises that in one sense the overarching value of all heritage items is their value to society. Byrne et al. (2001) make the valid point that in another sense all cultural heritage items have a level of social value as an overarching attribute that includes other attributes such as aesthetic, scientific or historical values, which can be seen as subsets of the general social value.

## **Organisation of themes**

In order to present, analyse and comment on the condition of the cultural heritage values of Kosciuszko National Park in a usable way, it is necessary to organise them under heritage themes. There are many variations on theme lists, which are slightly differently organised at national, state and local level.

On a general level, as part of a national heritage coordination initiative, the Australian Heritage Commission and state and territory heritage agencies are using a set of Australian historic theme groups. These are also useful in linking the local and regional alps events with nation-wide Australian themes (Australian Heritage Commission 2001).

The NPWS has used these Australian themes along with state themes and local themes to summarise the cultural heritage values of the two service regions that include part of Kosciuszko National Park, as shown in Table 13.1.

**Table 13.1 Cultural heritage values of the NPWS regions that include part of Kosciuszko National Park**

National themes	State themes	Local themes
Peopling Australia	Aboriginal culture - occupational and ceremonial sites	Meeting place for 13 nations
	Migration	Snowy Mountains Hydro Electric Scheme workers
Developing Australia's cultural life	Leisure	Skiing, bushwalking and recreational activities
Developing local, regional and national economies	Environment - cultural landscape Pastoralism Explorers Science	Conservation of Kosciuszko National Park High country grazing Exploration of high alpine areas Scientific research Mining Timber getting
Building settlements, towns and cities	Utilities	Snowy Mountains Hydro Electric Scheme
Working	Labour	Migrant workforce
Marking the phases of life	Persons Birth and death Events	Myles and Milo Dunphy Strzelecki named Mount Kosciuszko

Source: NPWS (2001ab)

A lot of the detailed research that has been done on the cultural heritage of the Kosciuszko region has tended to follow one set of themes that was first published in Scougall (1992). These themes, which can be seen as sub themes of the Australian themes listed above, are expressed as a fairly simple and to some extent chronological scheme. They focus on the key human activities carried out in the area of the park and surrounding region and on the items that remain as evidence of these activities.

For the sake of consistency and ease of use, the same scheme, with a few changes, has been followed here as an organising principle, but during the assessment of significance we have referred back to the larger Australian and state themes where necessary. Argue (2000) provides very useful data for such links. The 1992 themes headed 'Exploration and Survey' and 'Transport and Communication' have been subsumed into other themes such as 'Pastoralism', or run right through all the themes, and the Aboriginal theme has been expanded. Thus the revised set of themes is as follows:

- Aboriginal history and heritage;
- pastoralism;
- mining;
- logging, timber product extraction and silviculture;
- water harvesting;
- science, research and conservation;
- recreation.

The analysis of each theme is organised as follows:

- brief description of the theme - an outline of the history of the theme in the park;
- manifestations of the theme in the park - description of items within the park, or associated with the park, that are related to this theme (note that the NPWS definition of an 'item' covers both the tangible and the intangible);
- significance of the theme as it is manifest in the park - analysis and description of the level of significance of the theme as it occurs in Kosciuszko National Park and analysis and description of the nature and level of significance of each major item or set of items related to this theme.

The significance of some items and landscapes within the park arises out of more than one theme. These themes are layered across the landscape and many of the places and landscapes within the Park relate to many of the themes. One outstanding example of this relates to the group of Kosciuszko huts (a tangible item) and another to the continued association of related communities to the park, because of their part in its history and their associated customs, knowledge and attachment (an intangible item). Key items such as these are described and analysed separately, as well as being considered as part of each relevant theme. This is in line with NPWS policies (NPWS 2002a) that suggest that cultural heritage assessment work should use the following principles:



- An integrated, or whole-of-landscape, approach with regard to the identification and assessment of all cultural (both Historic and pre-contact Aboriginal) and natural values;
- A cultural landscape approach to understanding the values of the item within its wider environmental/biogeographic, historic and social setting.

## The themes

### General introduction

*The Alpine region ... constitutes merely 0.3% of the area of this time -worn continent, only one-fiftieth of whose surface rises above 1000 metres. Because of this unique topographic phenomenon among the continents, and because both human responses to environmental challenges and the nature of social and technological activities in mountainous terrain are distinctive, it is essential to treasure evidence relating to Australia's alpine cultural heritage. And not only for its scarcity value, or for its representativeness of unique living conditions and achievements; but even for its individuality rather than its typicality (Mulvaney 1992:9).*

The Kosciuszko region has a unique natural setting and environment that have influenced its cultural heritage. It has the highest altitude in Australia, a large percentage of land above the snow line, characteristic alpine vegetation and fauna, a rugged terrain, bountiful natural resources, and a severe and unpredictable climate.

The harsh and at times dangerous climate and the remoteness and difficulty of access influenced Aboriginal and European settlement. Unique building and working adaptations, and seasonal use of the high country, characterised European use of the area for much of its history. Topography had a great influence on movement through the area: routes were pioneered by Aborigines and used by pastoralists, miners, loggers, bushwalkers, engineers and park managers. The natural resources - bogong moths and uplands food resources, pasturage, gold and other minerals, timber, water, and indeed snow and scenery - have created a series of waves of settlers and transient users that have combined to give the alps in general and Kosciuszko in particular a rich and unique heritage.

Aboriginal people came to the general region at least 21,000 years ago, and there is evidence of them in Kosciuszko 4000–5000 years ago (Mulvaney and Kamminga 1999). The alpine people developed a unique and successful lifestyle, of which many traditions remain today despite the effects of European settlement. By the 1820s, squatting pastoralists with cattle were present at Tumut and spreading into the higher alps. For 135 years there was permanent pastoral settlement in the lower areas of the park and summer grazing in the high country, with the resultant development of a unique way of life and traditions.

Payable gold was discovered at Kiandra in November 1859, creating the first alpine gold rush; small-scale mining of gold and other metals continued throughout the century. Mining became more highly capitalised during the 1970s/80s with the introduction of hydraulic sluicing and dredging, which remained until the 1930s. Stamper batteries also illustrated the increasing capitalisation of Snowy Mountains reef mining. The area has also been used for the logging of native timber, harvesting of eucalyptus oil and forestry plantations. Skiing was introduced by the miners at Kiandra in the 1860s and has developed into a major industry, along with other recreation pursuits, especially bushwalking.

A continuing theme has been a strong appreciation of the park's aesthetic and natural qualities. Recognition of the unique qualities of Kosciuszko has meant that research in many fields, and efforts at conservation, have continued almost since the beginning of European exploitation of the area. Two great changes to the area occurred in the 1940s - the creation of Kosciusko State Park, later to be expanded into Kosciusko National Park; and the development of the Snowy Mountains Hydro Electric Scheme, which brought great physical and social changes to the area, and to Australia more generally (partly summarised from Ashley et al. 1991).

This rich alpine history is not confined to Kosciuszko. It applies more generally to the alps as a unit, and can be fully understood only by considering the whole of this biogeographical unit. Describing the cultural heritage values of Kosciuszko National Park is an essentially artificial exercise in this context.

## Aboriginal history and heritage

### Brief description

The emphasis on research into this theme in the park has tended to be an archaeological one. This is part of a general past tendency discussed by Byrne et al. (2001). This has meant that most of the items recorded have been archaeological remains, and most of the emphasis has been on recording, conservation and management of this part of the Aboriginal heritage. Other areas have been neglected to some extent - for instance, Aboriginal post-contact history, Aboriginal lifestyle and ceremonial life - although there are some exceptions such as the significant work of Young, Mundy and Mundy (2000). Most importantly, contemporary Aboriginal connections, attitudes and custodianship aspirations have not been articulated.

Recent consultation with the Aboriginal people who have cultural connections with the alps has been undertaken on behalf of the Australian Alps Liaison Committee (AALC) by Golding and Buckley (2002).

This consultation points to the need for a much more in-depth study to assess Aboriginal significance, and makes some general comments about significance which are relevant to future planning for the area:

### ***Living landscapes***

Some participants in this consultation process emphasised that cultural landscapes are living landscapes. They felt that land managers need to recognise that Aboriginal heritage values can live on in living Aboriginal people rather than seeing them as static “artefacts” of the past. It was also remarked that the views of archaeologists – fostered by heritage law – have encouraged the perception that artefacts left by ancestors are more important than the knowledge of living Aboriginal people: “These aspects of culture should not be separated”.

### ***Culture includes Aboriginal post-contact heritage***

It is clear that places relating to the post-contact period of Aboriginal history in the alps are valued by Aboriginal people. The point that was made frequently in meetings is that Aboriginal history is a continuum that started thousands of years ago and continues right up to the present. Cultural attachments to the alps that fall within the post-contact period can be just as significant as attachments that were formed in pre-contact times. (Golding and Buckley 2002, Chapter 3)

Little systematic work has been done in the park to establish the history of its Aboriginal occupation, the nature of contemporary Aboriginal links with land or the survival of traditional knowledge and practices. In these circumstances a full assessment of significance for this theme is not appropriate and would only continue the biased emphasis of previous work. A complete description and assessment of this theme must await the Aboriginal consultation process now under way. This chapter is therefore brief, tentative and open to correction by the Aboriginal custodians.

The Australian Alps provided a significant challenge to the first settlers, who adapted to the harsh environment very early. The evidence from the Birrigai shelter in the ACT (Flood et al. 1987) and New Guinea II Cave (Ossa et al. 1995) indicates that they were living on the fringes of the Australian Alps 21,000 years before present (BP) at the height of glaciation. In Kosciuszko, evidence from archaeology has so far revealed occupation 4500 years ago (Kamminga 1992). Kamminga notes that in the southeastern highlands generally there is a trend towards more intensive occupation from about 3000 years ago (Mulvaney and Kamminga 1999) but he also concludes that it is likely that evidence for Late Glacial Maximum era occupation sites (more than 20,000 years old) will be found in at least the lower altitudes of the Snowy Mountains and that different adaptive strategies and regional technologies developed very early during the human colonisation of Australia. Kamminga speculates that low visibility for possible earlier sites means that they have so far eluded detection. The subalpine and vegetated alpine environments in eastern Australia were vastly expanded during this time (Lennon 1999, citing Hope and Kirkpatrick 1988). Grasslands and open woodlands extended from the lower montane valleys to surrounding tablelands and beyond and were able to provide ample plant foods (Lennon 1999).

Numerous archaeological surveys have been conducted on the highland plateaus and less dissected ranges northeast of the divide. The distribution of site locations recorded so far suggests that both the wider river corridors and the major ridge lines were used as access routes through the ranges, the most common site type consisting of a low-density surface scatter of a small (up to 20) to medium (between 21 and 50) number of stone artefacts. Sites are almost exclusively located on level or low-gradient, well-drained ground. Within highly dissected ridge and valley topography, the proximity of soaks and springs close to ridge top locations appears to be an important site location criterion (Navin and Officer 2000). A search by Navin and Officer of the NPWS Aboriginal sites register revealed 89 recordings within an area 35 km × 40 km centred on the Main Range, alpine plateau and associated northern and eastern ranges. Of these, 24 recordings occur above 1550 m and just six above 2000 m. All consist of surface artefact scatters and are classed as open campsites.

Other remains that have been noted within the park and recorded in the park site register include ceremonial grounds and stone arrangements, burials, quarries, scarred trees and shelters with deposit (Lennon 1999). There is also an intriguing reference to the previous existence of cave paintings in Coleman Caves (Good 1992). In Chapter 7, Spate refers to evidence of Aboriginal use of the karst systems of Kosciuszko.

The potential range of items of cultural significance to Aboriginal people within Kosciuszko is much greater than this list implies. Recent consultations with Aboriginal people of the alps produced the following tentative and preliminary list of uses (Golding and Buckley 2002):

- travelling routes/tracks/pathways/trade routes;
- dreaming trails;
- burials;
- spiritual places/attachments;
- ceremonial places;
- story places;
- camps/meeting places/social places/trading camps;
- named places;
- massacre sites;

- food and medicine collection localities;
- raw material collection localities;
- birthing places;
- men's and women's sites;
- recreational places;
- historic camps;
- places where people worked;
- reserves (adjacent to the high country);
- missions;
- views of the mountains (from the coast);
- ancestor's country.

Early observers and later anthropologists and historians (e.g. Howitt 1904; Tindale 1974; Flood 1980; Wesson 2000; Jackson-Nakano 2001) have provided differing versions of the Aboriginal language groups and boundaries associated with the park at the time of first European settlement. Navin and Officer (2000) have also attempted a useful synthesis of some of this complex data.

The combined evidence, though often contradictory, suggests that the following groups had traditional connections to country that is now defined as the Australian Alps (Golding and Buckley 2002):

- Wolgol [Walgalu];
- Ngarigo [Monero-Ngarigo; Ngarego; Ngarrugu];
- Wiradjuri;
- Ngunawal [Ngunnawal];
- Krautatungalung;
- Brabiralung;
- Braiakaulung;
- Gunai/Kurnai;
- Minjambuta;
- Djilamatang;
- Jaimathang [Yaitmathang];
- Duduora;
- Biduelli [Maap; Bidawal; Birdhawal];
- Wurundjeri;
- Taungurung.

However this information can be misleading, because of the misunderstandings of early informants, and because of lack of input from Aboriginal people of today who retain important traditional information. More research with and by the Aboriginal people is required on this issue.

These groups are often referred to as tribes by early settlers, but the concept of the tribe is in some respects inappropriate for Aboriginal Australia (Mulvaney and Kamminga 1999). The groups were interactive, probably with bilingual skills and complex territorial, ceremonial, marriage and trading relationships, and all had some traditional and acknowledged rights within the area now known as Kosciuszko National Park.

The resources used for food included a wide range of land animals, reptiles, insects and small crayfish. Plants formed a very important part of the diet, especially edible tubers (Mulvaney and Kamminga 1999). Plants were used for medicines and fibres for making baskets, string and other objects. Aboriginal people survived the harsh environment of the high country by dressing in warm skins, mainly of wallabies or possums, and covering the exposed parts of their bodies in animal fat. They also knew which areas were havens from extreme cold (Hampson in NPWS 2001a).

The seasonal exploitation of the bogong moth (*Agrotis infusa*) was a major reason for Aboriginal visitation to the high peaks and ridges of the Snowy Mountains. Local groups such as the Ngarigo were joined by clans travelling long distances to large intertribal gatherings, which occurred in association with the collection of the moths and which included various ceremonies and the trading of commodities. These gatherings mediated and maintained the political and social links between the differing linguistic and social groups that used the Snowy Mountain regions. (Navin and Officer 2000). The gatherings involved at least 13 Aboriginal groups from as far as Melbourne to the south, Yass to the north, and the South Coast to the east, and from parts of the Central West of NSW (Young 2000). (Young, Mundy and Mundy is an important source of information for these sections in the present absence of a full Aboriginal interpretation of this era. They have collected and made available many of the early settler's, newspaper and official accounts which describe post contact Aboriginal history.

By their nature these reports are subjective and culturally naive and illustrate the contemporary bias towards Aboriginal people. For this reason some National Park staff have reservations about the use of this source in this document. However the authors are confident that Young, Mundy and Mundy have done a good job of initial analysis and consider that their collected records, judicially used, provide important evidence for post contact Aboriginal history. )

The early settlers vividly described these gatherings and perhaps overstated the role of the moths as a staple food. They were probably a highly prized and ceremonial food rather than a staple food (Chapman 1977; Kamminga 1992; Grinbergs 1992). The gatherings took advantage of the abundant food found during the summer, including fish, eels, possums, kangaroos and wallabies, and a number of birds that also feasted on the moths. The moths were collected from large groups of granite tors called boogongs (Hampson in NPWS 2001a). Each of the groups had their own boogong, to which they returned every year. The gatherings involved some 500–1000 Aboriginal people each year over a two-month period (Good 1992; Mulvaney and Kamminga 1999).

Several major access routes into the Snowy Mountains have been identified by researchers from oral accounts handed down by early white settlers, and backed up by archaeological work (Mulvaney and Kamminga 1999). These routes were associated with particular corroboree or ceremonial grounds and ritual procedures. (Navin and Officer 2000).

Young, Mundy and Mundy (2000) provides numerous vivid accounts of Aboriginal people of this period, when the impact of Europeans was minimal. Despite the bias expressed in some of the accounts, they show a thriving society, very well adapted to the highest country in Australia and with a range of sophisticated exchange patterns, a rich religious and ceremonial life and a very active social existence.

Aboriginal people would have been affected by disease and the disturbance of traditional boundaries before the first Europeans arrived in the district. When the first pastoralists came, many were guided by Aboriginal people, especially to the high country (Young, Mundy and Mundy 2000); Young Mundy and Mundy give many lively accounts of first encounters and of the mutual curiosity and methods of communication and exchange that followed, some of which occurred at places that may be identifiable today. Some of the first comers were convict servants, often left to their own devices. There was soon the type of frontier war that was common throughout Australia, with many recorded massacres and strong Aboriginal defence of their country (Young, Mundy and Mundy 2000). At the same time, attempts were made to placate the Aboriginal landowners with blanket distribution and the awarding of king plates (Young, Mundy and Mundy 2000). Crown land commissioners were appointed in 1837. Their role was to protect the Aboriginal people, but their reports relate the usual story of disease and decline. In these circumstances, social and ceremonial life were very much disrupted (Young, Mundy and Mundy 2000; Hampson in NPWS 2001a). At the same time there is ample evidence that Aboriginal people were becoming very important to the pastoral industry. Young, Mundy and Mundy document a number of instances of skilled Aboriginal assistance, and cites the appearance of Aboriginal employees in a number of station ledger books of the period.

With the gold rush, the non-Aboriginal population more than doubled and Young, Mundy and Mundy (2000) suggest that there was a change in attitude from curiosity, fear and some sympathy to contempt and racism. The general attitude to the Aboriginal people of the district during the latter half of the 19<sup>th</sup> century was that they were a 'fading race'. The Aborigines Protection Board gradually moved people to reserves such as Delegate and Brungle Reserve at Tumut, and they were forgotten by the wider world. By the end of the 1920s and 1930s the last people from the Delegate reserve had gone to the south coast of NSW and to Gippsland (Young, Mundy and Mundy 2000).

There are very few tangible items recorded within the park relating to the post contact period. This is in part because some of the evidence is ephemeral but also because systematic work with Aboriginal informants has yet to be undertaken. Many of the remains of the pastoral era homesteads, such as huts and yards, would also have a strong association with this theme - an association that should be recognised.

The resilience of the Aboriginal people and their retention of their culture is another very important story. Ironically, in part because of their exclusion from white society and compression into reserves, they retained important elements of their culture, including traditional and religious knowledge and practices, social relationships and a strong sense of place. Howitt (1904) found this to be so at the end of the 19<sup>th</sup> century, and Egloff was able to trace a similar pattern of continuity in the 1970s (Young, Mundy and Mundy 2000:346; see also Hampson in NPWS 2001a).

There is a lot of evidence of the continuity of knowledge and association between these people and the park and of the continuation of traditions and assertion of rights throughout the colonial period. In 1927, for example, an Aboriginal man named Jimmy Clements walked to Canberra from Tumut, for the opening of the new Parliament House by royalty, protested about the treatment of Aborigines in Australia on the spot where the Aboriginal Tent Embassy now stands, and specifically requested land rights. This man passed onto his large family a wealth of information and knowledge about Aboriginal use of at least 170 alpine plants, now being documented by an Aboriginal site officer (Mason 2001) and used to educate park visitors. Aboriginal knowledge, tradition and use of the high country still survive and are important elements of the traditional and contemporary significance of the park.

## Manifestations of Aboriginal heritage and history in the park - cultural heritage items

### *Tangible items*

Aboriginal access routes and traditionally exploited resource areas within the park, including:

- valley floor corridors and ridge and spur line crests, which may have served as access routes through the high country and formed part of a seasonal cycle of Aboriginal occupation;
- bogong moth aestivation sites;
- grasslands and herb fields in which edible plant tubers could have been collected, and animals such as wombats and possums hunted and trapped;
- natural landform features such as mountains, boulder fields and valleys that formed an integral part of a broader alpine and subalpine cultural landscape;
- the general natural environment values present in the habitat, plants, animals and landscape of the study area, which were valued as important contextual components of the broader cultural landscape.

There are probably also elements of the landscape, natural features, and geographical locations that are sacred or significant story or ceremonial places known to the Aboriginal community. (See above for an extended list of the possible items.)

- Very numerous scatters of stone artefacts, in some areas, with depth of occupation deposit, which illustrate the widespread and long occupation of the park by Aboriginal people, and many of which appear to be associated with the bogong moth festival (Navin and Officer 2000);
- Recorded ceremonial grounds and stone arrangements, burials (some in caves), quarries, scarred trees, and shelters with deposit (Lennon 1999);
- Places that relate to post-contact history, including possible Aboriginal associations with items listed under other themes, especially the pastoral theme;
- Places significant for their current/ongoing cultural uses such as teaching and discussing lore.

For more detail concerning tangible Aboriginal heritage within the park, see NPWS (2001ab).

### *Non-tangible items*

- Traces of Aboriginal nomenclature that may survive in some contemporary local names:
  - Mungyang (or Muniong), for example, is thought to be the Aboriginal name for the Main Range or alternatively named after the native yam *Microseris scapigera*, which was known as mur-nong by the Wurundjieri (west of Tumberumba), but as me-wan by the Ngarrugu (Navin and Officer 2000);
  - Evidence of traditional Aboriginal use at the time of the European settlement exists in names such as Dicky Cooper's Bogong, and Paddy Rush's Bogong for particular peaks in the mountains (Good 1992; Slattery 1998);
  - It has also been suggested that the name Tom Groggin is derived from an Aboriginal word (Don Maxwell, pastoralist, pers. comm., October 2002).
- Ethnographic and traditional evidence of the successful and unique adaptation of Australian hunter-gatherers to the alpine environment:
  - There is ethnographic and traditional evidence of the bogong moth festival, an occurrence unique in Australia, and with important parallels to other such Aboriginal gatherings to harvest natural resources, such as the bunya nut festival in Queensland.
- Traditional knowledge of the environment and its resources, stories, traditions, descent lines, customs and spiritual associations maintained and passed on by Aboriginal people descended from those who inhabited the area at the time of first European settlement.

## Significance of Aboriginal history and heritage as it is manifest in the park

Aboriginal cultural heritage values within Kosciuszko are manifest by the continuity of Aboriginal history represented by the connection of Aboriginal people with the natural environment (landscape, habitat, plants and animals), ethnographic accounts, traces of past occupation revealed by archaeological investigation, and the ongoing involvement and knowledge of current local Aboriginal groups (Navin and Officer 2000). The following list was adapted from Navin and Officer (2000).

- The Snowy Mountains alpine and subalpine regions are of high cultural significance to the descendants of the Aboriginal tribal groups who occupied and visited them;
- This alpine and subalpine Aboriginal cultural landscape includes places and pathways of special social and historic significance to Aboriginal people - some remembered in oral tradition, some documented in 19<sup>th</sup> century records, and some revealed by archaeological investigation;
- All of the Aboriginal heritage items documented within the park are considered to have potential historic and social significance to the local Aboriginal community. (but note that in their comments on this chapter Cultural Heritage Service staff have suggested that minor or degraded sites may not have much significance to the local Aboriginal community).

These sites in total provide a tangible link to a past way of life and manifest a cultural tradition of Snowy Mountains occupation and a sense of social identity that is given a high cultural value amongst many members of the Aboriginal community. (See Golding and Buckley 2000);

- The significance of these sites to Aboriginal people encompasses both material and non-material aspects;
- The potential use of sites such as these for teaching and education about Aboriginal culture is also a recognised component of significance.

The Kosciuszko high country was the traditional gathering place for the bogong moth festival, one of the most important Aboriginal cultural and social events in south-eastern Australia. Because of the importance and uniqueness of the festival, the ethnographic evidence, the continuing Aboriginal tradition about this event and the sites, routes and physical remains of the activities associated with it are of *scientific, historic and social value at a state and possibly a national level*.

The surviving archaeological resource within the park is a *historically and scientifically significant* component of the alpine and subalpine heritage landscape. The proven occurrence and distribution of subsurface artefacts within the alpine and subalpine environment provide both a marker of past Aboriginal occupation and an opportunity to study Aboriginal adaptation and exploitation of the high country. They provide evidence of a long history of Aboriginal occupation in the alpine areas of Australia, demonstrate successful adaptation to new environments unique to Australia, and have potential to provide important new information about the length and nature of Aboriginal occupation (Navin and Officer 2000).

Predictive analysis from surveys to date shows that large areas of the park have *significant research potential*, in the form of surface scatters of stone artefacts and possible archaeological deposits that will provide more information about Aboriginal occupation of the area and probably push back the date at which it can be demonstrated that Aboriginal people first settled in Kosciuszko. The new evidence for increased Aboriginal use of the alpine country, as well as being significant to Aboriginal people, provides important information for any researchers interested in the story of human adaptation to this ancient landscape. Lennon (1999) argues that some elements of the Aboriginal heritage of the park have potential *international significance*.

Sites associated with the contact period and post-contact Aboriginal life and history, including items from the pastoral and mining era, are also of potential *regional historic and social significance*, although not much research has been done to identify them or to pin down their associations.

## Dependence

The nature reserves and parks of the alpine region conserve a significant variety of ecosystems and terrains. They have the potential to be available to Aboriginal people to continue their cultural traditions in a way that is lacking in surrounding areas. The management regime in these areas is comparatively favourable to conservation, and therefore most of the remains of Aboriginal settlement and evidence of Aboriginal occupation are probably better preserved here than in many other areas in the region and will continue to be so. Of these reserves, Kosciuszko National Park is the largest and has the greatest variety of ecosystems and topography. It is also the centre of the ceremonial activities connected with bogong moths, has a high density of recorded sites in some areas, and has rich associated ethnographic and contemporary Aboriginal information.

For these reasons the continued existence and conservation of values related to Aboriginal history and heritage in the alps depend on their expression in the park to a very significant degree.

## Condition

There is insufficient evidence to assess the condition of Aboriginal heritage items within the park. There have been no systematic surveys of these items and no overall assessment of their condition. (An exception may be a Baseline Heritage Study of Kosciuszko National Park (Johnson and Jones 1991). However this document has not been available for study.) What follows is therefore necessarily generalised.

The condition of both physical remains and the cultural traditions and uses associated with them has declined dramatically since European settlement because of the loss of continuity and control by Aboriginal people. Aboriginal connections and traditions - the non-tangible values connected with Aboriginal history and heritage - have been violently and significantly damaged in the past by the processes of the European settlement and dispossession.

The present lack of formal Aboriginal involvement can be considered to be seriously affecting the condition of these remains and traditions, which cannot be clearly recognised, articulated or curated in this situation. The present plan of management does not acknowledge these issues and does not provide adequate management for them. Over the last two decades gradual recognition of Aboriginal traditions, the employment of Aboriginal staff and research and documentation in this area have improved the chances of preventing the loss of these values or further damage to them, but this trend requires active augmentation and management support.

Physical remains of Aboriginal history and heritage have been destroyed since the park was created, because of lack of proper consultation of systematic or project-specific archaeological and anthropological surveys.

Because of the widespread nature of the items and the lack of comprehensive information about them, any new development and some present management practices have the capacity to damage them.

New developments for tourism or associated purposes within the park are a cause for concern since they will lead to the gradual attrition of the resources and since they may endanger areas of unknown significance.

While the condition of the majority of the known physical remains is relatively stable, and the management regime that is now in place goes some way to ensuring less inadvertent destruction than previously, many of the physical remains are also subject to natural weathering and erosion.

Overall, it would appear that the condition of Aboriginal heritage items within the park is at best average and in many cases degraded or in danger of being so.

## **Pressures**

The present plan of management does not provide an effective framework for the identification, conservation and management of the Aboriginal heritage in the park, nor does it accord this conservation value sufficient priority. The NPWS regional cultural heritage strategies (NPWS 2001ab) provide only very low key and limited recommendations on Aboriginal heritage.

The lack of a full and comprehensive survey and analysis of the park's Aboriginal cultural heritage and contemporary Aboriginal links to it, conducted in association with the traditional owners, is a major lack that threatens inadvertent damage or destruction, misinterpretation and inappropriate use.

Increasing tourism and the increasing demands of development have potential to cause damage or destruction to items of Aboriginal heritage and elements of Aboriginal traditional use, and to cause the gradual attrition of the Aboriginal cultural landscape.

The lack of support for local Aboriginal organisations, and the disruption and frustration caused by historical displacement and current native title issues, impinge on the ability of Aboriginal people to present a united and effective voice on park management.

The traditional European emphasis on scientific (archaeological) research and on the role of men in Aboriginal society has left a legacy of biased recording and analysis of Aboriginal cultural heritage that has yet to be redressed. This has led to misunderstanding and downplaying of some aspects of Aboriginal culture in the park and an emphasis on places at the expense of landscapes.

There is a potential for conflict between the conservation of Aboriginal sites and some present management practices.

Aboriginal people and Aboriginal landscapes tend to be invisible to many Australians; in particular, contemporary Aboriginal connections in south-eastern Australia often go unrecognised or in some instances are actively denied. This situation constitutes a threat to the conservation and appreciation of the Aboriginal heritage in Kosciuszko.

## **Knowledge gaps and further research**

There has been no systematic study of the Aboriginal cultural heritage of the park. Such a study, with emphasis on current traditional Aboriginal knowledge and interpretation, is essential before proper analysis of significance and long-term effective management can be achieved.

There is a need for the development of a much more comprehensive and sophisticated database on cultural heritage within the park, controlled by the Aboriginal community.

Aboriginal people involved in the recent consultations described by Golding and Buckley (2002) identified a range of specific research projects that they considered should be given priority. Argue (2000) identifies other gaps, especially in the archaeological record.

## **Opportunities**

The NPWS regions in which Kosciuszko is situated have developed some strategic directions for cultural heritage management (NPWS 2001ab). These strategies are not well developed for Aboriginal heritage. This is in part because it is recognised that much greater active involvement by traditional Aboriginal custodians and the local Aboriginal community is needed before such a strategy can be developed. However the NPWS strategies provide general management policies relating to management of Aboriginal heritage that are well founded and will assist with improving the condition of Aboriginal cultural heritage items within the park.

Within the management of Aboriginal cultural heritage, the NPWS acknowledges the following:

- Aboriginal people were the original inhabitants of the land, are the rightful custodians of their culture and may have a unique view and set of management principles that need to be recognised in the management of their cultural heritage;
- Decisions about Aboriginal heritage management should be taken at the local level by the relevant Aboriginal people, and only after considering the range of issues and interests of all groups, including the broader community;
- The connective nature of Aboriginal cultures across the landscape makes it difficult to separate on-park and off-park cultural heritage management;

- There are inseparable links connecting Aboriginal cultures to the land and to their everyday lives so that managing Aboriginal cultural heritage is as much managing lifestyle issues, such as access to and use of resources, as it is managing places and landscapes;
- Natural and cultural elements of Aboriginal culture are inseparable;
- Elders and Aboriginal owners (under the Aboriginal Land Rights Act 1983) within Aboriginal communities are respected for their cultural knowledge and have a special role in the consultation process;
- Consultation with Aboriginal communities must be carried out using culturally appropriate time frames and methods;
- People in the Aboriginal community hold concerns about intellectual property rights and the way that cultural information is obtained, stored, accessed and used;
- Male and female elements of Aboriginal cultural heritage need to be considered in the process of consultation, distributing resources, information storage and access, and ongoing management;
- Historic heritage places and landscapes may have an Aboriginal heritage component that needs to be acknowledged and managed to reflect the co-existence of European and Aboriginal heritage;
- Aboriginal communities need to develop working relationships and protocols with local government authorities and other land management agencies for the management of sites and places off-park.

Taking this into account, the NPWS has developed a tentative priority management schedule for Aboriginal cultural heritage within the regions that contain parts of Kosciuszko National Park, with a primary management focus on conservation and community involvement. Specific goals identified are general and very low key - the establishment of an Aboriginal heritage committee, community consultation and the prioritisation of management of identified Aboriginal heritage places and landscapes.

Two new opportunities have recently arisen. NPWS has commissioned a study of Aboriginal interests and involvement in the park; this is under way. Also in final draft is a study of Aboriginal traditional and contemporary attachment to the Australian Alps more generally, which provides excellent general advice on the issues and concerns of contemporary Aboriginal people with a traditional connection to the area (Golding and Buckley 2002). This contains a good description of desired outcomes expressed by Aboriginal people in the Alps generally and will assist in developing appropriate policies for the park. The outcome of both these studies will considerably augment knowledge and appropriate management practice and should be part of the new plan.

### **Summary of themes and issues (from Golding and Buckley (2000 )**

#### **Principal Themes and Issues Raised by Aboriginal People**

##### **A. Issues Identified**

- A1. Who Speaks for Country
- A2. Access to Country
- A3. Representation of Aboriginal Culture in Alps Interpretative Material
- A4. Renaming Landmarks
- A5. Community Control Over Cultural Information
- A6. Tourism

##### **B. Management Processes**

- B1. An Active Role for Aboriginal people in Management of the Alps
- B2. Developing Partnerships with Land Management Agencies
- B3. Employment of Aboriginal People in Land Management
- B4. Protection of Aboriginal Cultural Heritage Values
- B5. Environmental Protection and Management Issues

##### **C. Improving Processes**

- C1. Fostering Connections Between Groups
- C2. Aboriginal Representatives on the AALC and the CHWG
- C3. Improving Consultation with Aboriginal People

##### **D. Research Directions Identified**

- D1. Future Research into Aboriginal Heritage in the Alps



## Desired outcomes

To bring the condition of the Aboriginal heritage items within the park to a satisfactory condition, the following outcomes need to be achieved:

- a sophisticated and comprehensive database of Aboriginal cultural items within the park, under Aboriginal control, which provides an up-to-date record of tangible and intangible items and their condition;
- an effective and formally established Aboriginal custodianship regime within the park, including a viable structure and the provision of resources for Aboriginal control of matters of traditional Aboriginal heritage;
- the provision of adequate access to the park for relevant Aboriginal people and groups;
- the development and implementation of comprehensive Aboriginal heritage research and interpretation plans in association with the Aboriginal community;
- the avoidance of deliberate or accidental damage or disturbance to significant Aboriginal heritage items within the park, and the establishment of a management regime that effectively minimises damage from natural processes;
- the conservation and interpretation of the most important elements of the Aboriginal cultural heritage of the park as identified by comprehensive surveys and analysis in association with the Aboriginal community;
- formal recognition that many of the Aboriginal cultural heritage values of Kosciuszko are landscape-based, and extend outside the park's boundaries, and the development of management policies that reflect this approach;
- the development of a monitoring system that measures the extent to which these outcomes are being achieved.

## Pastoralism

### Brief description

Don Maxwell, a local pastoralist whose family has a long history in the area, explains the pastoral history of Kosciuszko as a series of consecutive waves that closely reflect the history of the European settlement of Australia (Don Maxwell, pastoralist, pers. comm., October 2002).

The first wave of squatters, mainly from Monaro, came between 1823 and the 1830s. By 1823 the Prendergast family had settled the country around Jindabyne, and a group led by Captain Mark Currie and Major John Ovens first documented the existence of the mountains, viewing them from the distance, from north of Cooma. Other explorers and many grazing families followed (Good 1992). Pastoralists' access from the wider region to the biogeographic unit of the Alps was facilitated by prior Aboriginal land use patterns. Every explorer and squatter of note in the alpine district was assisted by at least one Aboriginal guide without whom little progress would have been achieved and loss of life would have been incurred.

By 1830 European settlers had arrived in the vicinity of the Alps to depasture their flocks and herds, and all the large station properties of the Monaro were established. Permanent pastoral settlement, as well as the perhaps more romanticised transhumance of stock to the high country, is very important in the history of the Kosciuszko region. Early family names associated with grazing in the area included Brooks, Ryrie, Spencer, Crisp, Slack, Buckley, York, Hall and Campbell. (Don Maxwell, pastoralist, pers. comm., October 2002). These early grazing families established permanent settlements in the foothills of the high country. In 1837 John Lambie was appointed the first Commissioner of Crown Lands for the region centred on the Monaro (Good 1992). Dr Andrew Gibson had taken up Kiandra by 1830, and his friend Terence Murray took up Coolamine in 1838. Convicts had a role as assigned servants working for squatters in the alpine region, especially in the 1830s expansion from Yass into the Monaro, and it could be claimed that they were the compulsory work force for the initial settlers (Lennon 1999).

The numbers of these early comers were augmented in the next decades by increasing migration from Britain, and other parts of Australia, into the high country. A notable group of settlers from one location in Scotland was part of this migration (Don Maxwell, pastoralist, pers. comm., October 2002). Drought in the late 1830s caused squatters from the Monaro to seek the high country for grazing. In 1845 William Bradley alone reported having 50,000 sheep and 2000 cattle on summer drought refuge pasturage in the Mount Jagungal area (Good 1992).

In 1839, routes from the north over the Brindabellas were established. In 1840 Europeans climbed into the highest Alps, attracted by the mountains themselves. Count Strzelecki climbed to the top of Mount Kosciuszko and named it on 12 March 1840 (Lennon 1992), though there is some dispute as to which mountain he actually climbed (Good 1992). Publicity following Strzelecki's explorations into Gippsland from the alps led to pastoral occupation of the Gippsland high country. By the early 1850s most of the Australian Alps had been nominally occupied by pastoralists, though the severe winters of the high country checked permanent occupation and grazing there (Lennon 1999). To many locals looking back, the decades that followed constituted the best years for pastoralism - good rain, increased access and infrastructure, and custom from mining activities. During this period stock travelled long distances to Victoria to both settle Victoria and supply Victorian goldfields (Don Maxwell, pastoralist, pers. comm., October 2002).

The Robertson land acts of the 1860s brought the third stage of pastoralism, with closer settlement and a new wave of selectors that essentially ended the long period of 'squatting' occupation. With the coming of closer settlement, summer grazing leases were established in 1889 and became necessary as drought refuges (Lennon 1992).

The late nineteenth and early twentieth centuries brought drought and depression. At about the same time, the first warnings of environmental damage (erosion, overgrazing of natural pastures, regular burning of the forests and scrubs) to the high country by grazing were made by Maiden, Helms and others (Good 1992). Young people began to leave the land - to the Boer War or to pursue a better life in the professions or the city. Much of the land previously selected by smallholders under the Robertson land acts was consolidated into company holdings, including the Scottish Australian Estate and the Australian Estate (Don Maxwell, pastoralist, pers. comm., October 2002).

To some extent these large holdings were broken down again with the provision of soldier-settler blocks after the two world wars. During this period summer grazing licences in the high country were also introduced (Don Maxwell, pastoralist, pers. comm., October 2002).

It was during the later period of limited pastoral leases, after 1920, that many of the huts associated with pastoralism were built as temporary camps for seasonal pastoral workers. (Ashley 1993, part C). During the same period a major report by Byles (1932) provided extensive evidence of the effects of grazing on the high country (Good 1992).

The Snowy Mountains Hydro Electric Scheme commenced in 1949 and the introduction of improved pasture brought more significant changes to the pattern of pastoralism. The Snowy Scheme construction and fire protection work radically and rapidly improved access to the high country. This change was augmented by the introduction of four-wheel drive vehicles, which also provided much greater access to pastoralists and others. The Snowy Mountains Authority also feared erosion caused by grazing and called for an end to grazing as well as undertaking soil conservation works. At the same time, the introduction of superphosphate and other pasture improvement methods made the graziers' home runs more fertile and dependable. These factors led to some decline in montane seasonal grazing. It was in this changed environment that the phasing out of grazing leases occurred and pastoralism ceased within the park (Don Maxwell, pastoralist, pers. comm., October 2002). By 1958, grazing above 1300 m was phased out, and grazing within the park ceased entirely in 1969 (Mosley 1992), though the park continued to take over pastoral holdings into the 1980s (Don Maxwell, pastoralist, pers. comm., October 2002).

In Kosciuszko, as elsewhere, the coming of pastoralism led to the steady decline of the Aboriginal population (Gardner 1992) and to the loss of rights to their traditional lands, though traditional knowledge and attachment to land has remained strong with the few survivors who were forced away to valley towns and to reserves. It is probable that Aboriginal people, as well as providing essential guiding services, played an important ongoing role in pastoralism in the Alps (Young, Mundy and Mundy, 2000).

Women played an essential role in the permanent establishment and running of pastoral households from earlier settlement, often in very difficult conditions, and had to be knowledgeable and skilful in the running of their properties, often in the absence of their partners. The role played by stock hands, shepherds and managers for absentee landlords was equally important, though their names are not as well known or remembered (Don Maxwell, pastoralist, pers. comm., October 2002). These families and workers early established the image and folklore of the mountains, and a tradition that continues to this day among long-established families who pursue essentially the same way of life. This tradition 'remains a significant part of European cultural tradition, known throughout the nation, and recognised overseas as part of the Australian ethos' (Good 1992).

The industries of pastoralism and the early gold rushes meant that the area that is now Kosciuszko National Park was home to many people, with a string of towns and villages, schools, public meeting places, communication networks and local and regional businesses. The area was a lively and active Australian region. A lot of this tradition still survives, along with the numerous items of cultural significance connected with it.

The economic significance of the alps for pastoralism extended far beyond the alps. In the 19<sup>th</sup> century travelling stock went from the high country to Port Philip, Warrnambool, Bendigo and Ballarat. During the first decades of the NSW snow leases in the late 19<sup>th</sup> century, pastoralists from the Western Division were conspicuous on the lists - buying insurance against drought. Sheep men from areas as remote as a Hay, Dubbo and Coonamble used high country snow leases during five months of the year. These extensive interrelationships between the distant Riverina and high pastures continued until mid-century (Mulvaney 1992). These pastoral migrations did not occur every year, depending on the balance between seasonal conditions in the high country and elsewhere (Ted Taylor, Manager, Currango Homestead, pers. comm., October 2002) but they provided an extremely important additional insurance against poor seasons throughout wide areas of Victoria and NSW. To this day, some stock are overlanded on along the northern route within Kosciuszko National Park, from the Adelong to Adaminaby in December, and returning in May.

Horses have played a vital role in the development of Australia, and certainly the development of the pastoral industry in the high country would have been impossible without them. Australia now has the largest population of wild horses in the world. Horses were introduced to the Kosciuszko area in the 1820s and 1830s. They were essential for pastoral life in the high country, and also provided a major method of sightseeing and recreation until the introduction of roads and four-wheel drive vehicles. They became established as wild populations as they escaped from their owners or were released by them, especially in drought times.

After the establishment of wild herds in the mountains, further horses were also released to upgrade these herds, which were used as a new source for stock horses, were trapped for skin sales, and were used for the Cooma and Jindabyne rodeos. 'Brumby running' or roping was a well-known form of recreation for riders of the high country from the 1920s on (NPWS 2002b). Horses were already very common by the 1890s, and the wild horses of Kosciuszko were the subject of probably the most famous Australian poem - *The Man from Snowy River*. Through this poem, and many other national and local stories about the pastoral way of life in general and the role of wild horses in particular, the horse and the horse riders of the region have acquired a romantic image and widespread recognition as an important part of the history of the mountains and of Australian folklore more generally. The running of wild horses continued in the park under licence until 1982, when this practice ceased because of concern over environmental damage. However, numbers have continued to increase and one current research estimate is that there are presently 3000 wild horses in the Kosciuszko area, (NPWS 2002b). Some locals say this estimate is far too high (Ted Taylor, Manager, Currango Homestead, pers. comm., October 2002). Recently the NPWS produced a draft plan for the management of wild horses, with the aim of gradually removing them from alpine areas (NPWS, 2002b).

### **Manifestations of pastoralism in the park - cultural heritage items**

The physical items that remain as evidence of the pastoral era include:

- evidence of transhumance, such as huts, mustering yards, fences, stock routes and watering points - for example, Oldfields Hut at Murray Creek and Farm Ridge ruins;
- evidence of settlement, such as homestead complexes, orchards, windbreaks, tracks, dams, shearing sheds, yards, dips and salt licks - for example, Currango;
- introduced animals, such as wild horses, with associated remains, including salt troughs and brumby traps;
- environmental effects of grazing, fire and human settlement that are still evident, such as erosion, vegetation change and introduced species.

Non-tangible items include:

- the decline in Aboriginal population, the destruction of the previous way of life pursued by Aboriginal people, and probable damage to or abandonment of traditional camps, ceremonial and gathering grounds, and other items of Aboriginal cultural heritage;
- place names from the pastoral era - for example, Mount Murray and Mount Ryrie, and Gibson Plains;
- at a local and regional level, a direct emotional connection with the land, the physical remains and the traditions of the pastoral era, maintained by many of the descendants;
- more general evidence of the high country pastoral history in the preservation of bush skills, vernacular hut construction techniques and traditions kept alive in oral history recordings (Hodges 1996), stories, songs, language, dress festivals etc - for example the Bush Poets festival, the work of Ted Winter, and the Kosciusko Huts Association recordings of stories and traditions;
- the pastoral era in the alpine country as a continuing powerful spur to the artistic imagination in the creation of poetry, literature, art and photography - for example, the paintings of von Guerard and Chevalier; the poetry of Banjo Paterson, Barcroft Boake, Will Ogilvie, David Campbell and Douglas Stewart; and the novels of Miles Franklin and the stories of Elyne Mitchell.

### **Significance of pastoralism as it is manifest in the park**

The pastoral theme, as it is expressed in the Alps in general and Kosciuszko in particular, represents a unique high country variation of a way of life and a period of economic and social development that is of *historic significance at a national level*. Pastoralism played a key role in the development of Australia. Montane pastoralism, and seasonal transhumance with its wide regional connections and economic implications, are more strongly represented in the alps than anywhere else in Australia, and some aspects of this history, being related to the highest land and vegetation complexes in Australia, are unique. The huts, homesteads, transhumance routes and associated remains constitute physical evidence of pastoral life that is only found at these altitudes. Likewise the topography of the region, its severe and unpredictable weather and the exceptional adaptation of the Aboriginal people to these conditions meant that the initial assistance of Aboriginal guides and the use of Aboriginal routes for transhumance played a crucial role within the Alps, of *regional historic significance*.

Within the park very few original squatting stations survive, though many of the surrounding properties have important remains of early pastoralism and an active and continuing tradition. Coolamine was taken up in 1838, and the current homestead built in 1892, and Currango in 1850. Currango is of *national historic importance*: it is the largest and most intact example of pastoral settlement above the snowline in Australia, with 25 remaining buildings and ruins spanning 150 years of European occupancy and the homestead is also important for the integrity of its historic furnishings and fittings (NPWS 1993).

The variety, geographic spread and representativeness of the pastoral huts of Kosciuszko, and their association with traditional pastoral routes and summer grazing settings, make them a unique manifestation of a particular type of grazing. They also represent the way of life of pastoral workers, a theme not well demonstrated elsewhere. The group of huts associated with pastoralism in Kosciuszko is of *national historic and social importance* as part of the complex in the alps generally.

The physical remains, especially the huts and homesteads and their exotic domestic plantings in a unique and beautiful alpine setting, have a very strong appeal to visitors and to locals imbued with the pastoral traditions. The pastoral history, stories and myths and the landscape and remains left behind have been used for more than a century by famous Australian artists to create works of literature and art that are nationally celebrated and that form part of the national psyche. The pastoral theme as expressed in Kosciuszko is of *national aesthetic significance*.

Many of the pastoral complexes have a high degree of authenticity. They preserve evidence of vernacular architecture and design that is a response to the unique environment, various bush skills, and traditional crafts and construction methods, and they are important for the continuation of traditional skills and for research into them.

The pastoral theme as expressed in Australia's highest mountains has strong *social value*, to descendants, to modern bush men and to many other Australians. This is demonstrated in the very active continuation and celebration of its traditions and the respect for its physical remains, including its pastoral landscapes, wild horses and stock routes. The high country's traditions are known, celebrated and passed on locally and regionally, and have an important place in the historical consciousness of Australians, especially in regional Australia, albeit in a somewhat romantic way. *The Man from Snowy River* is known in many households around Australia, both urban and rural. In this sense *the social value of pastoralism is of national importance*.

A recently completed detailed study of the cultural significance of horses in Guy Fawkes National Park provides useful comparative information (Heritage Working Party 2002). No such study of the significance of wild horses in Kosciuszko has been carried out. However we can make the following tentative general statements about their cultural heritage value, although the extent to which this significance resides in the present herds of wild horses is not clear.

- The horses played an important role in the cultural history of the region;
- They have a strong association with some sections of the local communities in the Kosciuszko area and the direct descendants of pastoralists and pastoral workers;
- The stories and traditions associated with them have a strong association with a group of people of importance in the cultural history of Australia - poets, artists and writers in the pastoral tradition;
- The most celebrated wild horses in the Australian pastoral tradition are those associated with Kosciuszko, which have to some extent become a national icon, along with their riders and musterers, as demonstrated in literature, art, film and the 'Man from Snowy River' sequence that opened the 2000 Olympic Games in Sydney.

On the other hand, the damage done and the management problems created by horses in the high country are very considerable and are thought by many people to be in direct conflict with other more significant park values. This is an area in which there is a clear potential for a conflict of cultural and natural values that will require careful management.

The darker side of the pastoral theme has also been played out in the Kosciuszko region. The pastoral history and landscape of the park contributed to the disappearance of the viable and uniquely adapted Aboriginal hunter-gatherer lifestyle of the Alps, the remarkable decline in the Aboriginal population, and the abandonment of many traditional places and items within the park. These happenings and remaining evidence of them constitute important *values of historic and social significance at a regional level*.

The whole Kosciuszko landscape has been affected by this pastoral phase in our national development, and it presents continuing evidence of this era. Significant evidence of the pastoral era on the landscape includes impressive and appealing cultural landscapes, vegetation change, a changed fire regime, the presence of wild horses and other introduced species, and distinctive erosion patterns. Much of this evidence constitutes damage to the pre-European environment left by the Aborigines, but it also has significant historical and scientific value. It should also be noted that current horse riding, especially in the north of Kosciuszko is impacting on Aboriginal sites, both known and unknown.

## Mining

### Brief description

Most of the information for this summary comes from Lennon (1999) and from LRGM Services (2002).

Pastoralists provided access to the region through a network of tracks and settlements, which provided access to hopeful miners and enabled them to begin prospecting in the foothills of the Alps in the 1850s. In 1859, gold was discovered at Kiandra, precipitating a dramatic major short-term rush. The Kiandra area supported a mainly alluvial goldfield and large settlements of people for a very short period, though mining continued on a much-reduced scale until the 1900s. The snow of the severe winters was a major limiting factor. The Kiandra field was the most economically important in the Alps. At its peak, Kiandra had probably about 10 000 people, 30 hotels, 50 stores, a courthouse, a police station, a school, a church, a post office and a cemetery (LRGM Services 2002:46). A quarter of the miners were Chinese and at one stage they outnumbered the Europeans. There was a separate Chinese camp and separate Chinese shops (Good 1992). Recent excavations at Kiandra have provided interesting and important new evidence about the era (Heffernan and Smith 1996).

Smaller rushes, mainly small-scale individual efforts with very minimal technology, followed in other alpine valleys in the park (Slattery 1998). Later, hydraulic sluicing and dredging was used at New Chum Hill, Kiandra and Gungahlin (Slattery 1998).

Copper, silver and lead were also prospected for and mined in numerous small ventures throughout the park, including at Yarrangobilly, Yarrangobilly Caves and the Coolamine plains. From 1874 to 1914, Lobbs Hole, with the associated township of Ravine, was a comparatively important copper mine that supported a township of 300 people for 50 years (LRGM Services 2002; Boot 2001). Ravine is the site of the ruins of the Washington Hotel, which was begun in 1905. The ruins consist of a substantial pise wall that, in construction terms, is one of the most interesting buildings in Kosciuszko National Park (Ashley 1993 Part C; Higgins and Scott 1995).

By the 1920s large scale mining had virtually ceased in Kosciuszko, though the gold price rise in the 1930s led to some sporadic small-scale mining efforts (LRGM Services 2002). Most of the towns and infrastructure have decayed or, in the case of Kiandra, been removed.

Mining in Kosciuszko brought a very significant increase in population, government representation and settlement to the alps, and immensely increased the number of official and unofficial access routes into the high country. Small towns developed as part of the rush and became service centres for grazing. Mining influenced patterns of agriculture in the area by increasing access and because of the demand for food and for farm allotments. Timber harvesting and saw milling began intensively in this period. Regional centres benefited from the population increase and augmented government activity. Government regarded mining as a major regional development engine, actively encouraged this development and increased its own presence, level of services and regulation (LRGM Services 2002).

The landscape, vegetation and fauna in some areas underwent dramatic and long-term changes as a result of the short period of intense activity (LRGM Services 2002). The multicultural flavour and the predominance of men in the population, for which the region became famous during the building of the Snowy Mountains Hydro Electric Scheme, was probably presaged during the mining boom. Certainly Chinese men were very well represented in the alpine gold rushes. Many Chinese people stayed on and local family names such as Yen, Yan and Booshang reflect this ancestry (Don Maxwell, pastoralist, pers. comm., October 2002). Undoubtedly also, the non-Aboriginal population suffered further loss of cultural continuity and traditional access to some areas as the population increased dramatically and the landscape was in some cases drastically altered.

## **Manifestations of mining in the park - cultural heritage items**

### ***Tangible items***

- Remains of the mining fields associated with the Kiandra area, including surface diggings, ground and hydraulic sluice workings, adits, shafts, mullock heaps, water races and dams, abandoned machinery and equipment, relic machinery sites such as Lorna Doone, Broken Cart, Blue Creek and Horseshoe mines (LRGM Services 2002), dredge tailings, and vegetation and topography changes.
- Remains of the associated settlements, including some buildings such as the courthouse and the chimneys of a store operated by a George Yan, a local businessman of Chinese origin (Ashley et al. 1991), and Matthews Cottage (Ashley 1993 Part C); and the sites of houses, huts, public buildings, street layouts, exotic plantings and associated artefacts.
- A range of numerous other localities scattered throughout the park that exhibit some of these features, including Grey Mare, Bogong diggings, Tin Mine and Elaine.
- Extant huts in Kosciuszko that are specifically related to the mining era or contain key evidence of it; isolated huts associated with mine workings include Tin Mine, Grey Mare, Pig Gully (ruin) and Four Mile (Ashley et al. 1991).
- The impressive cultural landscapes of some areas in the park that all these features combine to create, including the water races and workings constructed around the hills at Kiandra by the Chinese, and Lobbs Hole on the Yarrangobilly River (Ashley et al. 1991).
- The extended system of routes, tracks and roads, both official and unofficial, that resulted from mining activities.
- A more intensive and official pattern of agriculture and urban settlement in the area, brought about by mining.

### ***Non-tangible items***

- Place names associated with the mining era.
- Traditions, stories and skills arising from the mining era, and the historical, emotional and social links of descendants with the era and its manifestations.

## **Significance of mining as it is manifest in the park**

The significance of this theme in the Alps is summed up as follows:

- first bringing significant numbers of Europeans into the alpine environment;
- bringing colonial government action into the Alps;
- stimulating regional service industries such as agriculture and saw milling and developing regional economies;
- overlaying an infrastructure on the alps, particularly towns, roads and tracks (LRGM Services 2002).

The mining rushes of the 1850s and 1860s, of which the sites in Kosciuszko, especially Kiandra, were a part, represent a theme of *national historic importance*, encompassing as they do a major development in Australia history that had crucial social and economic consequences.

Mining had a major impact on the Alps, not so much because of the actual area mined, but because of the intensiveness of the operations. Mining brought large numbers of people into the alps at a time when they were sparsely settled or unexplored, and provided considerable impetus to infrastructure development (roads etc), regional supply and service industries (farming, saw milling etc) and the development of fledgling towns of the region. The complex of sites taken as a whole has the capacity to vividly illustrate the drama of the mining rushes of the 19<sup>th</sup> century and the intensity of individual effort and expectations. Together they provide a *regional expression of a theme of national importance*.

Another key element of the significance of the mining in Kosciuszko relates to the adaptations that were required in Australian mining practice to cope with an environment that was unique in Australia in terms of altitude and severe winters, with abundant snow and lack of access. This complex of sites forms an interesting contrast with the adaptations necessary to allow mining in the arid zone, where lack of water, timber and extreme heat created a need for other unique adaptations.

In particular, the remains of the Kiandra goldfield, being the most extensive and successful Australian goldfield at this altitude, demonstrates *national historic importance*. It is the best example of a goldfield operating in a context and environment that is unique to Australia –in comparison with Glen Wills in Victoria. This national significance is more readily interpreted in the Kiandra landscape rather than at individual sites. It is outstanding and unparalleled in having a range of cultural features associated with mining within an alpine natural environment. (LRGM Services 2002).

At the level of *state significance*, Kiandra also has significant historical themes that relate to the importance attached to the discovery by NSW, and the hopes and infrastructure invested in the field as a potential solution to the state's economic woes and as successful competition to the Victorian goldfields (LRGM Services 2002).

Other places within the park have been assessed as being of *state significance* because they are outstanding examples of different types of mining of different minerals - gold, copper, silver-lead. The sites thus have considerable historical and scientific value because of their research potential in a number of fields. They have representatives of a large range of structures and artefacts. They are outstanding examples of living and working conditions in a remote and rugged Australian environment. The sites at Grey Mare and Tin Mine, at New Chum Hill, south Bloomfield and the Empress mine within the Kiandra historic area, fall into this category. Tin Mine is notable for its extant huts, with their wealth of associations and representative construction techniques (LRGM Services 2002).

The majority of mining sites within Kosciuszko, being of a fairly low yield, on alluvial deposits, have been mined for a short period with very simple methods and using machinery only on a very small scale. They demonstrate basic technologies that are commonly represented elsewhere, and they exhibit low key and not easily interpreted evidence of mining and settlement that are duplicated throughout the alps. They are of *regional or local significance* (LRGM Services 2002).

## **Logging, timber product extraction and silviculture**

### **Brief description**

The alpine sawmills of Kosciuszko operated in a subalpine region, not an alpine one, although in winter the mills were sometimes blanketed by snowfalls. The mills were small family businesses (Broadheads from the 1860s to 1905 then the Kellys until World War II) and the timber cut was limited to Alpine Ash (*Eucalyptus gigantea*, now *E. delegatensis*) of a diameter that the water and steam-driven saws of the day could handle. They were always known as the 'alpine mills' because nearly all of them operated along Alpine Creek in the eastern section of the national park (Turner 1992).

Broadheads started with sawpits at Kalkite. They subsequently had a waterwheel-driven mill on Alpine Creek in 1885; this was replaced by a steam-driven one in the 1890s. It supplied timber for Kiandra Anglican church, Cooma courthouse, police station and police residence as well as numerous local huts. From around 1900 there were mills at Swamp Creek, Alpine Hill, Providence and, after World War II, at old and new Adaminaby (Turner 1992).

Following the establishment of the Forest Commission of NSW in 1916, assessments of the forests were conducted. In the area later gazetted as Alpine Creek State Forest No 579 (of about 7300 acres), it was noted that about 40% of the forest was Mountain Ash belts that had been cut and that there was then (1917) dense regeneration. The new commission was charged with establishing softwood plantations, as 75% of softwood was being imported (Grant 1988). Softwoods were planted at Jounama State Forest No 594 near Kiandra from 1924 to 1935. The state forest was included in Kosciusko State Park in 1944 but the plantation of 545 ha of unusual species - *Pinus ponderosa* and *P. larico* - remained (Grant 1988). This plantation is of cultural significance as an example of early softwood silviculture and acclimatisation trials for a sustainable timber industry in Australia.

Forests to the north, like Mount Tantangara, were logged, and the lower slopes on the northwest were logged from the 1870s for mills in Laurel Hill, Batlow and Tumut (Grant 1988). The Snowy Mountains Region Cultural Heritage Management Strategy (NPWS 2001a) also mentions McGregor's sawmill site and sawpits at Managle, but gives no detail.

After World War II, the mills employed Europeans who were used to working with softwoods - for example, George Vodicka, a Czechoslovakian migrant, who had to adapt to new timbers and different sawing techniques. Much timber was needed in the construction of the Snowy Mountains Hydro Electric Scheme; many migrants and Aboriginals were also probably employed in the forests.

## **Manifestations of logging, timber product extraction and silviculture in the park - cultural heritage items**

### ***Tangible items***

The following sites and items are included in this category:

- The boilers from the Providence mill (1936–46) still remain on site, plus the water race, hut remains and steam engine;
- Broadhead's Kalkite mill site (1870s) has the remains of the dam race, permanent habitation in the form of two buildings, and the graves of two children (Kosciusko Huts Association 2002);
- Broadhead's Alpine Creek mill site (1884–1901) has a cleared gravel area and deep gully;
- West/Kelly's Alpine Hill mill site (1918–36) has a cleared gravel area;
- Broadhead's upper Alpine Creek mill site (1901–05) has a cleared open spot beside the creek off the Alpine Creek fire trail;
- The site of the Bolara alpine sawmill at Adaminaby (1958–70s) is marked by willows and pine trees;
- Jounama plantation has exotic pines planted from 1924 to 1937;
- Local buildings made from timber from these mills, as well as other artefacts like early snow skis, furniture etc.

The structural composition of forests in what was the Alpine Creek State Forest is also important. Here, Mountain Ash were selectively removed between the 1870s and 1901 and again between the 1930s and the 1940s.

### ***Intangible items***

- Place names associated with logging, like Sawpit Creek at the Jindabyne road entrance to the park;
- Local stories associated with working in the forests and mills.

## **Significance of logging, timber product extraction and silviculture as manifest in the park**

Logging and timber processing is a theme of national importance in developing regional economies and the logging of Alpine and Mountain Ash forests required understanding of the snowy climate and regeneration requirements for sustaining the industry. Timber production was of regional importance in supplying building materials for the miners at the Kiandra gold rush and then for huts and later chalet buildings in the park.

The Alpine Creek sawmill sites are of state significance as they represent a range of techniques to process Mountain Ash timber from waterwheel through to steam and diesel power.

## **Water harvesting**

### **Brief description**

The following information, except where otherwise cited, is summarised from the Register of the National Estate Data Base entry for the Snowy Mountains Scheme (Pearson and Marshall 2001).

The water from the catchments of Kosciuszko has always been crucial to the maintenance of life and has dictated the way Aborigines, pastoralists and miners operated. For instance, a characteristic of the Kiandra diggings was the extensive dams and water races (Good 1992). On a larger scale, the characteristics of the yield from the alpine catchments make it particularly valuable in an arid continent. The rates of yield are high, the yearly variability is low by Australian standards, and the system provides a high percentage of the water available in south-eastern Australia for agricultural, industrial and domestic use (Slattery 1998). Schemes to harness this wealth and distribute it to the best advantage of agriculture and industry had been proposed since the 1860s and were augmented later by ideas for electricity generation.

During the immediate post World War II period, a coalition of circumstances and an era of national planning came together to create the Snowy Mountains Hydro-electric Scheme. A number of factors were significant: postwar reconstruction, concern for providing increased employment, more efficient agriculture and industry development, a need for population growth, and the availability of unlimited labour from Europe. Together these factors made the development of a water harvesting and energy creation scheme on a grand scale a practical and visionary prospect. The Snowy Mountains Hydro - Electric Scheme was aimed at moving 'unproductive' water west of the divide to provide an increased and secure water source for agriculture while at the same time generating cheap hydroelectricity for eastern Australia.

In 1949 the Commonwealth government passed special legislation to enable the inauguration of the Scheme and created the Snowy Mountains Hydro-electric Authority to develop it. Much of the infrastructure was to be built in Kosciusko State Park, which had been gazetted in 1944. There were two basic parts of the Scheme - reflecting the traditional state rivalry between NSW and Victoria - the Snowy-Tumut section and the Snowy-Murray section. When the Scheme was completed in 1974, it consisted of 16 large dams; 80 kilometres of aqueduct pipelines; 13 major tunnels covering more than 140 kilometres in all; 7 power stations, two of them deep underground; 8 switching stations and control centres; 3 towns to service the Scheme; and sites of about 120 work camps and former construction towns. (Pearson and Marshall 2001). It also had numerous stream gauges (Kosciusko Huts Association 2002).

Additionally, temporary shelters and huts associated with the Scheme sprang up all over the park. Most were for shelter, but some were associated with stream gauging (Kosciusko Huts Association 2002).

The Scheme was by far the largest national endeavour undertaken in Australia. It succeeded in providing cheap and reliable electricity and water for much of south-eastern Australia and in stimulating employment, agriculture and manufacturing.

Approximately 100,000 people worked on the Scheme over 25 years from 1949 to 1974, including some 70,000 from Europe. Many of these Europeans were displaced by the Second World War and directly recruited by the Snowy Mountains Hydro-electric Authority. The project brought new management and engineering techniques to Australia, encouraged growth of the Australian construction industry, and was the foundation of modern Australian multiculturalism. The tradition of endeavour and toughness in adverse conditions, already part of the ethos of the Alps, was continued and boosted by the Scheme. Workers were well paid but worked for long hours in risky conditions; 121 died. The Scheme had a deep and lasting impact on those who worked on it and is appropriately remembered by them and their descendants. Socially, the impact of many foreign male workers had a big effect on the life of the regional towns and their social mores.

Research and survey work for the Scheme provided immensely detailed data on the topography, geomorphology and geology of Kosciuszko. The massive investment of capital to utilise the water resources went hand in hand with a realisation of the value and recognition of the severe erosion problems that threatened the catchments. Consequently the Snowy Mountains Hydro-electric Authority undertook extensive soil conservation work within the park, partly to rectify damage caused by the Scheme itself. The authority also financed and supported conservation work conducted by the NSW Soil Conservation Service on the Main Range, and influenced the cessation of high country grazing. On the other hand, consideration of the possible adverse environmental effects of the Scheme gradually increased. In the later stages of the Scheme, conservationists successfully lobbied, for environmental and scenic reasons, against the proposed construction of the Spencers Creek Dam (Good 1992). Today the dramatically low flows in upper reaches of rivers such as the Snowy have been recognised as a major environmental problem and environmental flows have now re-commenced.

Many relatively good quality access routes were opened up, probably allowing further invasion of pest species and certainly providing for the development of recreation facilities, especially the ski fields that had been popularised by the European workers.

There were significant losses for many as a result of the Scheme. The loss of high country grazing leases and the way of life they represented was deeply felt. Many people were removed from their homes and towns, as at Old Adaminaby and Old Jindabyne, and relocated to enable the Scheme to go ahead; neither authorities nor the general community had any real comprehension of the social and emotional cost that is still felt strongly among the elderly in the area (Read 1996).

### **Manifestations of water harvesting in the park - cultural heritage items**

#### ***Tangible items***

- Much of the infrastructure of the Snowy Mountains Hydro-electric Scheme, including dams, pipelines, tunnels, power stations, roads, work campsites and towns, lies within the park;
- Many of the huts used for shelter today are buildings originally associated with the Scheme;
- The landscape of the park has been very significantly altered by the engineering works of the Scheme;
- Major public roads and maintenance tracks and roads bisect sections of the park;
- Major soil conservation works have been undertaken;
- Some introduced species have resulted from soil conservation work and from exotic plantings associated with the Scheme.

#### ***Intangible items***

- Place names have been given to new features developed with the construction of the Scheme;
- Many who worked on the Scheme have a direct and continuing emotional and social connection with it;
- There are sorrowful and powerful cultural memories of loss and mourning among some of the older local community whose lives were disrupted by the Scheme;
- The Scheme and its history remain an important and visible part of the story of the Kosciuszko region, a national icon, and of ongoing interest to visitors and the general public, who hold it in high regard as a nation-building exercise.

### **Significance of water harvesting as it is manifest in the park**

Water harvesting is an extremely important historical theme of *national historic and social significance* in Kosciuszko National Park. The Snowy Mountains Hydro-electric Scheme, a large part of which is within the park, is the largest engineering project ever undertaken in Australia. It has national significance as an engineering feat, as a symbol of Australian achievement and as a basis for Australia's multicultural society.

The following elements together give the Scheme as it is now manifested in Kosciuszko National Park *national historic, social, and scientific significance*:



- The Scheme represents an outstanding engineering success and achievement and is the largest and most complex example of such a scheme in Australia;
- The scale and nature of many of the Scheme's engineering and design components are rare, and it exhibits technical and design achievement of the highest order;
- Many of the components have the potential to provide more information about the experience and achievement of the Scheme's workers, designers and contactors;
- The Scheme adds to the complex layers of human occupation of an important and significant area, juxtaposing major engineering objects on a distinctive mountain landscape and exerting a profound aesthetic and environmental effect on the landscape;
- The Scheme is closely associated with a number of prominent Australians;
- The Scheme is significant in the history of post World War II migration and can be considered as the basis for Australia's multicultural society;
- The Scheme revolutionised post-war working conditions and industrial relations and introduced modern concepts of management and large-scale project development in Australia;
- The Scheme continued the already established alpine tradition of work by men in unusual and harsh conditions, and caused the evolution of work attitudes and management systems to cope with this;
- The Scheme is strongly symbolic for a large part of the Australian community and is held in high regard by them; it is very publicly and continually associated with Kosciuszko National Park and attracts many visitors in its own right;
- The large community of former Snowy workers and their families hold the Scheme in special regard; at a local and regional level the Scheme evokes sorrowful and powerful cultural memories of loss and mourning among some of the older community whose lives were disrupted by it;
- The Scheme was influential in phasing out alpine grazing and led to a program of soil erosion control, but also caused environmental damage within the park;
- The development of the area, the existence of the Scheme and the improvement in number and quality of access roads led to an increase in recreation opportunities and development;
- Snowy Hydro Limited is providing for the rehabilitation and restoration of many former Scheme work sites within Kosciuszko National Park.

## Scientific research, conservation and park management

### Brief description

The material for this theme comes mainly from Griffiths and Robin (1994), Macdonald and Haiblen (2001), Lennon (1999) and Slattery (1998).

### Scientific research

The history and achievement of alpine science are part of the cultural heritage of Kosciuszko even though historians of Australia have frequently neglected science in their narratives. Mulvaney (1992) points out that the anti-intellectualism in the Australian psyche has failed to acknowledge adequately the extraordinary feats of endurance and imagination in the scientific explorations of the early researchers such as Howitt and von Mueller. These people are not as nationally recognised as is the ethos encapsulated in *The Man from Snowy River*. The history of alpine science in this century is also not popularly recognised, but it has informed our fundamental principles of land management in the park and the Alps more generally (Griffiths and Robin 1994).

Before 1940, most science in the Alps was incidental, unrepeated and descriptive. It was the science of exploration - a traveller's and discoverer's science, conducted mostly by individuals. Since 1940, much science in the Alps has been experimental, problem-oriented and sustained over repeated visits. It has often been institutional in derivation (Griffiths and Robin 1994).

The 19<sup>th</sup> century botanical investigations of von Mueller and Maiden were of international interest, as were the geological studies of Edgeworth David, the anthropological work of Howitt and the meteorological studies of Clement Wragge (Lennon 1999). During this period also, extensive fieldwork established state and territory boundaries at the park edges and features such as the Willis customs house were established (Slattery 1998; Argue 2000).

The Australian Alps are significantly different from other alpine areas throughout the world - they are 'soil mountains' in contrast to the rock of Switzerland and New Zealand and the peat and oceanic mountains of Europe. Unlike rocky mountains, they have complex and interesting vegetation patterns. The tree lines and ecotones between different ecosystems are of particular scientific interest. Vegetation analysis studies shaped the way the soil conservation agencies of Victoria and NSW undertook their work. Costin's work on the Snowy catchment and the Fawcett studies on the Hume and Kiewa catchments became benchmarks of Australian alpine ecology (Griffiths and Robin 1994). The first attempts at reclamation and revegetation were undertaken in 1959 in the Mount Carruthers to Mount Kosciuszko area and have proved successful. This work in itself left significant physical remains in the high country, especially in the form of stone channelling to rectify erosion (Good 1992).

On the Main Range, geological features associated with the controversial glaciation debate about the extent of glaciation are important, along with sites associated with the dating of Australian glacial events. Monitoring sites, where measurements have been made of stone movement on Mount Twynam, karst processes at Cooleman Plain and Yarrangobilly Caves, and tree line dynamics in Thredbo Valley, are also sites of outstanding cultural significance associated with scientific research (Lennon 1999).

Archaeological research in the Alps, notably the pioneering work of Josephine Flood, has also generated investigations into human occupation of the alps and influenced perceptions of the past. Ecological research such as Ian Pulsford's Cypress Pine monitoring at sites along the lower Snowy River has provided valuable information about the pre-contact vegetation structure and dynamics of this area in relation to the high country (Pulsford et al. 1993).

Recent research by Aboriginal workers is convincingly documenting the continuity of Aboriginal culture in the park since the first European settlement. The formation of the Australian Alps Liaison Committee has stimulated a raft of excellent quality research into the cultural heritage of the Australian Alps, including the Kosciuszko area, and has enriched our knowledge of the effects of the human presence in the park and the significant fabric and traditions created by this presence.

In the 20<sup>th</sup> century, the emphasis of scientific work has been on water catchment and engineering studies related to the Snowy Mountains Hydro Electric Scheme, and on ecological studies largely driven by concerns about conservation - vegetation and soil conservation, conservation of water quality and quantity, and, recently, concerns about the conservation of wilderness. Science has aided conservation to repair the damage done to fragile alpine ecosystems by cattle and sheep grazing over the last century, and to conserve the vegetation cover of the vast water catchments (Lennon 1999).

### **Conservation and park management**

By the last decades of the 19<sup>th</sup> century, scientists such as Maiden, Stirling and Helms were warning of the destruction to the high country caused by grazing, feral animals and the practice of regular burning to promote 'green pick' (Good 1992). The rapidly accumulating research results on the natural environment of the Alps provided a firm foundation for the ecological studies of the 20<sup>th</sup> century.

Improved access by car and train and the growth of recreation in the bush as a promoted healthy pastime brought many people to the Alps in the early 20<sup>th</sup> century, raising the awareness of the need for conservation measures in this fragile environment (Gare 1992; Slattery 1998). By the 1930s, the bushwalking clubs were organised and focused enough to provide a good base for active lobbying for a government conservation agenda. In 1935 the first proposal for a Snowy-Indi Primitive Area was generated (Gare 1992). Meanwhile, a dedicated young Commonwealth forester, Baldur Byles, documented the widespread erosion of the high country. His report provoked the establishment of the NSW Soil Erosion Committee and, in 1938, the NSW Soil Conservation Service (Good 1992; Slattery 1998).

During the 1940s, Kosciuszko State Park was established in response to the growing conservation and recreation lobby; grazing was controlled to some extent, but it still continued and in fact provided income for the park trust (Gare 1992). Leases granted from this period onwards had a requirement for rabbit control, since rabbits were recognised as one of the major threats to the high country (Don Maxwell, pastoralist, pers. comm., October 2002). An alliance of the Soil Conservation Service and the Snowy Mountains Hydro-Electric Authority, with a remarkable coalition of individuals, each with a slightly different agenda, combined forces to generally protect the high country from grazing, with the initial limitation of grazing occurring in the 1940s (Slattery 1998). Meanwhile the Snowy Mountains Hydro-electric Authority and the Soil Conservation Service had put in a massive effort in soil conservation works. Their initial methods were somewhat heavy-handed and included the use of exotic plantings, but these practices gradually improved (Good 1992).

A growing realisation of the impact of the Snowy Scheme itself on the alpine environment led to a variation in the Scheme. Good (1992) argued that this was an important early example of the community and scientists succeeding in an environmental argument. It also led to the creation of the first primitive area in the Spencers Creek area in 1963. The area was open to skiers and walkers, but protected from previously planned massive Snowy Scheme engineering works (Slattery 1998).

In 1965, the NPWS was created and Kosciuszko National Park was declared in 1967. Management for nature conservation became a priority. After another debate, the 135-year practice of high country grazing ceased and a 25-year restoration process was put in place. The creation of alpine parks in Victoria in the 1980s immensely strengthened the size and viability of the alpine conservation reserve system (Slattery 1998).

As the largest, and probably highest-profile, park in Australia at the time of its establishment and early development, Kosciuszko has also played an important role in the evolution and development of the profession of park manager, and of the discipline of park management generally.

Concentration on nature conservation has had its costs. Certainly the removal of stock from the high country had been well demonstrated to be an ecological necessity, but there was perhaps initially insufficient recognition of the loss of a way of life and treasured traditions, and of a breaking of strong emotional ties, all of which resulted from the cessation of grazing in the high country.

In the same way early zeal to restore a 'pristine' environment initially ignored the long Aboriginal heritage of the park, and also led to the destruction or damaging neglect of valuable historical heritage fabric, most notoriously at Kiandra.

This in turn has led to protest, lobbying and research by heritage conservationists, and a gradual revision of policies and procedures to protect cultural heritage. The challenge that remains however is the integration of the management of the natural and cultural values of Kosciuszko.

Another key development in conservation has been the recognition of the conservation value of the alps as a unit - hence the development of the Australian Alps Liaison Committee, which has made some progress in the standardising of identification and management policies for natural and cultural values in the alpine parks of NSW, Victoria and the Australian Capital Territory (ACT).

## **Manifestations of scientific research, conservation and park management in the park - cultural heritage items**

### ***Tangible items***

- Experimental and monitoring sites of historic importance in the history of research in the park - examples include Carruthers and Twynam ridges transects, Dainers Gap and Hotel Kosciusko sites, Main Range glacial sites (Guthrie saddle, the David moraine, Perisher Creek exposure, 'Railway Embankment' moraine), Costin's carbon-14 sites, Clement Wragge's weather observatory on Kosciuszko summit, and the earliest (1950s) plots of the Soil Conservation Service of NSW at Long Plain;
- Experimental and monitoring sites of current importance for ongoing research and monitoring in the park (Lennon 1999):
  - Kiandra plots for the work of John Leigh, Dane Wimbush et al;
  - rock movement monitoring sites on Mount Twynam;
  - the Cooleman Plain karst area and Yarrangobilly Caves monitoring sites;
  - Slatyer's Thredbo Valley tree line monitoring sites;
  - Pulsford's sites in the lower Snowy.
- Examples of historic early nature conservation work - for example soil conservation and restoration works on Mount Twynam and Mount Carruthers;
- Numerous examples of conservation management, infrastructure and activity throughout the park;
- Destruction of or damage to parts of the park's cultural heritage fabric with the aim of restoring the natural environment;
- Border markers delineating the boundaries of NSW, Victoria and the ACT and associated cadastral information.

### ***Intangible items***

- The strong tradition of conservation, activism and dedication that created the park and seeks to maintain its values;
- Loss of a way of life and treasured traditions, and a breaking of strong emotional ties that resulted from the cessation of grazing in the high country;

The contribution of alpine research in Australia to the creation of an enriched global perspective on alpine research generally should also be acknowledged.

## **Significance of scientific research, conservation and park management as manifest in the park**

The theme of science and conservation in Kosciuszko National Park is of international and national significance.

The nineteenth-century botanical investigations of von Mueller and Maiden were of international historic and scientific interest, as were the geological studies of Edgeworth David, the anthropological work of Howitt and the meteorological studies of Clement Wragge.

Establishment of state and territory borders at the edges of the park was a significant element in the administrative management of the continent. The border markers and associated remains are likely to have national heritage significance (Argue 2000).

The ecological studies of the Australian Alps are of international significance for historic and scientific reasons. The Australian Alps are significantly different from other alpine areas throughout the world because of their 'soil mountains' nature, their complex and interesting vegetation patterns, and the pattern of tree lines and ecotones between different ecosystems. This makes the intense and thorough research work on these ecosystems of international significance for historical and scientific reasons.

Sites of particular significance associated with scientific research include those listed earlier as tangible cultural heritage items related to scientific research, conservation and park management, as well as those mentioned in the description of scientific research near the start of this theme's section. The level, range and importance of this suite of research have national significance.

The story of research in the park is associated with a range of internationally and nationally famous scientists, many of whom carried out their seminal work within the park and the adjoining alpine areas.

The conservation of an area that juxtaposed outstanding natural areas, opportunities for much-needed water harvesting and power generation, and economically important pastoral activity posed a challenge for the community and conservationists. The conservation effort that created Kosciuszko National Park was of historic importance in the development of the conservation movement at a national level, and subsequent development as a major national park has had an important national influence on the development of park management policies and procedures in Australia.

## Recreation

### Brief description

The information for this theme is derived mainly from Gare (1992), Slattery (1998), Lennon (1999) and Freeman (1998).

Recreation has been described as the pleasurable and constructive use of leisure time or as a refreshment of the strength and spirit after toil (Gare 1992). Kosciuszko National Park offers such a range of combined recreation opportunities that it has attracted a wide range of people from earliest times. It provides recreation opportunities unique in Australia, containing as it does alpine scenery, the snow fields, Australia's highest mountains and the romance of the history of the high country. Recreation has taken many forms - bushwalking, sightseeing, rock climbing, horse riding, canoeing, skiing, caving, camping, fishing, photography, sketching, painting, aesthetic appreciation and inspiration. Some people take resort-style holidays in the park. People have sought exercise, excitement, peace, solitude, beauty, health, spiritual refreshment, social life, family gatherings and relationship therapy in the area. The recreation patterns of the park and the heritage left by this use are rich, complex and sometimes in conflict with the park's other values.

Aboriginal people from the coast, the highlands and the inland used the resources of the Alps, including the Kosciuszko area, for the important and exciting Bogong moth festival that integrated summer recreation and feasting with ceremonies and with material and social exchange (Gare 1992; Young 2000).

The graziers who were permanent residents of the area for more than 100 years likewise used it not just for livelihood but also for rest and recreation. Photographs held by the Maxwell family show that horse riding has a long tradition in the area and was the principal means of sightseeing for pastoralists and their guests as well as for early tourists until relatively recently (Don Maxwell, pastoralist, pers. comm., October 2002).

At the time of the gold rush, Kiandra was the birthplace of Australian skiing, which was first noted as a recreational pursuit in 1861. By the 1870s, the Kiandra Snow Shoe Club had become the Kiandra Pioneer Ski Club, the oldest in the world. There is significant reference to this club, complete with artefacts in the Holmenkollen Skimuseum in Oslo, Norway. The club still exists in Perisher valley having transferred from Kiandra in the late 1950s. By late in the century the first wave of urban recreational users had begun regular mountains visits. These early visitors included Banjo Paterson and Charles Kerry, the photographer who recorded early skiing at Kiandra and led the first winter ascent of Kosciuszko in 1897. By 1898, recreation had become an important aspect of the public value in Kosciuszko. Also in 1898, the first complaints of damage to the high country by grazing were made by Helms, who complained that it interfered with 'the artist and tourist who seek the picturesque' (Gare 1992).

By this time the bicycle, railways and motorcars, along with increasing prosperity, had increased mobility and the popularity of tourism. Active pursuits in pristine mountain country with good air and a bracing climate, away from the unhealthy and disease-ridden cities, were seen as important for health and actively encouraged by government and the medical profession. This period saw active government encouragement of recreation in Kosciuszko, with the development of Yarrangobilly Caves and the construction of the Kosciusko Road, Yarrangobilly Caves House, accommodation at the Creel for fishermen and the Hotel Kosciusko. Associated walking tracks were also constructed, and people increasingly visited the mountains to walk, fish, ride horses and bikes, skate on the artificial lake or play tennis and golf on facilities provided at the Hotel Kosciusko. The new government-owned and run facilities were modern, luxurious and well appointed, the equivalent of today's top-class resorts (Gare 1992).

The focus of skiing shifted from Kiandra to Kosciuszko with the building of Hotel Kosciusko and it took on an elite dimension. The Kosciusko Alpine Club began in the Kosciusko Hotel in 1909 at Diggers Creek (Dainer's Gap). This club has continued at Charlotte Pass and at the Alpenhof Lodge in Perisher Valley and highlights the history of competitive skiing in the 1920s and 30s by people such as Tom and Eleyne Mitchell and Ken Breakspare. The National Cross Country trophies are kept at the KAC Alpenhof Lodge and the National Mens 15K Cross Country Trophy dates back to 1919 and is regarded as one of the oldest trophies in world skiing (Melvey 2003).

The chalet at Charlotte Pass was erected in 1930 and rebuilt after fire in 1939, due in part to pressure by the Ski Club of Australia. It gave much greater access to the Main Range (Freeman 1998, vol 2). Arduous ski trips taking several days were organised, and with them a series of huts were provided for overnight accommodation and shelter in bad weather. Tin Hut was specifically built for the first winter crossing from Kiandra to Kosciuszko in 1927 (Kosciusko Huts Association 2002). Seaman's Memorial Hut was built in 1929 and the Alpine Hut in 1939 (Gare 1992). However, accommodation (250 beds) at the ski fields was very limited by today's standards (Freeman 1998 vol 2), and mass downhill skiing did not commence until the 1960s, when chairlifts, increased resort development and better road access to the ski fields increased their popularity and enabled day and weekend visits (Good 1992).

Bushwalking in the Alps also became popular during the early 20<sup>th</sup> century. Myles Dunphy founded the Mountain Trails Club in 1914; by 1931 the club was operating actively in Kosciuszko, and beginning to lobby for a primitive area to provide an unsullied experience for those seeking peace, solitude, nature and an aesthetic experience in the Alps (Slattery 1998). World War II temporarily disrupted recreation pursuits such as skiing, but saw the creation of Kosciuszko State Park to be available for riding, biking, camping and snow sports, with free access for all. The Kosciuszko State Park Trust was specifically empowered to carry out recreational development, including roads, paths, walking tracks, ski trails and the erection of hostels (Gare 1992). The Snowy Mountains Hydro-electric Scheme popularised skiing further through its workers, developed its extensive road network to and through the park and raised awareness of the Alps through its publicity. Its massive engineering works became new focal points of interest and education for tourists (Freeman 1998 vol 2).

The Hotel Kosciuszko burned down in 1951, but the influx of visitors seeking winter sports continued to increase, encouraged by the activities of the trust, and there was pressure to allow private and commercial development in the snowfields. In 1952 the minister was empowered to grant leases for hotels, accommodation houses and other visitor facilities. The trust continued to run Kiandra Chalet Hotel, Yarrangobilly, the Rules Point Guest House and the Creel, and developed the Cooina Motel at Wilsons Valley. Recognising the need for further accommodation, the trust encouraged the construction of non-commercial lodges built by ski clubs and community groups. Within a few years, commercial enterprises were also allowed, and the period of the ski resorts had begun. This activity has developed into a huge commercial enterprise that has had a profound effect on the environment, culture, visitor numbers and infrastructure of the park (Freeman 1998 vol 2). There are some 150 clubs and lodges that have a unique culture developed over the last half century. The club lodge, formed as a business cooperative is a concept unique to this part of the world and has allowed the development of skiing accommodation as an affordable option for families and friends of modest means and has now served up to four generations (Melvey 2003).

The popularity of downhill skiing and the consequent commercial success and power of the resorts have caused some strains between park managers and those in the industry. Issues such as the number of beds to be made available within the park have been a long-running matter of debate and have put Kosciuszko on the state political agenda on a number of occasions. The natural values of the park have been utilised for over a century as an increasingly important commercial asset by the tourism industry; and the industry in turn generates employment, wealth and local development. The resorts include Perisher Blue Ski Resort, Thredbo Alpine Village, Charlotte Pass Village and Selwyn Snowfields. A more recent development within the park, which was very controversial at the time and which aimed to ease problems with winter traffic congestion and pollution, has been the development of the ski tube that runs from Bullock Flat to the new resort of Blue Cow. This development was innovative and a major feature in terms of design engineering and construction. Its successful completion contributed to the decision to build the Sydney Harbour tunnel and proved an important practice run for this larger and more public development.

In their genesis, planning, mix of non-profit and profit elements, architecture, layout and ambience, the resorts reflect the different trends in postwar architecture, planning and landscape design, as well as the special design and environmental needs for building in the high country, the development of the ski industry since the 1950s, and the park authorities' responses to this development. The industry has brought many people from different nationalities to the Alps, and has created its own subculture, social mores, nomenclature and legends, unique in Australia, but known throughout the country.

It should also be noted that skiing and snowsports are more than recreation –they are also important and Olympic sports and Australia has produced a surprising number of Olympians in winter sports, including Perisher's Zali Stegall (Olympic Bronze medallist and World Slalom Champion and current athletes such as Jenny Owens. NSW school children come to the Jindabyne Winter Academy specifically for snowsports. The cultural values of sport need more study.

The demands of recreation also led to the introduction of a range of species into the park, including game fish, deer, and horses for sightseeing and riding. This in turn has led to the creation of facilities such as fishing huts (including the stone fishing huts in the Geehi area), stables, riding tracks etc.

As the downhill ski industry developed, so did the popularity of, and support for, bushwalking, cross-country skiing, camping and the general appreciation of nature and alpine scenery. Summer visits to Kosciuszko became increasingly popular, with appreciation of nature and wild flowers and ascent of Mount Kosciuszko high on the agenda. A network of huts, many adapted from earlier uses, provide shelter and facilitate cross-country skiing and bushwalking; they have become an important feature of the park. The bushwalking clubs of the 1930s developed into today's active conservation movement, which provides a strong lobby group that seeks a limit to development in the park and the restriction of recreational use and access that could be harmful to the environment and interfere with others' enjoyment. In turn, these demands are seen as elitist and unrealistic by some.

A strong element of the recreation theme in the park has been one of incipient and sometimes outright conflict between the demands of visitors, and the tourism industry more generally, and the need to conserve the- extraordinary natural and cultural values that attract visitors to the park. There is a history of tension and compromise between the requirement to conserve these assets and to provide access to them and enjoyment of them, especially when such access and enjoyment require the development of significant infrastructure.

Another theme inevitably associated with recreation in Kosciuszko is injury and loss of life. Many people have lost their lives through exposure over the years, ski injuries are frequent, and one of the most dramatic disasters of modern Australia - the Thredbo tragedy - took place in the Kosciuszko snow fields. This event has now in itself become a significant part of the history of the park.

As a response to the remote and sometimes dangerous conditions, the park has developed a series of innovative rescue procedures and methods, and there are also physical memorials in the park, such as Seaman's Hut, which commemorate these events.

### **Manifestations of recreation in the park - cultural heritage items**

Evidence of the recreation theme in Kosciuszko is contained in the following items:

#### ***Tangible items***

- The inspirational landscapes of Kosciuszko that are a key attraction of the park and that have become familiar to people through their depiction in paintings, poetry or song;
- The network of historic walking tracks and ski trails, including the walk to the summit and the historic and well-known overland ski and walking routes used for more than a century;
- The lookouts and views associated with iconic alpine scenery;
- The associated access routes, including the ski tube;
- Yarrangobilly Caves complex, including caves adapted for visitors, Caves House, the thermal pool and associated landscaping and bushwalking trails;
- Government-built historic accommodation and resort complexes, including the chalet at Charlotte Pass, the site of the Hotel Kosciuszko and the remains and sites of enterprises that are no longer operating;
- The ski resorts within the park, with their design history, layout, buildings, infrastructure, services, settings and associated ski fields;
- The accumulated park infrastructure, designed to welcome visitors and enhance their stay and to educate, assist, protect, rescue and manage them in the fragile and sometimes dangerous environment of the alps;
- The extensive network of huts throughout the park - some dating from the pastoral or mining era or originally part of the Snowy Scheme infrastructure, some developed specifically for recreation - that are a significant feature of the recreation opportunities of the park;
- The memorials to those who lost their lives in Kosciuszko in the pursuit of recreation and adventure;
- The significant changes to the natural environment of the park brought about by the demands of recreation and the gradual accumulation of in-park settlement, infrastructure, access routes, resource demands etc.

#### ***Intangible items***

- The general, national appreciation and knowledge of the park and its features, as a special and precious place, where for over a century many Australians have had unique and memorable experiences;
- The subculture, mores and legends of the ski fields and resorts;
- The traditions and memories of cross-country skiers, walkers, and other recreational users;
- The occasional tension and conflict between park visitors with different aims, and between the needs of conservation, recreation and tourism.

### **Significance of the theme as it is manifest in the park**

Some of the walking tracks and viewpoints have *national significance* because of their *historic, aesthetic, inspirational and social* qualities.

Mount Kosciuszko itself in its alpine setting as Australia's highest mountain has *national significance* as a symbol, a source of inspiration, and a unique recreational attraction for national and international visitors.

The Kiandra area, apart from its mining history, has *national significance* as the place where downhill skiing was first practised as a recreation in Australia. It also has a claim to *international significance* as the Kiandra Ski Club established in 1861 is the oldest in the world.

Yarrangobilly Caves complex and Caves House and associated developments have *state and regional historic and aesthetic significance* as part of a complex of cave sites developed for tourism in the context of an important national social movement. The architecture of Caves House is also a significant intact example of early twentieth-century resort style development (Argue 2000). The remains of the other government-built accommodation within the park is of *state significance*, reflecting an important historic state government initiative and associated typical architecture and infrastructure, and representing an important social movement.

The extensive network of huts in the park, used for shelter, safety and accommodation, are part of a network of *national significance* and are in themselves of *state historic and social significance* as a response to the needs of recreation in a challenging and often dangerous environment, and as reflecting the historical development and adaptation of a unique alpine network for this recreation.

The ski fields and ski resorts have elements of *state and regional significance* for historic, aesthetic and social reasons because of:

- the important social movement they reflect and represent;
- elements of architecture and layout, which reflect important developments in the history of postwar design, and its adaptation to the high country;
- their influence on visitor numbers, patterns and behaviour and the consequent management and infrastructure of the park.

Freeman (1998) lists Rock Creek, Telemark and Edelweiss at Perisher Valley resort, and the chalet at Charlotte Pass resort as being of *state significance*, and the Perisher Valley resort and Smiggin Holes resort as a whole as being of *regional significance* for the cultural landscape values implicit in their development plans. He lists 27 other buildings and elements as being of *regional significance* and 34 as being of *local significance* (Freeman 1998 vol 1). Many of the names in the resorts commemorate the pioneers in the Australian ski industry, such as Sponar's and Anton's T-bars in Thredbo and Zali's run at Perisher Blue, and are important means of preserving the cultural heritage of the park.

The ski tube and its associated engineering work have *national historic and scientific significance* as an innovative and excellent example of design, engineering and construction in a difficult and sensitive environment. An earlier example of innovative engineering work associated with the sport of skiing was the construction of the world's longest chairlift running from the Alpine Way to Charlotte Pass.

The range of memorials to disasters that caused loss of human life in the park is also significant. These include Seaman's Hut and the memorials to the loss of the *Southern Cloud* and to the Thredbo disaster.

## The Kosciuszko huts

Most of this information is from Ashley (1993).

The Macquarie dictionary defines a 'hut' as 'a simple small house [such] as a beach hut, bushwalker's hut ... accommodation for employees on sheep or cattle stations'. Ashley (1993 part A), in his study of huts in the NPWS estate, defines huts as having three key elements - they are small, they are used as human dwellings associated with different purposes, and this purpose is often seasonal or temporary. They are often built of local material, in vernacular style, and in remote locations as single buildings. They are essentially buildings pared down to an absolute minimum, either because they are for temporary use or because they are all that it is possible to construct at the time. The reason for constructing huts is generally one of the following:

- They are for temporary accommodation in the locations associated with the activity they are designed to facilitate;
- They are built as affordable dwellings in times of hardship;
- They are built as first-stage dwellings, intended to be replaced at a later date as resources allow.

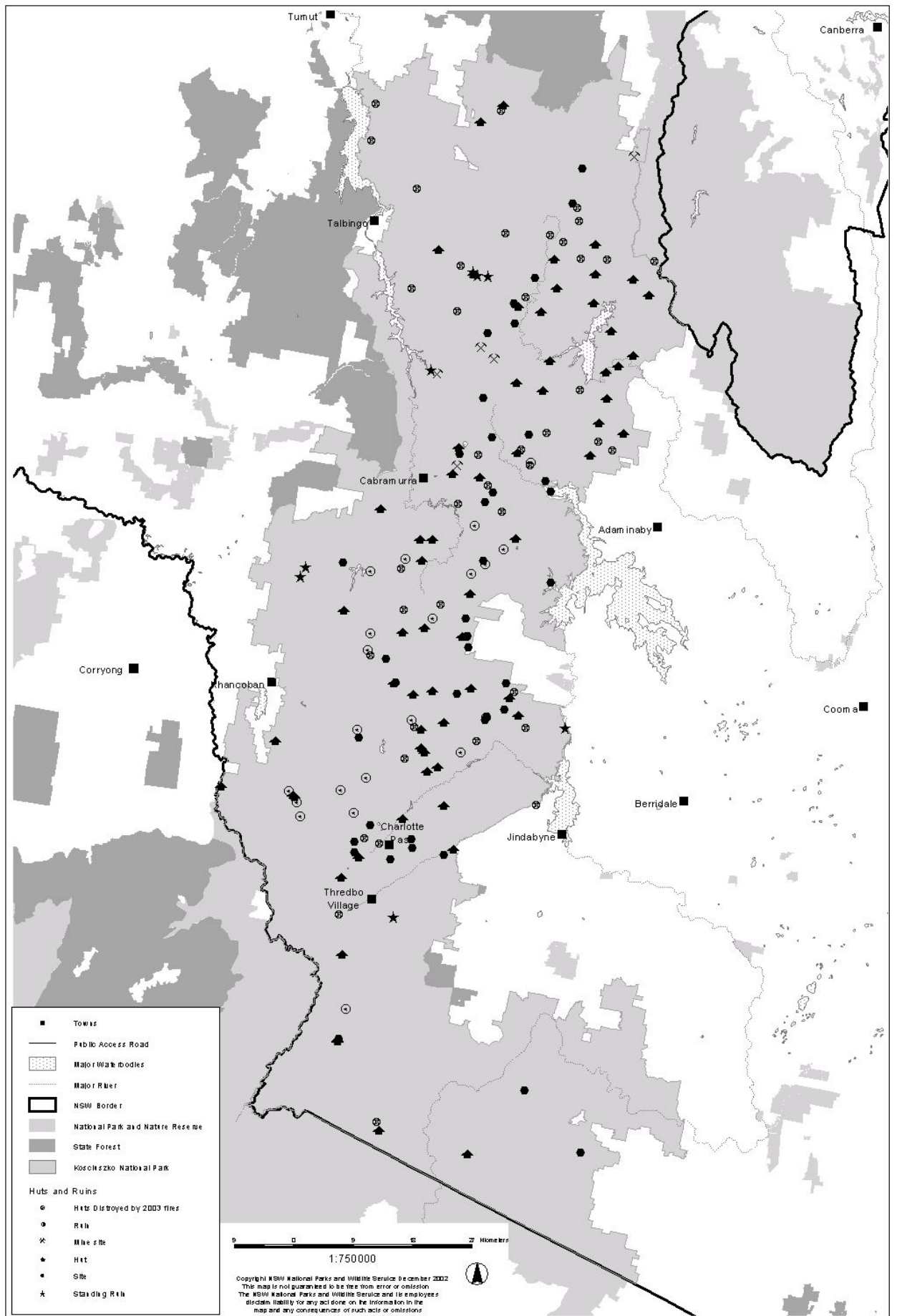
Ashley (1993 part C) describes Kosciuszko as having 90 intact huts, or 61% of the total of 130, which includes intact and ruined huts. Altogether there are 239 huts, ruined huts and known hut sites. Some changes have occurred since 1993 and the Kosciuszko Huts Association usually says there are around 100 intact huts in Kosciuszko today (Kosciuszko Huts Association 2002). The geographic location of these huts is illustrated in Map 13.1. This is perhaps a little more than half of the original number of huts in the area that now comprises Kosciuszko National Park. (By way of contrast the Alpine National Park in Victoria contained 111 huts in 1996.) The Kosciuszko huts together make up the biggest complex of different types of huts, congregated in an area of comparative size, in NSW, and possibly in Australia, and represent a rich range of uses. Their uses relate to the history of transient land use in the park - pastoral, mining, Snowy Mountains Hydro Electric Scheme construction, and shelter for skiers, walkers, park staff and researchers. The huts are important historical markers of different, often overlapping, land use but do not necessarily reflect a balance of these phases, since most extant huts date from the 1920s to the 1950s. Many of the huts are recent, with 12 associated with pastoral use after 1944 and 19 associated with the Snowy Mountains Hydro Electric Scheme (Ashley 1993 part C2).

A characteristic of the huts is their continual adaptation - from grazing to mining, from Snowy Mountains Hydro Electric Scheme construction to grazing, or from any of these to shelter for skiers, walkers and researchers.

About 60% of the huts have primary association with pastoralism, the oldest being actually established as homesteads on pastoral runs (Cooimbil, Old Currango, Currango). Most of the extant pastoral huts date from the 1920s, when the seven-year maximum grazing leases were introduced for areas above 13 000 m (Ashley 1993 part C). Pastoral huts show a clear concentration in the central and eastern sections of the park, and can be associated with the known movement of sheep and cattle. A substantial majority of these are associated with cold air drainage, which prevented the growth of trees and subsequently created grassland vegetation. These natural grasslands were used for sheep, while cattle were more often grazed on alpine vegetation. The huts are positioned on the edge of the trees above these natural grasslands, providing increased shelter and access to firewood (Ashley 1993 part C).

Map 13.1

Geographic location of huts in Kosciuszko National Park





Mining huts that remain were later also used by stockmen. The oldest mining huts are the Four Mile mine goldminers hut built near Kiandra in 1937 and the Tin Mines complex near Mount Pilot, 1936–1937 (Ashley, 1993 part C: 4). Most of the extant huts have now been used for recreation shelters for longer than the purpose for which they were originally designed. In 1935, 53 huts were listed by the Australian and New Zealand Ski Year Book as being available and useful shelter. Some were purpose-built for recreation - for instance, the Tin Hut built in 1925 by the ski club and the tourism bureau. In the 1940s the Geehi huts and Bullocks Hut were built for fishing and recreation. One hut associated with tragedy is Seaman's Hut, built by the NSW government with money from Seaman's parents to commemorate his death in a blizzard in 1928 (Ashley 1993 part C).

Nineteen of the huts are primarily associated with the Snowy Mountains Hydro-electric Scheme construction work. They were used by survey teams and hydrologists planning construction work, and some are still used by the authority (Ashley 1993 part C). They add an extra and unique layer to the Kosciuszko huts picture.

Most of the huts show some adaptation to the harsh environment and to the limited seasonal time available for their construction. Some have vertical access for occasions when snow prevented any other. Several huts have double sets of entry doors to keep out the cold and snow. Almost a third of the huts are built of material found nearby - horizontal and vertical slabs of timber, logs and stones, but in the more modern huts weatherboard and corrugated iron predominate, with some weatherboard being hand-split or coming from local bush mills. There are 12 remaining slab huts in the park, which comprise almost all the NPWS collection of such huts. Many huts have internal linings of flattened kerosene tins, tar paper, malthead or pasted newspaper. There is a notable group of five river-stone fishing huts near Swampy Plain and Geehi (Ashley 1993 part C).

It appears that the huts used for pastoralism, mining and the building of the Snowy Mountains Hydro Electric Scheme represented a largely masculine domain, but the history of women in the pioneering record is often lost or neglected, and the role of women here, as elsewhere, needs more research. Certainly the huts reflect the rugged and sometimes hazardous lifestyle of their occupants. Another characteristic of the huts is that they are associated with pastoral workers, often small-time miners, the unemployed and rabbiters from the Depression period, and the migrant workers of the Snowy Scheme - a class of users that is often not well represented in our heritage database. Their modest and makeshift nature conveys a unique psychological and social meaning.

Associated with the huts are traditions, legends, stories and particular notable people and families. They do not date just from the pastoral and mining era but also include Snowy Mountains Hydro Electric Scheme staff, bushwalkers, skiers and park staff. They are the focus of many of the European story lines that criss-cross the park and that are in many cases built on ancient Aboriginal pathways to the high country.

The recent bushfires which burnt almost 70% of Kosciuszko National Park also destroyed or seriously damaged 19 historic huts, namely:

- Boltons
- Boltons Hill
- Boobee
- Orange (Diane)
- Brooks
- Burrungubuggee Shelter
- Delaneys
- Patons
- Stockwhip
- Dr Forbes
- Geehi
- Pretty Plain
- Grey Hill Café
- Happy Jack 3 and 4
- Linesmans 2
- Old Geehi (YHA)
- O'Keefes, and
- Opera House.

The Service has initiated a process with key stakeholders to determine these huts individual and collective significance in order to determine an appropriate management response.

The Kosciuszko huts probably comprise the biggest complex of different types of huts, designed for the widest range of purposes, in a comparative area anywhere in Australia. Individual huts have considerable archaeological, social, historical or aesthetic significance, but the huts, ruins and hut sites have *national historic and social significance* as a complex. Within this general field we can identify a number of particular values:

- The complex has historic value, representing the major extant evidence for the major non-Aboriginal land use phases of the park. Many of the huts, by their historical association, provide a major element of the evidence for types of work that are no longer practised or that are a unique project such as the Snowy Mountains Hydro Electric Scheme;
- The complex has social value as representing a way of life that has iconic status in Australia and that is associated with important social movements and persons. The majority represent the work and lives of pastoral workers, small-time prospectors and migrant workers. Because many continue to be used today for shelter and recreation, they constitute an important link between today's park users and those of the past, and for modern users they provide a tangible and important trigger to the historical imagination;
- The Kosciusko Huts Association, the history of that association's recognition of the value of the huts and the remarkable voluntary work to conserve and repair them and to maintain their use give a strong indication of their current social value to many park users. On the other hand there is some evidence that, at the time of preparation of the present Kosciuszko National Park Plan of Management, some park users and managers saw the huts in a negative light, as impacting on the environment;

- The huts between them represent a wide range of materials, design, construction, maintenance and adaptation techniques, and they constitute an important architectural, archaeological and historical research resource for this reason;
- Many of the huts, especially the slab huts, because of their vernacular construction and setting, have an element of simple beauty, which blends well with the dramatic and austere alpine landscape and environment and gives them aesthetic value;
- The conservation and present curation of the huts represents an important milestone in the history of natural and cultural conservation in NSW - a gradual development by the NPWS of an understanding of the nature and value of non-Aboriginal cultural heritage and of the necessity of involving and working with its traditional owners and the community generally to conserve it.

## Dependence

The reserves and parks of the alpine region conserve a significant variety of ecosystems and terrains. They constitute the only alpine environment in the world's flattest and lowest continent. The natural characteristics of the Alps have in turn led to a unique and complex cultural history, as outlined above. Within this general context, Kosciuszko itself contains a range of unique cultural items. The area of Kosciuszko National Park constitutes the largest and most varied protected natural and cultural landscape in the Alps. Therefore the cultural heritage values of the area, many of which have national importance, are highly dependent, as a group, on Kosciuszko National Park for their conservation.

Within this generally significant cultural landscape setting, some cultural heritage items within Kosciuszko National Park are of particular significance, being a key or unique manifestation of a theme of national importance. These include:

- the historical associations and contemporary traditions of the montane pastoral theme in Australia history, tradition, ethos and creative expression;
- Currango homestead complex, the oldest high country pastoral station;
- the Kiandra cultural landscape left by the occurrence of high country mining;
- the landscape, engineering works and unique historical associations of the Snowy Mountains Hydro Electric Scheme;
- the collection of huts that exist throughout the park and are not found anywhere else at the same level of historical complexity in terms of the values they express relating to the layering of history, varied use, architectural style and diversity, evidence of environmental adaptation and social significance;
- Mount Kosciuszko itself, as Australia's highest mountain, with a unique historical, social and aesthetic significance;
- the evidence of scientific research, conservation and early park management endeavours;
- the first recorded skiing in Australia at Kiandra, the birthplace of winter snow sports.

## Condition and trend in condition

### Issues relating to data and methodology

The methodology proposed for use in assessing the natural environment is not appropriate for assessing the cultural environment. In Australia, the only relevant condition assessment methods for cultural heritage are those that have been designed for the *Australia State of the Environment Report 2001* (Lennon et al. 2001). Of most relevance is an assessment of the physical condition of historic heritage places (Pearson et al. 2001). This was a survey of a 12% sample of historic heritage places listed on the Register of the National Estate, which assessed physical condition and determined whether it was good, average or poor, based on a number of defined criteria. Such a sample survey would provide a basic condition assessment of the tangible heritage items of Kosciuszko National Park.

However no overall survey of condition has been carried out for the cultural heritage of the Australian Alps or Kosciuszko National Park. Nor is there any regional framework into which to fit this suite of items. Many types of sites, especially archaeological sites, have not been systematically identified. Many intangible items, especially relating to the traditions and social history of the park, have likewise not been recognised and documented. There have been assessments of certain major items such as huts, past and present resorts, homestead complexes and the Kiandra cultural landscape. However the surveys have, by and large, been on a needs basis and offer little comparative data. Until recently, a consistent methodology was not used. Therefore work to date cannot effectively be used to give an overall assessment of condition. The regional cultural heritage management strategies (NPWS 2001ab) do not assess condition overall, and their priorities for conservation work are based on a different set of criteria. In these circumstances it is not possible to adequately or accurately assess the general condition of the heritage items within the park.

The closest we can get to a condition survey is to look at the data on the Kosciuszko huts. Ashley (1993 part C) gives records of 90 intact huts, 40 ruined huts and 109 hut sites, making a total of 239. The Kosciuszko Huts Association (2002) says that there are around 100 intact huts in Kosciuszko today. It is not clear from the literature whether the total figure (239) is the result of systematic survey and represents all huts previously built in the park, but it is assumed that most of them or their sites have been located. The spread between huts that are intact, are in ruins or are no longer in existence is an indication of condition.

More than half the huts have been ruined or destroyed. Less than half are intact. About 30 huts have been lost in the past 30 years, some deliberately destroyed but most lost to fire (Kosciusko Huts Association 2002). Because cultural heritage is of its nature subject to decay and change, it is not appropriate to simply characterise this figure as poor condition. On the other hand these figures do point out the fragility and vulnerability of the cultural items in the park, and the necessity for their active management –undertaken in some cases since 1971 when the Kosciusko Huts Association was formed. Since 1993 both loss of huts and their more active management have been in evidence. Harris's Hut and Broken Dam Hut have been lost to fire. Some, such as Gooandra, have been restored. Pressures on the huts are similar to pressures on many other cultural heritage items in the park - they were built for temporary purposes, they are located in remote areas of the park, and their history and cultural importance are not well known (Kosciusko Huts Association 2002).

### **Current condition**

Taking the problems outlined above into account, the most we can do is to give a sketchy and somewhat subjective assessment of the condition of some of the items.

Places that are of high public visibility and current use (including active interpretation) and that have been subject of specific conservation work tend to be in relatively good condition. These include historic homesteads; huts in current use; resort buildings in current use; the infrastructure of the Snowy Mountains Hydro Electric Scheme currently in use; and historic walking tracks and recreation facilities that are in use. Some other major items, such as Yarrangobilly Caves House, while not in current use, are stabilised and have current priority for restoration.

The past history of park management has affected the condition of some of its cultural values and has led to their diminution. The previous lack of understanding or sympathy among park managers for cultural heritage items, augmented by a lack of resources, and in some cases their misguided destruction or neglect, has led to the diminution of some values. For example, the 1974 plan of management made certain provisions for the removal of some evidence of previous European occupation of the park, including a number of alpine huts and fence lines. In some cases, management practices aimed at nature conservation have been in conflict with the conservation of cultural values. As a result, the condition of a number of cultural heritage items is poor or the items no longer exist. These include buildings, ruins and landscape features.

Read (1996) has described a similar lack of sympathy and understanding towards the items of our heritage that relate to the pastoral era, especially the loss of legitimacy and acknowledgment suffered by those whose way of life this was and is. In turn, this means that the heritage values of Kosciuszko's pastoral era have suffered in the past through lack of recognition, inclusion and interpretation. People feel unduly blamed for damage that has occurred to the park as a result of pastoralism, and some feel that this damage has been exaggerated or wrongly attributed (Ted Taylor, Manager, Currango Homestead, pers. comm., October 2002). The hostility of some members of the community to the establishment and management of the park has compounded these problems, causing the loss or diminution of some social aspects of the park's cultural heritage.

Heritage places do not renew themselves; their natural tendency is towards change or decay, especially if they constitute evidence of the past rather than being in current use. Their condition is not naturally stable, although an aim of good management is to make them as stable as possible. Some cultural landscapes are being lost or diminished as revegetation, control of introduced species, and the general diminution of signs of human activity occur. Many minor elements of these landscapes, such as mine workings, small structures, ruins and archaeological sites, are in average to poor condition and trend towards significant decline in condition. Overall knowledge about and appreciation of the cultural heritage items of Kosciuszko in the general community is probably only average to poor.

### **Some trends in condition**

The condition of cultural heritage values in the park is improving in some respects. Cultural heritage management staff within the organisation at all levels have contributed greatly to improving the level of knowledge and of management of the park's cultural heritage during the period of the present plan. The newly drafted regional strategies (NPWS 2001ab) are an indication of the recognition of cultural heritage as a legitimate value, and of priority being given to its management. The strategies have identified needs for specific sites and identified priorities for site management. The strategies identify a number of encouraging trends in cultural heritage management in the regions, including:

- a growth in interest in cultural tourism;
- the development of an integrated (natural and cultural) landscape approach to management;
- the increasing prevalence of proactive surveys for sites ahead of proposed development;
- the development of Perisher Visitor Centre in a way that will emphasise historical and Aboriginal heritage;
- the trend to consider huts in their landscape setting.

The Australian Alps Liaison Committee's research work is intended primarily to focus on values common to all the alpine parks. However this work has in fact provided a great deal of basic information about the cultural values of Kosciuszko National Park and consequent recommendations relating to management, especially within the themes of mining, science and cultural landscape management; though the outcomes have perhaps been underused in the Kosciuszko management regime to date.

Overall, the trend is improving because of these factors, but this trend is from a very low threshold, and is in need of proactive consolidation and augmentation. For example, in 1994–96 park staff were part of teams developing cultural landscape management guidelines that aimed to further identify, assess the significance of and manage the specific cultural landscapes of the alpine parks (Lennon and Mathews 1996). Specific guidelines were given for managing exotic and Aboriginal vegetation, animals, visitor impacts, access, level of facilities, interpretation, traditional and continuing uses and community groups, but these guidelines have yet to be systematically implemented. For many sites, a lack of active management such as restoration, stabilisation or regular monitoring and corrective action, and lack of attention at a similar level to non-tangible items, will lead to their inevitable decline.

## **Pressures**

The following significant pressures can be identified:

- climatic factors, which can place considerable stress on some heritage items and can make access and maintenance difficult;
- the lack of knowledge of the existence or location of many items and hence a danger of inadvertent damage or destruction;
- a lack of resources and a relatively low priority for the conservation of cultural heritage items in some instances, leading to decay or destruction of cultural heritage items;
- an emphasis on the management of tangible heritage items, sometimes at the expense of the intangible;
- potential conflict between management for cultural heritage values and for natural heritage values - for example, wilderness and exotic weed eradication and wildfire and fire management;
- failure of the wilderness legislation to recognise the significance of cultural heritage in the landscape problems and consequent management problems;
- lack of on-park expertise to deal with cultural heritage issues generally, and an unwillingness to engage in cultural heritage issues because they are considered to be of lesser conservation value or too complicated and specialised;
- lack of recognition of the values of the cultural heritage asset as an integrated and complex system and landscape which needs managing as such;
- fire and fire management as a significant threat to unique cultural heritage places and landscapes;
- the impact of an increasing number of visitors to cultural heritage places and landscapes;
- the local community's feelings of isolation and some hostility because of past disregard of its heritage and the removal of cultural heritage features of significance to it.

## **Knowledge gaps**

Knowledge gaps have generally been identified by the work of the Australian Alps Liaison Committee; a research strategy to fill these gaps has been designed and is gradually being implemented (Argue 2000). In her analysis of state heritage themes in the park, Argue identifies a number of significant gaps. The integration of this data into park databases and management policies and procedures is still needed in many cases. As we have shown, data and information such as specific guidelines are often available, but staff are unaware of or unwilling to use these.

It is important that the existing data bases be kept up to date. Additional information on new items, existing items and information progressively collected on the condition of items should be included in the NPWS data base specifically in the HHIMS.

In some areas basic data are still needed. Elements such as the traditional Aboriginal lifestyle and its continuity, the traditional pastoral lifestyle and its contribution to the Australian ethos and its manifestation today, the history and contribution of women, and the role of horses in the history of the park have not received the systematic and community-based analysis they deserve. In particular, basic research on the role of Aboriginal people and women in the history and development of the Alps is needed. In addition, the historical processes have determined the evolution of the cultural heritage, especially in its landscape setting; a knowledge of fire histories, and which areas were burnt and when, is crucial for understanding the rate of regeneration or the length of time for restoration of some landscape elements.

## **Opportunities**

The cultural heritage management strategies for the Snowy Mountains region and the south-western slopes region for 2001–06 (NPWS 2001ab) between them offer brief summaries of the heritage resource of Kosciuszko National Park. There is a potential problem in this management split and it is clear that the park's plan needs to be based on an integrated, Kosciuszko-wide strategy for cultural heritage management.

The recommendations of the regional strategies should form part of this Kosciuszko-wide strategy, but they need to be augmented. The focus of the priority actions in the regional strategies is on the stabilisation or restoration of the physical fabric. Specific programs and action need to be devised to deal with issues such as social history, cultural landscape management, historical archives and community involvement.

A key management aim in the Kosciuszko plan of management should be the conservation of all the significant natural and cultural values that the park contains. In considering strategies to achieve this, it is useful to keep three issues in mind:

- The conservation of all values as an outcome of the new plan will require a higher priority being given to cultural heritage values than in the previous plan;
- The conservation of values cannot be achieved without a strong partnership relationship with those who have custodianship of such values. Such partnerships need to be forged with appropriate people with traditional knowledge and feelings of responsibility in the local European community as well as in the Aboriginal community. The resorts see themselves as an excellent future resource for cultural tourism including providing the public with a better knowledge of science, mining, pastoralism and Aboriginal heritage as well as the resort experience –and Thredbo already provides a self-guided heritage walk around the Village;
- It is useful to remember that there is a wide range of ways to conserve and celebrate heritage. Physical conservation is one way, but in many cases - especially with intangible items or with evidence of the past, such as the Kosciuszko horses - acknowledgment, commemoration, community celebration and recording or alternative use may be the most appropriate way of conserving elements of our past while looking after other values. A cultural heritage community outreach program could be augmented by park management engaging with the local historical societies and providing a central repository for local historical material such as letters, books, reports, copies of oral history transcripts etc that would provide a useful local resource. In turn the societies might care to assist in managing such a resource.

It is also important to acknowledge the distinction between community association and links with heritage as illustrated in past practices, and the present situation, in which these land use practices may not be an appropriate method of conserving all the cultural and natural values of the park.

### **Desired outcomes**

The following outcomes have been adapted from NPWS (2001ab), with some additions by the authors:

- Acknowledgment by management of the outstanding national cultural significance of the park and its heritage items and a focus on proactive, long-term conservation and management outcomes for cultural heritage of the park;
- A cultural heritage management strategy for the park as a whole that integrates the relevant sections of the relevant NPWS regional cultural heritage management strategies for 2001–06 (NPWS 2001ab) and appropriately augments these documents;
- Documentation and assessment of all significant heritage items within the park;
- No further loss of heritage items by accidental or deliberate damage;
- The protection of cultural heritage items from the effects of inappropriate or excessive tourism;
- Recognition of the value of intangible items and their enhancement by documentation, research, publication and active, cooperative management;
- More research to redress the male bias of the historical data into women's roles in the mountain environment as stockriders, scientists, wives of Snowy Scheme workers, and in establishing the health and well being of communities;
- Achievement of a strong heritage management partnership with communities surrounding the park or with traditional links to its history, through the development of dynamic and socially responsive policies and possibly joint archives of social history material;
- Active management of a selected range of representative and/or unique cultural heritage places and landscapes as outlined in the regional strategies (NPWS 2001ab);
- Stabilisation of the condition of all items assessed as being of regional, state or national significance;
- The development of appropriate re-use options for selected cultural heritage items as a means of long-term conservation;
- Management of cultural heritage items within the park:
  - within a historical thematic framework that interlinks places/landscapes as part of local, regional and state networks;
  - as dynamic places with opportunities for cultural tourism, recreation, education, commercial activities , re-use and community involvement as appropriate;
  - in a way that integrates the park's natural and cultural heritage and that resolves potential conflict between these values;
- The commitment of sufficient resources to achieve these ends.

## Monitoring

The regional strategies suggest a range of measures for monitoring their success. These measures are useful and should be implemented, but they often relate to planning and recording achievements. For the purposes of the park's plan it will be important to establish some baseline data and from this to measure actual conservation results on a regular basis. The following range of measures could be considered:

- a survey of the present condition of a sample of different types of significant heritage items;
- a survey of the attitudes of the local community to cultural heritage within the park, and of their involvement and sense of ownership;
- a survey of attitudes and knowledge levels of the general public about cultural heritage items in the park, and the cultural heritage of the park generally;
- the repetition of such surveys at regular intervals to measure change.



# Chapter 14

## social values

Prof Elery Hamilton-Smith AM<sup>1</sup>

### Introduction

This paper endeavours to describe and analyse the social dimensions and values of Kosciuszko National Park, together with the social and cultural relationships between the park and its various communities of visitors and other stakeholders. It also examines some of the assumptions made by the park managers, and in the current management plan, about the nature of these values and relationships.

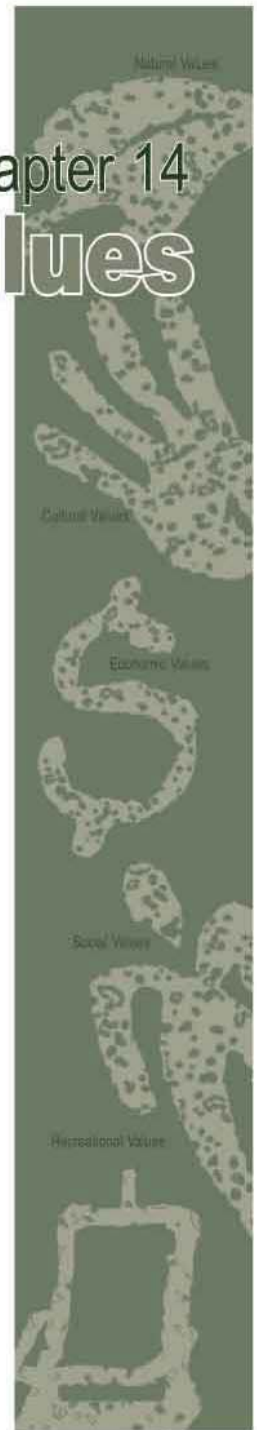
We must conclude (see below, Knowledge gaps and further research):

*'In so far as the social dimensions of park management have already been considered, this has been based primarily in the utilitarian spheres of recreation, tourism and public education. There has been little or no exploration of the spiritual, ideological, and community identity elements of the park experience; we know all too little about how people perceive or value the park experience, or what that experience really means to them.'*

The major problem in this discussion is that the social dimension of the park is not a series of sites or other tangible objects; rather it is a perspective upon each and all of the sites and other tangible phenomena. Further, the social values of the park are those values held by staff, neighbours, visitors, and others. Social values arise out of personal meanings, rather than the activity or phenomenon to which the meaning is ascribed (Hamilton- Smith 1980). They may be associated with specific components of the park - but it is of limited value to simply say, for instance, that visitors greatly value the opportunity for snow sports. This does not tell us which people subscribe to which social values; for example, whether they value the movements and skills of snow sports, the challenge of striving for greater personal competence, the companionship, entertainment and social ambience associated with a resort, the aesthetic or spiritual quality of the snow experience or the escape from everyday life. It can, however, be assumed that many snow skiers value the opportunities the park provides and, through a tradition of visiting (some for generations), ascribe a social value to the area and the park.

We can make assumptions about how communities value a place, but they can lead us dangerously wrong. In some circumstances, changing the setting or experience offered in recreation or tourism facilities or services can disenfranchise current or past user groups. Geehi camping area, previously a natural setting with minimal bush facilities and informal camping, frequented by groups that returned time after time, received a major refurbishment some years ago. Paved tracks, defined camping areas, higher standard toilets, interpretation and shelter changed the nature of the setting quite visibly. Those people who preferred the former minimal facilities moved on to look for other sites that met their needs. Geehi is still highly used, but by a different group who prefer a higher standard of facilities in a natural setting.

Many similar examples could be cited because park managers often assume that their personal values are more widely understood and shared by the public than is actually the case. We need to understand not only the physical details of people's use but also the range and depth of their values about the park. The scope of these social issues overlaps other fields such as economic, cultural, recreational and natural uses and values.



*“Significant social values and dimensions are largely unknown at this stage.”*

<sup>1</sup> Janet Mackay co-authored sections of this paper.



## The historic and cultural context

### Social history

Any consideration of the social dimensions of a situation has to be based in history and the ways in which current realities have been shaped. People relate to the park in diverse ways, largely because they may have images and values, and practise activities, that are drawn from different eras of the park's history.

The social history of the Snowy Mountains region falls into three broadly defined eras:

- many centuries of Aboriginal occupation and management;
- European exploration and occupation for mining, grazing and other land uses; and
- a period of immense and rapid change, ushered in by the establishment of the Snowy Mountains Hydro-electric Scheme in 1949 and the Kosciusko State Park in 1944, and continuing to the present day.

The many centuries of Aboriginal occupation and their management of the environment left behind a rich heritage in the form of the landscape and its vegetation. However, few spectacular sites (to the eye of white visitors), such as stone constructions or painted sites, have been revealed. But there is a rich heritage of dreamtime stories about specific places, and some knowledge of the rightly famous summer festival season when bogong moths (*Agrotis infusa*) were harvested.

The second era was marked by:

- grazing (from the 1830s onwards), which made an immense impact upon the environment, many signs of which continue to the present day;
- mining (from the 1850s onwards), although in the Snowy Mountains it was relatively short-lived and of lesser significance than in many other regions;
- The establishment and development of skiing as a major recreational activity and hand-in-hand with this,
- the beginnings of tourism, with the construction of state hotels (from 1912 onwards) and the further development of existing local opportunities for fishing and snow sports to specifically cater for the affluent classes; and
- commitment by some scientists to enhance understandings of the high country.

During this era, one of the remarkable features of the Kosciuszko region within New South Wales (NSW) is the extent to which it was relatively ignored by the wider society until the 1940s. Thus, during the 19<sup>th</sup> century the region received only a brief mention in Garran's (1888) *Picturesque Atlas of Australia* and little or no attention in other publications of the same period. There were probably only four major nineteenth century paintings of the region, by Chevalier and Von Guerard, who had visited with Von Mueller. Only Charles Kerry photographed the region extensively, as compared with the dozens of professional and amateur photographers who helped to make the Blue Mountains justly famous. The only generally recognised poetry consists of Banjo Paterson's legendary *Man from Snowy River*, which is one of the great icons of Australian bush culture, some lyrical tributes by Charles Harpur and the work of the ill-fated Barcroft Boake. There are no well-known novels and the only music appears to be Lhotsky's obscure European notation of songs from the Aboriginal women. It is almost as if the mountains strangely terminated at the Illawarra.

Thus, there is an immense difference in the early traditions that grew up in Victoria on one side, and the Illawarra, Blue Mountains, Central West and Hawkesbury of NSW on the other. So, although there is little question that the Snowy Mountains region represents a very significant part of the cultural and natural heritage of Australia (Good 1992, Lennon 1999), it had little impact upon the national sense of cultural identity in Australia until the 1940s. Even though there was a flowering and growing self-awareness of the cultural heritage of the region in the first half of the 20<sup>th</sup> century, this was mainly exhibited within in the region and otherwise, remained marginalised. Probably the most important exception is Patrick White's first novel, *Happy Valley*, based on his experience as a jackeroo at Adaminaby, yet this seems to be rarely cited by residents of the region. I know that many lovers of the mountains disagree with my assessment, but when they turn to specific examples, they all too often draw upon the post-1945 era or upon examples which originated far from Kosciuszko.

The advent of the SMHES in the 1940s marked the beginnings of massive change in the physical, social and economic character of the region. The boom in photography, and in publications ranging from photographic collections to novels, particularly the works of Elyne Mitchell, brought about a new cultural awareness. There is an extent to which the flowering of culture after 1945 exemplifies Davison's (1998) comment that in a young country like Australia, heritage is 'not a product of tradition, but of the need to create one.'

The new awareness and opportunities created by access and accommodation fostered the continuing growth of tourism and snow industries that has occurred since. The changes not only brought a great deal of positive change to the region, but were also characterised by a great sense of loss of the mountains as they had been, particularly by many of the long-standing mountain people, some of whom had been physically displaced in towns relocated for the Scheme.

The establishment of the Kosciusko State Park resulted in positive relationships with conservationists and other visionaries, but caused a long period of antagonism with rural residents and many members of the local Snowy Mountains community that, in some cases, continues to this day.

The evolution of the Kosciuszko National Park through periods of acquisition, resort development, varied management, and the development of plans of management has impacts on the social values attributed to the park by a range of groups.

### **Some social heritage themes**

Cultural heritage issues are dealt with more fully in Chapter 13, and will only be summarised briefly here, partly as one basis of the social context, and also in terms of the linkage between historic sites on one hand and visitor awareness and experience on the other. The intrinsic values ascribed to culturally significant sites must be recognised and significant sites preserved, but only certain of these can make a major contribution to the visitor experience of the general public (as compared with specialist visitors: students, professionals, researchers and amateurs). However, a focus on sites can give a misleading impression of the actual qualities of people's connection to a region, hence a landscape approach should be adopted.

### **Aboriginal culture**

The coming Aboriginal heritage study is geared to provide a particularly strong input to the planning process. Therefore, this will not be further discussed in this chapter, other than to emphasise the importance of the cultural and social heritage that spread over so many centuries of Australian (pre)history. In recent years, the park has started to acknowledge and engage traditional owners of the region, with enhanced partnerships in appropriate opportunities for sharing the traditions of the region with non-indigenous visitors, but this still demands further development.

### **Communication and access**

The Aboriginal people laid down the foundations of communication infrastructure. They took many of the European 'explorers' into the mountains. Their long-established trails became the bridle trails and stock routes of European settlers. Roughly the same routes are still used by bushwalkers and horse-riders. The pioneering role of Aboriginal people in recognising the opportunities offered by topography and hence in shaping our own infrastructure has rarely been given adequate recognition.

### **Exploration**

The greater Monaro region, including the Snowy Mountains country, was opened up and settled by pastoralists some years before the 'explorers' arrived (Hancock 1972). Lhotsky and Strzelecki were the most notable, but although Strzelecki is highly respected for his many accomplishments, neither claimed nor achieved the heroic status commonly accorded to many of our explorers. Thus, little attention has been given to the explorer tradition, which is intermingled with the pastoralists' occupation.

### **Settlement, grazing and horsemen**

The graziers therefore laid the main 'whitefella' foundation for a Snowy River country tradition and cultural heritage (Hueneke 1994). Today, this is celebrated by the physical evidence of the restored homesteads at Coolamine, Currango and elsewhere, together with a multitude of mountain huts (Hueneke 1982). It is indeed regrettable that so many huts have recently been destroyed by fire – hopefully at least a number will be restored. Paterson's *Man from Snowy River* established and developed the notion of the Snowy River people as horsemen and, with help from Hollywood, is probably the most widely known image of the region and may influence the way people think about it now.

### **Mining**

The Kiandra gold field was relatively short lived and the virtual destruction of the former township leaves little evidence of interest to general visitors. When one compares the potential tourism experience of mining with other sites in Australia, it is easy to see that, as important as it might be to those specifically interested in mining history, it offers little excitement to the general tourist. More specialised visitors will find interest in the massive works done by hand from 1860-1900 to deliver water over very long distances to gold-mining claims, and many other lesser relics of the period. Other mining sites were of even less importance, and are relatively little known to any but the mountain people and some bushwalkers. But Kiandra must be recognised as the birthplace of the other great image of the park: as a place to go skiing.

### **The Snowy Mountains Hydro-electric Scheme**

The Scheme was not just a great engineering vision, but also a great social achievement in the development of Australia, and the local region, as a multicultural society. It left a mark on both the terrain of the region and the ethos of Australian society. It also impacted heavily on the local community at the time, as towns were relocated to enable the Scheme to be developed. At the same time, the Scheme laid a social foundation for the development of skiing into a major regional industry. The Scheme not only opened up and left significant infrastructure in the mountains, but changed the population of the region, and left local towns quite reoriented in their function. It also changed the image of the mountains for a whole generation of Australians. The infrastructure established has tended to dictate our patterns of movement to and in the mountains today, as well as changing the nature of land use and settlement over a much wider area.

## Kosciuszko National Park

The evolution of Kosciuszko National Park to the present day has engaged the commitment of a vast range of community groups on an array of issues. Advocacy and lobbying by groups pursuing a myriad of changes from grazing, ski resort expansion, new developments in the maintenance of huts, has resulted in many groups and individuals that ascribe strong social values to Kosciuszko National Park.

### Skiing and associated snow sports

Kiandra was the site where it all began, with the establishment of a ski club. It is sometimes claimed that this was the birthplace of skiing as a recreation, rather than as a mode of movement for work or military purposes. But for present purposes, it did provide the beginning of a significant change in land use within the alpine area. Participation in skiing and other snow sports has increased to a remarkable degree but, more importantly, snow sports have changed from a relatively informal community-managed activity to a major industry.

The industry so dominates visitor use that the alpine region now has two virtually separate identities, as a great national park and a great series of ski resorts. These two entities have an uneasy relationship to the extent to which skiing is seen by some non-skiing visitors as an undesirable or even disturbing intrusion upon their own experience.<sup>2</sup> On the other hand, skiers may have little awareness of the wider range of values and opportunities in the park or the extent to which the landscape is affected in summer by evidence of their use in winter. In the southern resorts, the park and its surrounds are incredibly rich in both social values and cultural heritage sites. The northern and western areas of the park, whilst receiving lower usage, are valued for their natural and cultural attributes as well as for recreational opportunities.

Another interesting question therefore arises from the difference summer and winter visitors and whether any action should be taken to bring about a greater sharing of the two different sets of perceptions and values. In fact, probably the most important thing is that the differences should be recognised more clearly and properly respected.

### The basis of social management

The management of national parks in English-speaking nations suffers from a strange paradox. Although park managers are generally educated in the environmental sciences, they are not given adequate preparation for dealing with social issues. Yet, many of the major problems that they must confront are to do with human and social issues, and most of the problems in environmental management arise out of social behaviour and issues (Hamilton-Smith 1989).

This makes it particularly difficult to prepare an overview of the social context and dimensions of the park. First, there is not only the question of the overarching relationship between the park as a site and its social context, but each of the specific issues being examined by the independent scientific committee has its own social context and issues. The resource constraints upon the current examination mean that it is impossible to do justice to the topic and this chapter can only be a broadly generalised one. Second, there is an immense dearth of systematic social information with even a reasonable degree of reliability or validity.

Further, the statutory basis for this review is indeed slim. In defining the objectives of the legislation (*National Parks and Wildlife Amendment Act 2000* Section 2A), there is no specific reference to social dimensions other than references to places of social value. Similarly, even the concept of sustainability is qualified by the constraining adjective 'ecological'. This suggests a much narrower view than the prevailing concept of a dynamic and holistic tripartite sustainability across the environmental, social and economic spheres.

In dealing with national parks (NPW Act 1974, s30E), the mandate is significantly broadened to include 'opportunities for public appreciation and inspiration, and sustainable visitor use and enjoyment. Further, the enunciated principles of management include:

- (d) *the promotion of public appreciation and understanding of the national park's natural and cultural values;*
- (e) *provision for sustainable visitor use and enjoyment that is compatible with the conservation of the national park's natural and cultural values; and*
- (g) *provision for appropriate research and monitoring.*

Despite a recent review of the legislation, it is clear from recent events, and particularly in relation to the management of skiing, that further review is needed. The lack of adequate recognition of broad social and cultural questions also demands further review and response.

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<sup>2</sup> This discussion is based largely upon the views of many people involved in the tourism or snow sports industries, but also on the author's informal interviews and discussions with some 150 resort visitors.

This relative lack of attention to social dimensions is carried through in the prescription for preparation of management plans (Section 72AA). In summary, within the current legislation, social dimensions are seen essentially as only providing the basis for values that may be ascribed to specific sites and for the development of visitor enjoyment and education.

Similarly, although the corporate plan of the NSW National Parks and Wildlife Service (NPWS) recognises the actual and potential social responsibility in providing for public access and involvement, it remains embedded in a site-based philosophy and does not give recognition to the totality of the social values and dimensions of parks. Further, management currently focuses on defining and delimiting uses, which ignores the totality and complexity of the visitor (and non-visitor) experience.

It is important to also recognise that the Park is now in the process of coming to grips with the world-wide changes in the assumptions underlying national park management. The ecocentric philosophy and practice that has dominated Australian parks since the 1970s is being steadily replaced by a more holistic approach which aims at balancing ecological and cultural imperatives. This volume exemplifies the extent to which we are all caught in that change process, and the extent to which the Plan of Management must look forward in the directions which are now emerging.

The current crisis in public management and governance, arising out of fiscal constraints and the current managerial emphasis upon accountability and administrative trivia, also acts as a constraint upon management. It severely limits the resources available for effective and productive on-ground management of the park.

The nature of the legislation means that, perhaps inevitably, the park and its heritage values become constrained by a tyranny of cadastral and internal zoning boundaries. Holistic management of the Snowy Mountains region and the people who either live within or visit it is severely constrained by this, but there is an important opportunity to at least partly overcome this problem. The Kosciuszko area is not only a national park, but also one of the first areas in Australia to be designated (in 1977) as a biosphere reserve. However, constraining the boundaries of the biosphere reserve to coincide with those of the national park is out of step with international practice and mitigates against the effective use of biosphere reserve status. The Park Service has also failed to recognise the inherent principles of present-day biosphere reserve practice and appears to regard the biosphere reserve status more or less as an honorific rather than a tool for enhancing management.

The biosphere reserve concept should be seen as a social designation as well as an ecological one. It provides an extremely powerful tool for furthering regional inter-relationships and partnerships, for the development of sustainability in the full sense of that term, for more effective public education and consequent changes in land management, and for more holistic and thus enhanced programs in both management and research<sup>3</sup>.

### **Summarising the historic and managerial context<sup>4</sup>**

The good news is that:

- the park is a treasure house of remarkable geosystems, ecosystems and other natural features and of a wonderful cultural heritage;
- these values are held on high esteem by most Australians, both visitors and others;
- the biosphere reserve concept provides an important opportunity for overcoming some of the regional (or even wider) problems that face the park; and
- there has been improvement over time in the relationship between park stakeholders and park management.

The bad news is that:

- social dimensions of park management are given limited recognition in legislation, yet are a key component of management practice;
- the park as a place of natural and cultural heritage sits in an uneasy relationship to the park as a major center for skiing and other snow sports; and
- there are a number of significant social barriers to effective and holistic management of the park.
- the relationships between park management and the community which have improved in recent years, will need considerable effort to remain positive with some sectors of the community in the light of recent fires.

## **The park in contemporary social context**

### **Regional and state relationships**

The Kosciuszko State Park was established in 1944, and gradually evolved, hand-in-hand with a series of other significant events.

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<sup>3</sup> See <[www.unesco.org/mab/brfaq.htm](http://www.unesco.org/mab/brfaq.htm)> and associated pages

<sup>4</sup> This format is derived from the Australian State of the Environment Report 2001

These included the establishment of the SMHES in 1949, the progressive removal of grazing, the rapid and extensive development of the ski industry, the development of the high profile and controversial 1982 Kosciuszko National Park Plan of Management; and the settling of a memorandum of understanding to establish the cooperative management program for the Australian Alps national parks overseen by the Australian Alps Liaison Committee (AALC) (Good 1992).

From the beginning, there has been a series of major problems in local relationships, and sometimes deep and long enduring resentment of the park. These primarily centred on the change in land tenure to a protected area that required cessation of grazing and resulted in loss by the cattlemen of part of their commercial operation. In particular, although leaseholders received compensation, many of their workers lost both their job and their highly valued lifestyle. For many, the mountains and the mountain lifestyle have been their family tradition and heritage, which is valued and continued, where possible, to this day. A great deal has been done by the NPWS in recent years to build bridges with the mountain community, although a dogged minority still maintain their hatred of the park, and consider the recent bushfires further justification for their views.

At local, state and national level, it appears that the park and its staff have gained increasing community respect. This is due very largely to the commitment of the on-ground staff, who have direct responsibility for shaping visitor experience. Respect comes not only from visitors, but also from local communities including some of the earlier antagonists who see that staff are making enormous efforts to work and develop relationships with neighbours.

However, complaints about the perceived heavy-handedness of the park bureaucracy are common, which may in part be due to lack of effective communication or to deep-seated community attitudes to parks and bureaucracies in general. Some of these complaints may grow out of the Australia-wide struggles of land managers to cope with the 'new managerialism' of the public sector. 'New managerialism' is based in the ideology of the new liberalism (Bauman 2001). It includes a range of managerial changes such as regular restructuring, reductions in staffing, excessive working hours and changes to or discarding of career structures; and expectations of economic efficiency and even profitability, through the growing expectation of governments that parks should 'earn' much more of the funding needed to maintain the park and its services. A further important group of risk management and related problems arises from the heightened emphasis that park managers are forced to place upon issues of public safety as a combined result of the 1995 New Zealand Cave Creek Incident (Commission of Inquiry 1995), the increasing propensity of Australians to seek compensation for loss or injury through the courts, and the recent financial crisis of the insurance industry. Some of these are relevant to the Kosciuszko situation. There is also longstanding dissatisfaction with the underlying bases of park management, which tend to alienate the general public (eg, Moorhouse 1976, Chase 1986, Hamilton-Smith 1989, Jacoby 2001).

One of the important changes for Kosciuszko in recent years is the increased focus upon a strategic approach to tourism development in the national parks, arising partly out of the report of Worboys et al. (1997) and partly from the efforts of some tourism managers. The term 'icon' is now more commonly applied to the region than previously. However, at present this appears to be somewhat ambiguous or even problematic and brings us back to consideration of the two identities issue. This term, in modern usage, does not just imply high importance, but rather refers to a symbol of some larger entity. So, if the term 'icon' is used to describe the park, is the park an icon of its natural and cultural heritage and the resulting sense of place, or is it an icon of commercialism?

Consideration of icon status needs to be a key element of the planning process, to ensure effective management of resultant tourism.

## **Gateways to the park**

The central meaning of icon status for the park is thrown into high relief by the very different character of the major gateway towns. Gateways to the park vary considerably in their role and relationship to the park, and in their general characteristics. The combination of these factors seems to result in differing social values attributed to the park by communities. A shared sense of concern as many of the gateway communities were affected by the January 2003 fires, and a common perception of the role of Kosciuszko in bringing in this concern, may have strengthened the relationships between some communities. The characteristics of the gateways as well as the residential communities (see Map 14.1) within the park are an important part of the social context in which Kosciuszko National Park exists.

### **Northern gateways**

#### *Tumut*

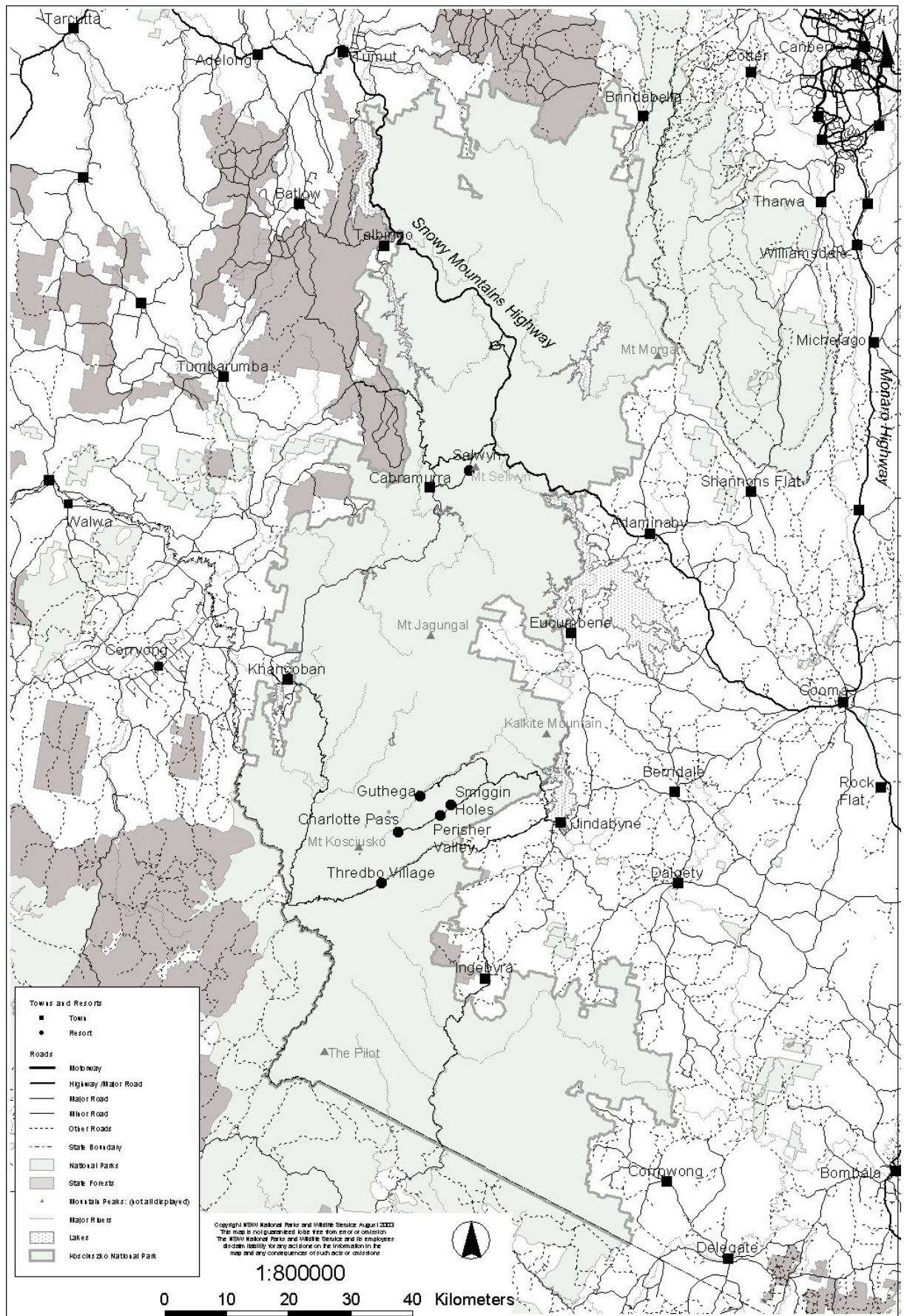
The township of Tumut was originally at the centre of a farming community with grazing, a dairy industry and cropping as the key rural activities. With the advent of forestry production some 50 years ago, the town developed a vibrant timber industry. This industry has waxed and waned, to be revived in recent years with the establishment of the Visy Mill which has provided direct employment for approximately 150 people and indirect employment through the opportunities in forests. Some 6000 people now live in Tumut, with an increase in employment of 4.8% over the period 2000–02, some 2% higher than the state average.

Tourism has gradually increased in the town as a gateway to Kosciuszko, with the greatest increase resulting from the western access to the ski fields including Selwyn snowfields as well as improved marketing of Yarrangobilly Caves. Tourism seems to be reasonably stable in the area.



Map 14.1

Residential communities within and surrounding Kosciuszko National Park



Kosciuszko National Park provides a playground for some Tumut residents who appear to predominantly value three opportunities: skiing, the water activities afforded by Blowering foreshores, and the natural horse riding opportunities available in the north of the park. For many residents, the national park is simply a backdrop that they might occasionally travel through en route to the coast. The town is still home to people who value the mountains and the previous cattlemen's lifestyle, and who have passed this tradition down through their families and continue to ride in the park and hold a deep love for the tradition and opportunities it provides.

The relationship between the NPWS and Tumut community has, like many areas, been moulded through controversy on such issues as horse riding as well as management issues such as weed control, feral animals, law enforcement and wilderness. Relationships with the tourism industry and the community have improved in recent years, with the initiation of a visitor centre managed cooperatively by Tumut Shire Council and NPWS.

### *Batlow*

Batlow, with a population of around 1200, may be considered a gateway to Kosciuszko National Park, but has been independent in its development and really quite remote from the park.

Batlow developed through its orchard industry and the development of the Mountain Maid cannery. It has also been a key area in the timber industry. The closure of the cannery as well as relocation of the forestry office has resulted in a decline in employment, and most school leavers are moving away. To revitalise the town, a strong community, with the support of the shire, is working on new initiatives including orchard related industry.

Whilst some residents use Kosciuszko National Park in a similar way to Tumut people, there is not a strong link with the park, nor a dependence on it for attracting tourism.

### *Talbingo*

Talbingo, geographically the closest town in Tumut Shire to the park, has declined from a population of 400 to some 220. Talbingo was established as a residential area for employees of the SMHES, and serviced a number of the Snowy installations as well as construction. Many previous residents of Talbingo reside in other parts of the region, and seem to hold memories of this settlement as a special place in their life.

The handover of the town from SMHES to Tumut Shire marked the end of its useful life as a service town. Many houses are empty, but several have been purchased as holiday and retirement homes for people seeking to use Kosciuszko National Park for skiing and, more commonly, fishing.

The relationship between Talbingo people and the park has varied and has been enhanced at times through the relationships established by NPWS families living and socialising in Talbingo. The present residents and those who are coming to live and play in the area perhaps value the park more than the SMHES residents who predominantly worked in it.

## **Southern Gateways**

### *Bombala*

Bombala was a major timber and agricultural service town and has suffered from the downturn in the wool industry and restructuring of the timber industry. With extensive additions to national parks in the area, NPWS is seen as a key cause of many of the issues associated with economic decline. Unlike other towns, which service tourists to Kosciuszko National Park, there is limited potential for economic gain from the park. As a result, the community is more likely to focus on negative issues. Despite efforts of park managers and improving relationships with some sectors of the community, NPWS is likely to have a difficult ongoing relationship with the people of Bombala.

The town receives limited tourism from traffic on the through routes between NSW and Victoria. NPWS has a shopfront that provides information about parks and opportunities in the area.

### *Delegate*

Delegate is a strong and vibrant town recognised for its efforts to maintain and improve its community and services and enhance its economic development.

The surrounding rural area includes neighbours to the Byadbo area of Kosciuszko, a part of the park with a history of conflict with neighbours. The issues of feral dogs and fire are ongoing and continue to cause uneasy relationships with park management. Neighbours maintain strong links to the park and use it in the way they did before it was park. Despite this, there has been an improvement in relationships over time due to the efforts of key park managers and, to some extent, a realisation by some that the establishment of wilderness has not significantly impacted on them.

## **Western gateways**

### *Tumbarumba*

The shire of Tumbarumba has a population of some 3600 with the highest proportion living in the town of Tumbarumba and the balance in the rural areas as well as the settlements of Khancoban, Laurel Hill, Jingellic, Rosewood and Tooma. Tumbarumba was originally a pastoral area until softwood and hardwood forestry were established some fifty years ago. Whilst a softwood mill in the township provides some employment, and traditional agriculture continues, other innovative agricultural industries including horticulture and viticulture have been developing as alternate opportunities.

Tourism is not a high growth or yield activity for Tumbarumba, although the sealing of the Alpine Way is expected to result in some increase in through traffic on roundtrips in the mountains.

Tumbarumba is seen as one of the communities with a historical relationship with the park, although issues within the shire, where rural lands adjoin the park, have caused conflict in relation to weeds and feral animals from time to time. As with all local communities, there remain people with a strong connection and a belief in the cultural heritage they associate with past use of the park for grazing activity. Recreational use by the community is limited but, to some, the park is probably seen as something of a 'backyard.'

### *Khancoban*

Khancoban is, like Talbingo, an SMHES settlement established to construct and service the western installations of the Scheme. The majority of employment for residents is provided by Snowy Hydro Limited, as the SMHES is now called. Khancoban is also home to some retirees, attracted by cheap housing in an attractive rural setting with opportunities for fishing and other recreational pursuits. Recreation focuses on the Khancoban pondage as well as the streams nearby and in the park.

Khancoban is the gateway for people coming from Victoria to Kosciuszko for skiing as well as for summer recreation and sightseeing. With the sealing of the Alpine Way, there has been an increase in through traffic and people staying in the town. This is expected to continue. Whilst the absence of a high profile visitor centre on the main road may reduce the numbers of people travelling through who talk with NPWS staff, the Service has a good relationship with and plays an important role in the community.

## **Eastern Gateways**

### *Cooma*

Cooma is the largest town in the Snowy Mountains, with a population of some 9500 people. As the first gateway to the national park, some 70 kilometres from it, Cooma is primarily a service town for tourism in the region. Cooma has been the centre for rural activity in the region and, with decline in the industry, is not experiencing growth. The establishment of a call centre that employs some 150 people, combined with the re-opening of the Cooma Jail, has seen a stabilisation in the town.

Apart from cooperative tourism effort, and liaison between government departments, there is a limited relationship between Cooma and NPWS. The exception to this has been with the establishment of recent off-park reserves, to which the Cooma community has had both positive and negative reactions.

Cooma has a good proportion of older people, including long-standing mountain people, both from the grazing era and the former Snowy Scheme workers with their direct descendents. The relationship to the high country is particularly visible and explicitly celebrated in Cooma. The visitor information centre provides a diversity of heritage-oriented publications and information, while the town park offers both the time-walk display of ceramic mosaics and the Man from Snowy River statue. Snowy Hydro Limited is also based in Cooma and operates a large visitor information centre.

### *Berridale*

Berridale is a small community of some 950 people, many of whom are employed in the construction, service and tourism industry. Initially, the town was a rural community, which grew as a dormitory town during the 1980s when Skitube employed large numbers of people. The town now has a good proportion of holiday houses as well as a community established through the availability of cheaper housing and a quieter village atmosphere than at Jindabyne.

For many Berridale people the park is important for recreation, including summer and winter sports, as well as the destination for weekend picnics. It is a part of their life that is valued for all that it offers in terms of recreation and tourism. The community is not directly affected by the controversies of wild dogs, wilderness etc, except to the extent that it is communicated to them via the local media.

Like other local towns, Berridale is home to some of the older generation and to descendents of cattlemen who still have their concerns about the past but, more importantly, value the high country for the cultural heritage it represents. Park neighbours on the eastern boundary of Kosciuszko National Park are also linked to the Berridale community and issues of wild dogs, wilderness, weeds are of concern and cause a difficult relationship with the park. The relationship with NPWS in this area, whilst perhaps not as bad as it has at times been, is not as good as it is in other areas where similar issues exist.



## *Dalgety*

Prior to the SMHES, Dalgety was a prosperous country town that serviced a rural based community. Dalgety is located on the Snowy River and the advent of the SMHES resulted in a significant reduction in the flows of the river. This has had a long term social and economic impact. The community has, over past years, worked effectively together to lobby for increased flows in the river, as well as to pursue a range of community development improvements. In the last six months a number of these have come to fruition and a heightened sense of optimism exists. There is a strong link and connection with the park through the Snowy River.

There are still many antagonists of NPWS in the Dalgety area, and issues such as wild dogs and weeds directly affect landholders adjoining and near the park. Despite this, some members of the community believe that, through the efforts of specific key park managers, there is a better relationship with NPWS now than there has been for decades.

## *Jindabyne*

Jindabyne is the major town servicing the ski resorts in winter as well as summer recreation in the region. The winter population increase is the largest of any of the gateway townships. Perhaps even more importantly, the shire is one of the most rapidly growing in NSW. Whilst the town still has many mountain people, as a proportion of the population their numbers are not high. The descendants of cattlemen still value the park for the heritage it represents, and whilst they may not agree with management, they still want to be able to enjoy their traditional recreational activities.

Particularly during winter, the population largely comprises younger people, born outside the region, who are engaged in the tourism, hospitality and retail industries. But at the same time, there is a year-round growing number of the population that represents families with children who have grown up there and value the park as their 'playground' for skiing, for summer recreation and as an educational resource.

The development of the Snowy Region Visitor Centre in the mid 1990s was a positive step in the relationship between the NPWS and the community, providing a strong and visible presence in the town as well as a facility that the community valued and perceived as providing economic benefits. It also brought staff more into the community and has improved the relationship between the town community and NPWS despite ongoing issues of concern such as park use fees, feral species and wilderness.

There are many residents who have a real sense of attachment to the park, but that is not very evident to the visitor. The commercial sector and, in particular, the ski resort industry, totally dominates the townscape. Most of the shopfronts offering information are in fact sales outlets for the industry. A statue of Strzelecki on the shores of the lake is so located that very few people approach close to it and most do not even notice it.

## *Adaminaby*

The township of Adaminaby services a community of some 600 people although only a third of these live in the town itself. Adaminaby has been a rural community in the past, and was relocated to enable the flooding of the Eucumbene River as part of the SMHES. With the downturn in the rural economy, the Adaminaby community has worked strongly to identify alternate opportunities including tourism.

The town does play a role in tourism to the northern parts of Kosciuszko and provides the primary accommodation for Selwyn Snowfields in winter. Summer and shoulder season recreation is focused on fishing, although sightseers using the Snowy Mountains Highway and people travelling to Yarrangobilly Caves also use the town.

The relationship between the Adaminaby community and NPWS has varied over time, but the general trend is not positive. Since the closure of the NPWS office in the town in 1987, there has been an ongoing feeling that not enough is being done about park issues affecting this part of the region. The values attributed to the park perhaps mirror this, with traditional users and other members of the community seeing the park as an area they can use regardless of the management policies in place.

## *Cabramurra*

The township of Cabramurra is exclusively an SMHES town, established to house construction workers and subsequently operators on the Scheme. With increased automation of power stations and other installations, downsizing and the relocation of many staff to bigger centres, Cabramurra has some empty houses. Many of those who operate from the town live there during the working week and go to the bigger centres of Tumut or Cooma for their time off. Whilst the primary school is still operating, the demand is decreasing.

As the town is located directly within the national park, there has been a history of issues that have, to some extent, been resolved over time. As workers living in their own town, the residents have perhaps seen the park as their backyard and their 'entitlement'. Management has done most of the negotiations on residents' issues, such as domestic pets and access, so that there has been a non-relationship or a negative view of NPWS by those living there. Despite this, many have probably developed strong links with the park through their work efforts, the grandeur of the place they have lived, and the range of recreational opportunities they have been able to enjoy. More recently, with the corporatisation of SMHES, a 75-year lease was granted to Snowy Hydro Limited for the occupation and use of Cabramurra.

## Thredbo

The ski resort village of Thredbo has a year-round population of some 200–300 people and a winter population capacity of 4200 beds. This village has a strong and vibrant community, almost certainly made even stronger through its efforts to recover from the landslide in 1997. Thredbo has been the single most successful ski resort in Australia, attracting high levels of summer tourism and, as a result, is active and busy virtually year round. Situated directly within the national park, there are everyday issues that impact on the relationship with NPWS, most recently the bushfires of 2003 which had the community either evacuated or on high alert for an extended period of time. Despite this, and with families that have lived in the village for three generations, there is a strong attachment to the village, the park and what it offers.

Many snow resort visitors show little or no interest in the park as a whole, and may even be unaware of its existence unless they drive into the park and pay a fee for entry to a park officer! Some of these visitors seem to believe that they are paying for admission to the resorts rather than a national park. There is little evidence that they are aware of the heritage values, or even the geographic extent of the park.

### Summarising the contextual issues

The good news is that:

- the park and its management are steadily increasing the extent to which both attract widespread public recognition and respect;
- in general, new groups moving to such places for lifestyle reasons tend to be more sympathetic to nature conservation as a land use; and
- as the park gets older it becomes more significantly entrenched in people's minds as a park rather than for its former uses and status.

The bad news is that:

- there are still a number of people, particularly within the region, who continue to resent the very existence of the park, or who have extremely negative feelings about the quality of management within the park; and
- there is steadily increasing ambiguity in the minds of managers and many stakeholders about the basic nature of the park as both a site of great natural and cultural heritage values and a major tourism destination, even though both are vital in constructing the very character of the region.

The constraints within which the park will need to negotiate or reinvent its own position for future management include:

- the normal human dislike of change;
- the absence of a holistic view of national parks, which fully recognises the total social and cultural nature of the park, within the very legislation that establishes them; and
- the reality that the media in the local area plays a strong role in shaping views about the park and its management.

At the same time, there is a special opportunity to realise the potential for much more effective management and greater sustainability that is inherent in the Man and Biosphere program.

Obviously, these comments contain an implied criticism of the National Parks and Wildlife Service, which is disappointing given the recent report *Visions for the New Millennium* (Steering Committee to the Minister for Environment 1998). However, this is simply because the issues raised here were not included in the terms of reference for the report's Steering Committee. Thus, their resolution within the Kosciuszko National Park demands consideration of the implications for the park service as a whole.

## The people of the park communities

### Current research and knowledge

There is some readily available and useful statistical information on the demography of the various regional communities, and this will not be reproduced here. The intention in this section is to discuss some of the key social characteristics or issues that have been identified as directly relevant to the future of the park. However, the limitations of available data mean that it is possible only to make generalised statements. There is no basic comparability over time, and so any comments on trends can only be impressionistic and based on professional judgment rather than hard data.

### Regional residents

A study carried out as part of the Regional Forest Agreement process (Joint Commonwealth NSW RFASC 2000) found that residents of the Southern region saw a number of issues as being of concern. Table 14.1 lists these and shows how the responses of the Southern region residents compared with those of NSW as a whole.

**Table 14.1 Percentages of residents reporting various issues as being of concern in the Southern region of NSW and in all of NSW in 2000**

Issue	Percentage of residents reporting the issue as a concern	
	Southern region	NSW
Unemployment	44	50
Education	30	31
Health	36	29
Environment	35	23

Note: the southern region survey was undertaken within the context of the RFA study and this may have partly led to the much higher environmental concern than for the state as a whole.

Although forest-related issues were seen as the most important environmental issue, and this may have some relevance to parks, the other specific environmental issues of concern were more global, including pollution, the atmosphere, agriculture and waste disposal. Clearly, the protection of natural heritage has neither high visibility nor a high priority in the public mind, although a more detailed analysis indicated some concern about loss of biodiversity (but this is not related to protected areas in the mind of most people). Exactly this issue is highlighted in some current international debates, and points to the need for a much higher priority being given to nature conservation awareness and understanding. The survey also confirmed that many people (36%) were unaware of the difference between state forests and national parks. This latter result is comparable with the results of a study in Tasmania (Hamilton-Smith 1998) and indicates that many people in NSW are not highly aware of the purpose or values of national parks and are not as concerned about biodiversity as they are about some other environmental issues.

### **Snowy River Shire residents**

A public consultation was held in the Snowy River Shire to examine the preferences of residents in the development of a local environment plan (UTS 2001). The results are summarised on an area-by-area basis. For present purposes, we will look only at the relevant ideas put forward from residents of Jindabyne.

For Jindabyne, there appeared to be agreement that tourism should be further encouraged and developed. At the same time, there were demands for a more effective protection of rural character, the development of a 'village atmosphere', a restriction on foreshore development, limits on building size and tight control over sub-divisions and the provision of improved amenity infrastructure. Although all of these concerns relate to the area outside of the park, they will inevitably impact upon the experience of park visitors.

### **Awareness of and attitudes to the park**

Several studies have been carried out, but they are based on a very small sample of the relevant populations and the first is focused upon the Canberra and Namadgi areas. So, although they are cited and described here, they can only be seen as indicative, and offer little that can be generalised to the park as a whole. The first study was carried out in 1995 by Market Attitude Research Services for the AALC. Although most of the results deal with the Australian Alps national parks as a whole, some are specific to Kosciuszko. Some key points are:

- From a national survey, 60% reported they were not aware at all of the Australian Alps national parks;
- Similarly, 58% reported that they were not aware of the natural and or historical features of Kosciuszko National Park (even 32% of Canberra residents responded in this way);
- However, 23% of the Australian sample, which was surveyed on location in Canberra, reported having visited Kosciuszko National Park in the previous 5 years; and
- Although satisfaction levels of actual visitors to the Kosciuszko National Park were high (about 80%), those satisfied with Namadgi were likely to be dissatisfied with Kosciuszko National Park: a clear example of differing preferences in recreation experience or the varying level and standard of facilities and services provided.

Those who enjoyed Namadgi expressed their concern about Kosciuszko National Park in terms of overcrowded or uncomfortable facilities, over-development, too much direction and control by management, and excessive encroachment of development. This is almost certainly based largely on a perception of the resort areas.

A somewhat similar study by Worthington Di Marzio Pty Ltd (1999), which included a specific percentage of 'neighbours' residing in settlements close to Australian Alps national parks, reported the following:

- There was a high awareness of the existence of the Kosciuszko National Park (98%);
- A majority of respondents reported that they became aware of national parks through 'word of mouth' (31%), 'residing nearby' (about 30%) or 'saw road signs on the way to another destination' (about 16%); not through mass media;

- More males than females visited national parks and related this to the parks' focus upon traditional male oriented outdoor adventure activities;
- Motivations for park visiting included 'a healthy family holiday', 'getting back to nature', and 'instilling a sense of nature and environmental values/education for the children'; again, these results are broadly in agreement with the present author's more in-depth studies in Tasmania;
- A large number associated the Australian Alps national parks with snow, snowfields and skiing;
- Approximately half of all respondents claimed they only 'knew a little' about the Australian Alps parks; in particular, they were not informed about the Aboriginal heritage, history or natural features of the parks; and
- The most frequently reported activities were bush walking and picnicking; however, the survey had multiple responses, possibly diminishing the dominance of skiing.

### **Outdoor recreation visitors**

The AALC commissioned an evaluative study of the minimal impact brochure series (Beckmann 1999). The study established that the main constraint on effectiveness of the minimum impact program was the low level of brochure distribution. Word of mouth was identified as the major source of park information. The fact that other sources of information were largely park visitor centres or other specific information sites is not surprising, given that the sample questioned was drawn from park visitors. In spite of the poor distribution of brochures, visitors found them useful and indicated that they had changed their behaviour as a result. However, those who had not seen the brochures did not appear to differ significantly in their behaviour from those who had. This suggests the truth of general observations that the behaviour of park visitors has gradually changed for the better over the last 30 years and, obviously, this change has come from a wide range of influences, including the minimum impact educational programs.

### **Summarising information on the park communities**

It is difficult to generalise from the above information as it is fragmented, the representativeness of the sample populations studied is often unknown and the study objectives were not necessarily comparable.

The good news is that when attitudes to the park and to the NPWS have been assessed, these appear to be generally positive.

The bad news is that there are clear gaps in awareness of the park and its values.

We just do not know how or what to characterise and communicate to the many communities that visit, or have at least a potential interest in, the park.

### **Assessing the social situation**

The framework for assessment that was recommended and has been used in other chapters is extremely difficult to apply in the social realm, partly because it assumes a site-based discussion, which is a negation of the social perspective. Significant social values and dimensions are largely unknown at this stage. They must be recognised as distinct from, but potentially arising from, other values including recreation, aesthetics, personal and community identity, educational, spiritual, ideological, cultural and historic. The significance of these values cannot be ascertained because of the dearth of relevant and sufficiently thorough research and the time available.

It is worth endeavouring to summarise the groups that hold strong social values for Kosciuszko National Park, regardless of how these have evolved. Whilst perhaps not exhaustive, the key groups include:

- Aboriginals that lived, or whose ancestors lived in the mountains and or visited them;
- families and descendents of graziers and mountain cattlemen;
- the 'younger' local community that sees the park as its 'backyard' and children's playground;
- those people and groups that have lobbied extensively over time for their issues (e.g. ski industry, Kosciusko Huts Association, Snowy Flows);
- residents of Thredbo who have lived there for up to three generations;
- regular visitors that may have been skiing in the park for 50 years;
- outdoor recreation users, particularly summer bush walkers;
- casual visitors who may stay a very short time but whose behaviour patterns significantly affect all other users;
- tourist and recreational visitor groups, because their patterns of use affect so many of the local and community groups; and
- business people and other residents of the gateway towns.

This list is rather arbitrary and limited because it is the interactions between users with differing values that is often problematic.

The extent to which the social dimensions of the park are often, at least in part, shaped outside of the park is often overlooked. Some may even be primarily, or totally, expressed outside of the park, yet be important to the overall social context.

Turning to the question of indicators, the proper use of indicators to assess the social dimensions of the park will only be practicable if there is some baseline research (see below) to delineate the communities associated with the park, and to explore the social dimensions. This would provide a basis for the identification of appropriate indicators and their targeted application to relevant park communities. One area of social dimensions that can be explored immediately is the quality of visitor experience, and it would also be feasible to include some baseline research in visitor surveys. Indicators that should be tested in the early stages of this work include:

- expectations of park experiences;
- reality of the experiences;
- meanings ascribed to those experiences;
- secondary activities;
- quality of services;
- best and worst elements of visit; and
- non-visitors' values.

Arguably, broad measurement of these indicators should be undertaken through a household-based survey, probably using a combination of telephone and postal (and e-mail) inquiry. However, this should be supplemented by specific studies of identified park communities.

## Looking forward

### Knowledge gaps and further research

*Throughout this document, it has been necessary to emphasise the extent to which there is inadequate social information upon which the social dimension of planning and management might be better grounded.*

In so far as the social dimensions of park management have already been considered, this has been based primarily in the utilitarian spheres of recreation, tourism and public education. There has been little or no exploration of the spiritual, ideological, and community identity elements of the park experience; we know all too little about how people perceive or value the park experience, or what that experience really means to them.

In fact, there are literally thousands of papers in the natural science disciplines, many of pre-eminent quality. There is only a handful in the social sciences, most of a very superficial quality. This imbalance demands urgent attention.

The present diversity of the regional park community has probably been underestimated. The park is large, and its community of users is becoming quite diverse, far beyond mountain horsemen, bush walkers, skiers and park managers. Even each of these gross categories contains at least a number of quite distinctive communities.

A possible approach is to develop and apply an adaptation of the Canadian Visitor Activity Management Process (VAMP) approach (see Parks Canada 1991, Rethink Consulting et al. 1998) that would more clearly identify and characterise the park communities. This would provide practical data for managers and staff that could be used for development of targeted programs to cater more effectively for the various visitor communities across the whole visitor experience cycle. This could be carried out progressively, with high priority communities being the first to be investigated. It could in large part be implemented by existing park staff and local stakeholders, which would mean that the outcome would be not a series of reports sitting in the files, but a real advance in on-ground knowledge and understanding of the various visitor preferences and values.

Such a study might well be commenced as part of a regional action-research investigation and located within the process of developing an effective biosphere reserve program.

### The social dimensions of park management

Park management suffers a number of constraints that provide a barrier to proper recognition of and action upon the social dimensions of the park experience. These are broad problems of the park system as a whole and not specific to the Kosciuszko National Park.

The current review of the park plan provides an opportunity to give critical consideration to some of these problems. In particular, it might explore and test new approaches, rather than pursuing the traditional search for more-of-the-same. The potential value of the biosphere reserve concept has already been emphasised. Opening up other potential strategies might well commence with an extended staff development program aimed at capacity building in more effective and holistic approaches to social management. In turn, this could be associated with an action-research program on more effective ways of furthering quality approaches to the public interface of the park.

## Conclusion

Although there is much that might be criticised or changed for the better, the central reality is that an immense number of people enjoy visiting the Kosciuszko National Park. They come as individuals, as family or friendship groups and as members of organisations. They participate in an immense range of activities, some of them formal and highly organised, but probably most are informal and relatively unorganised. The park can enhance the range of activities undertaken by providing a better range of opportunities, and by encouraging visitors to experiment with new activities or interests, but should not make the mistake of relying upon more highly organised and formally managed programs. International experience is moving away from regulation and control and increasingly towards visitor management through park design, education and community involvement. Key proposals which arise from this paper include:

- consideration of full development of the biosphere reserve concept in co-operation with neighbouring authorities and the regional population;
- the need to review and develop the social capacity of the park service; and
- the need for systematic research and monitoring of social dimensions.



# Chapter 15

## tourism and recreational values

*Graeme Worboys and  
Dr Catherine Pickering*

### Introduction

This chapter is a statement about the tourism and recreational values of Kosciuszko National Park. It analyses the concept of tourism and recreation values and concludes that the intrinsic natural and cultural heritage qualities of the park are the most important tourism and recreation values. What constitutes these qualities, and how the tourism and recreation opportunities and experiences based on these qualities are maximised, is discussed by evaluating 10 attributes that underpin tourism and recreation for Kosciuszko National Park.

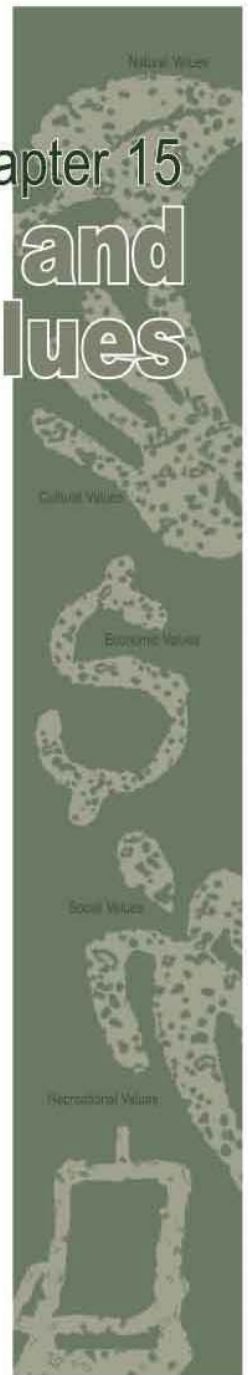
This approach ensures that the park's special heritage qualities are not impacted by the very industry (tourism) that is so dependent on Kosciuszko's intact natural and cultural heritage. The effects of the 2003 bushfires on visitor use emphasise the dependency of tourism upon the park's natural and cultural values. This approach recognises that tourism and recreation to the park will benefit from strategic investment to achieve a sustainable future for this very important regional industry.

This chapter has incorporated input from the public consultation process for the interim report, and we would like to thank those who took the time to provide valuable comments.

Tourism and recreation values were not specifically addressed in the 1982 Kosciuszko National Park Plan of Management. They are an important consideration in the new Plan of Management, reflecting global trends for a more sustainable, responsible and well managed tourism industry (WTO 1999, De Lacy et al. 2002).

### Protected Area Tourism

There is a growing recognition of the need for professionalism in the management of tourism and recreation in protected areas (Weaver 2001, Worboys et al. 2001, Eagles et al. 2002, Newsome 2002). This has included the development of a range of methods to evaluate tourist motivations, expectations and satisfaction, market segments and carrying capacity. Various planning frameworks, such as limits of acceptable change, visitor activity management process, visitor experience resource protection, recreation opportunity spectrum, visitor impact management and tourism optimisation management model, assist with the management of sustainable tourism in protected areas (Ryan 1991; Weaver and Opperman 2000; Weaver 2001; Worboys et al. 2001; Eagles et al. 2002; Newsome et al. 2002). The benefits to individuals from tourism and recreation experiences in parks have also been examined in studies such the Canadian Parks/Recreation Association Benefits Catalogue (1997, Box 15.1). These studies reinforce the importance of the tourism and recreation values of Kosciuszko National Park and the need to protect them and the need for its positive and wise management. We have drawn on the body of knowledge and experience noted in this section in developing this chapter.



*“Protected landscapes can provide the matrix for a wide range of tourist experiences involving the utilisation of attraction and facilities in a particular landscape.”*



## Box 15.1 Benefits of tourism and recreation

(Source: The Benefits Catalogue: Canadian Parks/Recreation Association, 1997)

The Canadian Parks/Recreation Association generated a comprehensive account of why recreation, sports, fitness, arts, culture, and parks are essential to personal, social, economic, and environmental well-being. They recognise eight key themes:

- Recreation and active living are essential to personal health - a key determinant to health status.
- Recreation is a key to balanced human development - helping Canadians reach for their potential.
- Recreation and parks are essential to quality of life.
- Recreation reduces self-destructive and anti-social behaviour.
- Recreation and parks build strong families and healthy communities.
- Recreation reduces health care, social service and police/justice costs.
- Recreation and parks are significant economic generators in your community.
- Parks, open spaces and natural areas are essential to ecological survival.

## Structure of this chapter

Initially, we examine the basis for management by the NSW National Parks and Wildlife Service (NPWS). Then the background and context to tourism and recreation in Kosciuszko National Park is addressed. This includes a review of the importance of tourism and recreation in general and in protected areas in NSW specifically. In this section, we outline the history of tourism in the park and describe its current tourism and recreation use, and visitor awareness and visitor satisfaction for Kosciuszko National Park.

The chapter then deals with the tourism and recreation values of Kosciuszko National Park. It defines these values and then documents a number of attributes that underpin them. Tourism and recreation values are defined by Clarke and Stankey (1979) who recognised, what they called, 'recreation opportunity settings', as a critical element in describing tourism and recreation values. They described recreation opportunity settings as the combination of physical (such as scenery), biological (such as native plants and animals), social (such as family, friends and/or other visitors), and managerial (such as the facilities and regulations imposed at a setting) conditions that give value to a place. They described the tourism and recreation value of an opportunity setting as the function of the perceived ability of that opportunity (setting) to provide certain activities and experiences.

Adopting this definition, this chapter identifies a number of attributes that help to make up a recreation opportunity setting and underpin the tourism and recreation value of a setting. The attributes have been identified for Kosciuszko National Park, and fit the six management factors of Clarke and Stankey (1979; Attachment One for this chapter). Managing the attributes contributes to management of the tourism and recreation value of the park.

The attributes selected have been brought forward following evaluation of tourist motivational behaviour theory as described by Beeton (1989) and Ryan (1991), as well as geographical, social, managerial and intrinsic factors associated with the recreation opportunity setting as outlined by Clark and Stankey (1979), Beeton (1989), Weaver and Opperman (2000) and Eagles et al. (2002). The attributes are discussed in detail later in this chapter. Briefly, they are:

- the park as a natural attraction;
- the park as a cultural attraction;
- educational activities;
- diversity of tourism and recreation opportunities;
- access to the destination;
- access within the destination;
- services and facilities;
- impacts of use;
- affordability; and
- regional recreation opportunities.

Each attribute is assessed relative to the dependence of the attribute on the park, the condition of the attribute, the trend in its condition, pressures on the attribute, knowledge gaps and opportunities. It is a means of assessing the overall condition of tourism and recreation values for the park, and the trend in condition.

Based on this assessment, a number of findings have been prepared relative to the attributes. These are followed by management advice, including potential environmental management performance monitoring indicators. Lastly, it should be noted that this chapter does not consider the economic values of tourism and recreation, which are addressed in Chapter 17.

## Terminology

The term 'tourism' is used in this report to refer to travel away from home for recreation or pleasure and associated activities (Worboys et al. 2001). 'Visitor use' is any use of protected areas by visitors and tourists. The term 'recreation' is used to refer to any activity voluntarily undertaken principally for pleasure and satisfaction during leisure time. 'Recreation opportunity settings' are areas or sites where a combination of six management factors (Attachment One) provides a distinctive destination condition suitable for certain recreation opportunities and the possibility of certain experiences (Clarke and Stankey 1979). For simplicity, tourism and recreation have been treated together when discussing opportunity settings, but the authors recognise that there are differences at a level of detail.

## Basis for management

The *National Parks and Wildlife Act 2001* (NSW) (NPW Act) and the Kosciuszko National Park Plan of Management (as amended, 1988) provide guidance for the management of tourism and recreation within the park.

Under section 2A(1)(c) of the amended Act (*National Parks and Wildlife Amendment Act 2001*) the NPWS has a responsibility to foster public appreciation and enjoyment of natural and cultural heritage and their conservation. Under section 30E(2)(e) of the Act, this must be done within a sustainable visitor use framework. The plan of management principles requires the economic and social context of the park to be considered within the plan (section 72AA(1)(u)), along with the provision of opportunities for public understanding, enjoyment and appreciation of natural and cultural values, including opportunities for sustainable visitor use (section 72AA(1)(l)).

The management of tourism and recreation opportunities in Kosciuszko National Park are described in the 1982 Plan of Management. Recreation and tourism are specifically addressed in Section 6, 'Management of Outdoor Recreation Opportunities', and Section 7, 'Management of Skiing Facilities' (NPWS 1982). For some aspects of tourism and recreation management, the plan is inconsistent with the 2001 amendments to the NPW Act. This anomaly will be corrected in the 2003 plan.

Section 6 of the 1982 plan outlines the policies that guided its strategy for managing tourism and recreation practices (NPWS 2000). These include the following principles:

- In exercising 'the encouragement and regulation of appropriate use' of national parks, the NPWS has a primary responsibility to provide outdoor recreation opportunities requiring no facilities and services or only basic facilities and services;
- National parks provide only some of the outdoor recreation opportunities in any region, not all of them. When providing facilities and services in national parks, an effort will be made to provide opportunities different from, and generally less sophisticated than, those provided elsewhere in a region;
- Facilities and services provided will be consistent with the protection of features and processes of high aesthetic, scientific, conservation, educational, recreational and/or cultural value, and satisfy a demonstrated need;
- Only those facilities and services that assist in 'the appropriate use, understanding and enjoyment of each national park' will be provided. Facilities that create artificial features, attracting visitors in their own right, are not appropriate in a national park;
- The widest possible range of opportunities for the appropriate use of national parks by as many people as possible will be maintained, consistent with the protection of the natural and cultural features of such areas;
- National parks are public lands and decisions to enhance the opportunities for appropriate uses by any one group should not consistently be at the expense of opportunities for appropriate use by any other group. Nevertheless, the NPWS acknowledges that in many cases it has a responsibility to respond to expectations for recreation opportunities held by only a small number of people, and that many uses are more appropriately conducted outside national parks;
- The NPWS recognises that there is a wide range of socio-economic capacities and physical abilities within the community. When allocating opportunities for appropriate use, the NPWS has a responsibility to minimise or avoid discrimination for or against sections of the community on the basis of socio-economic status or physical handicap, within its constraints of finance and human resources; and
- In many cases, the small-scale facilities and services provided by the government, through the NPWS, for activities undertaken by a smaller number of people or physically handicapped groups will not be commercially viable. However, in other cases, the scale and nature of the facilities provided in national parks will provide economic opportunities for private enterprise. In such circumstances the development and operation of the proposed facility and/or provision of the proposed service may be offered under lease or licence to private enterprise.

## Background and context

### Tourism and recreation

Tourism is an important global industry, accounting for 12% of global gross national product, or around US\$4.8 trillion (Newsome et al. 2002). In Australia, the tourism sector directly contributes 4.7% of gross domestic product (A\$31.8 billion), with 551,000 people directly employed in the industry (6% of the labour force) and another 340,600 indirectly employed (ITR 2002). Recent international and domestic events, such as the terrorist attacks in New York and Bali, the drought, bush fires, the Iraq war, the collapse of Ansett and the Severe Acute Respiratory Syndrome sickness, have changed patterns of international and domestic tourism. For example, there are fewer international visitor arrivals to Australia, but in some cases more domestic tourism (Brown 2003). The Australian Tourist Commission's managing Director, Mr Ken Boundy stated in February 2003 that, "The (Australian) industry has now suffered two years of flat performance, with visitor arrivals down by 3% in the year end 2002 and down by 2% in 2001. In addition to a slump in consumer confidence, arrivals to Australia were also impacted by the trend for international travellers to holiday closer to home for shorter periods".

Tourism to natural areas, including national parks, is a growing segment of the tourism industry, accounting for 20% of all international travel expenditure (Newsome et al. 2002). For overseas visitors to Australia, the natural landscape and heritage is seen as a major drawcard, although fewer people visit national parks than visit capital cities or other key destinations such as the Gold Coast (see Chapter 17). Protected area tourism is popular with domestic tourists, with over 22 million visits to national parks and reserves in NSW in 1994 (Worboys et al. 2001).

Protected area tourism is a distinctive segment of the industry (Worboys et al. 2001, Eagles 2002, Newsome et al. 2002). It incorporates both traditional natural area tourism (tourism in a natural setting) and cultural tourism, where the cultural landscape or built environment occurs within a protected area. Protected area tourism incorporates nature-based tourism, adventure tourism, wildlife tourism and ecotourism (Newsome et al. 2002).

Nature-based tourism occurs where viewing nature is the primary objective. It occurs in natural settings, with an emphasis on understanding and conserving the natural environment. Examples from Kosciuszko National Park include sightseeing, camping and walking. Adventure tourism also focuses on activities in natural areas, however, the activities are the focus rather than the natural area. Examples from Kosciuszko National Park include downhill skiing, snowboarding and rafting. In wildlife tourism, the fauna and flora are a primary attraction. Wildlife tourism is becoming increasingly popular, with estimates that 75 million people in the United States watch wildlife each year (Newsome et al. 2002). Kosciuszko National Park has distinct wildlife tourism opportunities including birdwatching and interacting with kangaroos. Ecotourism should foster sustainable use through resource conservation, cultural revival and economic development and diversification (Worboys et al. 2001, Newsome et al. 2002). For a specific tourism activity to constitute ecotourism, it must be nature based, ecologically sustainable and environmentally educative, it must benefit the local community and it must generate tourism satisfaction (Newsome et al. 2002). In Kosciuszko National Park, examples of ecotourism include the education centre at Sawpit Creek, cave tours at Yarrangobilly and some commercial tours including guided walks that have a strong environmental and educative component.

Cultural tourism in protected areas such as Kosciuszko National Park includes activities such as:

- Aboriginal cultural education;
- visitation to standing structures such as houses and outbuildings, sawmills, power stations, dams, etc;
- visits to surface features such as mining sites, and grazing sites etc) and to cultural landscapes such as Kiandra and 'Man from Snowy River Country'; and
- participation in cultural activities such as festivals etc (Worboys et al. 2001).

### Tourism and recreation in NSW national parks

Tourism to protected areas in NSW, including national parks, is managed by the NPWS. The total area managed is over 5.39 million hectares (as of June 2001). This consists of 161 national parks, 359 nature reserves, 13 historic sites, 11 Aboriginal areas, 22 state conservation areas, 10 regional parks and 4 karst conservation areas (NPWS 2001a).

Tourism and recreational use of these parks is very popular. Visits to NSW national parks rose by around 2.5% per annum in the years up to 1994, with over 22 million visits per annum to parks in 1994 (Worboys 1997). Under the *National Parks and Wildlife Amendment Act 2001*, visitor use must be consistent with the primary purpose of the protected areas, which is conservation of natural and cultural heritage. Visitor use to protected areas is an important source of revenue to the NSW NPWS, with total revenue associated with tourism (from all sources, entry fee's, camping fee's, leases, and sales) providing 8% of the total budget (total budget for 2001/02 = \$284 million), with KNP contributing approximately 40% of this revenue (\$9 million/year or 3% of the total budget) (NPWS Annual Report 2001-2002). Expenditure for management of KNP exceeds the revenue generated from its commercial activities (P. Abelson, 1998).

To assist in the management of tourism in protected areas, the NPWS have developed some planning papers. The most recent statements include:

- the Draft Nature Tourism and Recreation Strategy (Worboys 1997)
- the NSW NPWS Visitor Use Charter (NPWS 2001b)
- the Recreation Planning Framework for NSW National Parks (NPWS 2002).

## **History of tourism and recreation in Kosciuszko National Park**

### ***Early tourism and recreation***

Tourism and recreation have a long history in Kosciuszko National Park. The first ascent of the summit is thought to have been made on 12 March 1840 by Paul Edmund de Strzelecki (Gare 1992). He was more intent on exploration and discovery than tourism, as were a succession of scientists including the Reverend WB Clarke in 1851, Baron Mueller in 1855, Richard Helms in 1889 and Edgeworth David in 1907 (Gare 1992).

Documentation of early tourism is scant, however, the limestone caves at Yarrangobilly were first discovered by Mr Bowman of Talbingo in 1834 (KSPT 1960). The first documented use of the area for ski tourism was in 1861 at Kiandra, when local miners went 'ski-running' using modified palings known as butterpats (Hueneke 1987, Good 1992). The first ski club, the Kiandra Snow Shoe Club, was formed in 1878 and held annual ski competitions (Hueneke 1987, Gare 1992). Other early tourism use included the establishment of cave reserves between 1872 and 1890 for 'Public Recreation and the Protection of Caves' for Yarrangobilly, and the use of sites such as Rules Point Guest House and Yarrangobilly Cave House for fishing and other recreational activities. The first cottages developed for tourism at the caves were constructed in 1888 (NPWS 1991). Exploration of the area overlapped with recreational activities, with the routes established by explorers, graziers and miners soon used by others for recreation. This included ascents of Mount Kosciuszko on horse, on bike and on skis during the 1880s to 1900s (Hueneke 1987).

### ***Further development***

The NSW government recognised the recreational value of the mountains and snow country when, in 1906, it established a reserve around Mount Kosciuszko (Snowy Mountains National Chase) 'for public recreation and preservation of game' (Good 1992). In addition, under the supervision of an engineer named Rennix, the government constructed a road to the summit of Mount Kosciuszko to provide vehicle access to continental Australia's highest mountain (KSPT 1960). This was completed in 1908. The government also built hotels, including Yarrangobilly Caves House (1901), the Hotel Kosciuszko (1908) and the Creel at Waste Point (1908), to provide accommodation and activities for tourists (KSPT 1960, Gare 1992, Good 1992). The Creel provided accommodation for fisherman and other tourists. The Caves House complex was completed in 1916 with the building of the two-storey wing, and in 1936 it became a hotel, with the transfer of the liquor licence from Rules Point. It was managed by the NSW Government Tourist Bureau from the late 1800s to 1963, when it was transferred to the Kosciusko State Park Trust. It operated until 1966 (NPWS 1991).

By the 1920s, parties of bushwalkers, horse riders and skiers regularly used the area during summer and winter, with marketing of summer and winter recreational activities to wealthy residents of Sydney and Melbourne (Hueneke 1987).

As a result of increasing interest in mountain tourism, additional huts and hotels were built by the NSW state government and private clubs specifically for tourism in the high country. These included the Chalet at Charlotte Pass, built in 1931, burnt down in 1938 and rebuilt in 1939 (Good 1992). A series of small lodges, mainly for back country skiing, were built in more remote locations on the Main Range by the government tourist bureau and ski associations, with the approval of the newly formed Kosciusko State Park Trust. These also included the construction of Lake Albina Lodge in 1951, Kunama Lodge in 1952, and Illawong Lodge in 1956, an extension of Pounds Creek hut built in 1926 (Hueneke 1982, 1987, Good 1992). Facilities provided for the Snowy Mountains Hydro Electric Scheme were also used for tourism and recreation, including workers' huts at Guthega, Schlink Hilton at Schlink Pass and huts within the Jagungal Wilderness Area (Hueneke 1982, 1987).

In 1944, the *Kosciusko State Park Act* was passed by the NSW government, protecting a total of 2000 square kilometres. The provision of formal downhill skiing facilities commenced in 1952, when the Act was amended to provide for ski lodge leases (Good 1992). Commercial developments based on alpine skiing commenced in Perisher Valley in 1959, at Thredbo in 1958, and at Guthega, Kiandra and then Mount Selwyn in the 1970s (Hueneke 1987; Good 1992). There was rapid development of the ski resorts in the 1960s, 1970s and 1980s. This included completion of the chairlift from Thredbo Village to Top Station in 1962, the approval of the Thredbo Village Master Plan in 1964, Antons and Sponars T-bars in the late 1970s, the expansion of ski lifts in Perisher Valley in the early 1980s, the Perisher Valley Centre in the mid-1980s, Mount Blue Cow in 1986, the ski tube in 1987 and the sports academy in Thredbo in the late 1990s.

In 1960, there were more than 100,000 visits to the park (Good 1992). In the same year, there were some 16,000 visits to the Yarrangobilly show caves (KSPT 1960). In 1967 the NPWS was established, recognising the importance of conservation of the natural and cultural values of national parks as well as nature tourism and recreation opportunities (Good 1992). The NPWS took over from the Kosciusko State Park Trust. The NPWS began to manage tourism and recreation in the park, including addressing issues associated with increased use. For example, in 1974, due to traffic congestion, traffic jams and associated problems, the summit road from Charlotte Pass to Rawson Pass was closed to private vehicles.

However, from 1976 to 1982, a shuttle bus continued to operate during peak periods. The road was closed to all private vehicles in 1982, and pedestrian access to the summit, via the Thredbo Village to Top Station chairlift, was promoted. As a result of increased numbers using this route, the NPWS built an elevated steel mesh walkway (1982 – 1987), which extended from just beyond the top of the Crackenback chairlift to Rawson Pass, close to the summit (Worboys and Pickering 2002). The mountain huts are important destinations for many cross-country skiers and bushwalkers, and became an important part of the recreational experience.

Ski resort development in the 1980s and 1990s involved diversification of use in winter and summer, and introduction of snow-making facilities (Grenier 1992; Buckley et al. 2000; NPWS 2001c; Pickering and Hill, in press). In the 1990s, and more recently, development has focused on providing improved services and facilities for visitors to the resorts through accommodation and commercial space. There are now 11,899 officially approved beds in Kosciuszko National Park. Snow sports are a very important activity within the park, and the sport of skiing has become more sophisticated, with many Australian skiers performing successfully internationally at the highest levels of this sport. The area of the park that has 60 or more days of snow cover is estimated to be 1201km<sup>2</sup> or 18.5% of the park (6494km<sup>2</sup>). In comparison, Switzerland has 41 times more snow covered area (area with 60 or more days of snow cover) than this (Slatyer et al. 1984). The ski resort management units constitute some 3.5% (42km<sup>2</sup>) of the snow covered area, however, the area directly influenced by the ski resorts is much larger (Good 1995, Buckley et al. 2000).

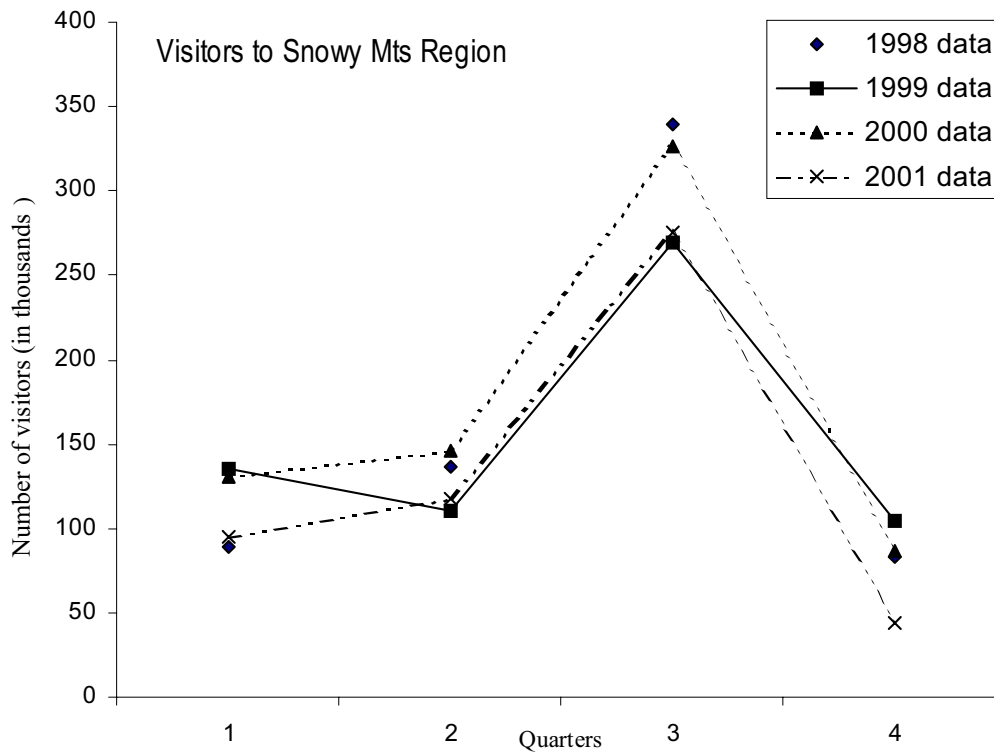
### **Data on tourism and recreational use of Kosciuszko National Park**

There are a variety of ways to measure tourism and recreation use of protected areas such as Kosciuszko National Park. Data on visitor use of protected areas can include entry gate figures, road traffic counters, visitor surveys within the protected area at specific locations and/or for specific activities, ticketing for facilities such as chairlifts and general tourism surveys that include questions relating to a region or park. For Kosciuszko National Park, sources of visitor data include: park entry gate figures (e.g. Alpine Way and Kosciuszko Road), traffic counters (on several roads including those in the northern part of the park such as Kings Cross Road etc), surveys conducted within the park (ski resorts, summer tourism in the alpine area etc), surveys taken outside the park, of specific user groups (park visitors, members of ski clubs etc), surveys of general visitors to region (Mules et al. 2002), and national visitor surveys (BTR 2002). These data are collected for specific reasons. Each provides different measures of use, and each has its own benefits and limitations. We have included a variety of sources here to provide a picture of current tourism and recreation use of the park.

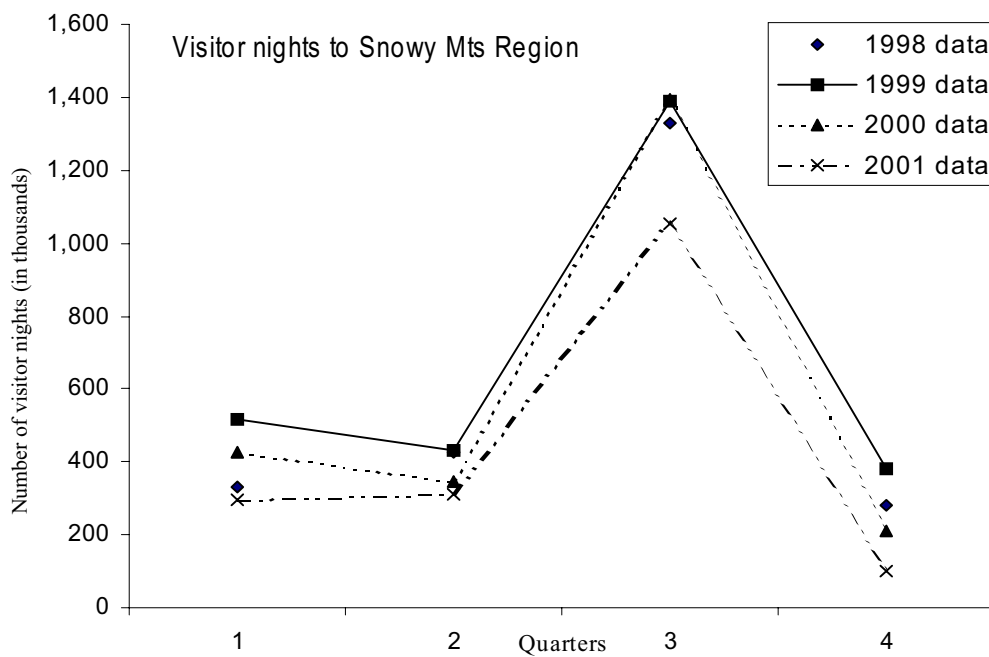
At a national scale, visitor data is collected by the Bureau of Tourism Research (BTR). This non-statutory, intergovernmental agency compiles a National Visitor Survey of 80,000 Australian residents each year. The BTR provides data on (1) Number of overnight visits, (2) Number of day trip visitors and (3) Visitor nights, the number of people in the region overnight, summed for a specific period (often year). This value combines number of visits by the number of nights spent in the area. From the first two values it is possible to estimate the number of people who visit the region.

Based on four years data (1998-2001) from the BTR, the average number of domestic visitors (different people) each year who travelled for tourism and recreation to the Snowy Mountains region that includes Kosciuszko National Park was 861,000 (Figure 15.1). The average number of domestic visitor nights per year (number of nights on which visitors stayed in the region summed for all visitors) was 2,308,000 (Figure 15.2).

**Figure 15.1** Number of domestic visitors (overnight visitors plus day trip visitors, in thousands) per quarter to the Snowy Mountains region, 1998–2001 (data from the Bureau of Tourism Research, 2002)

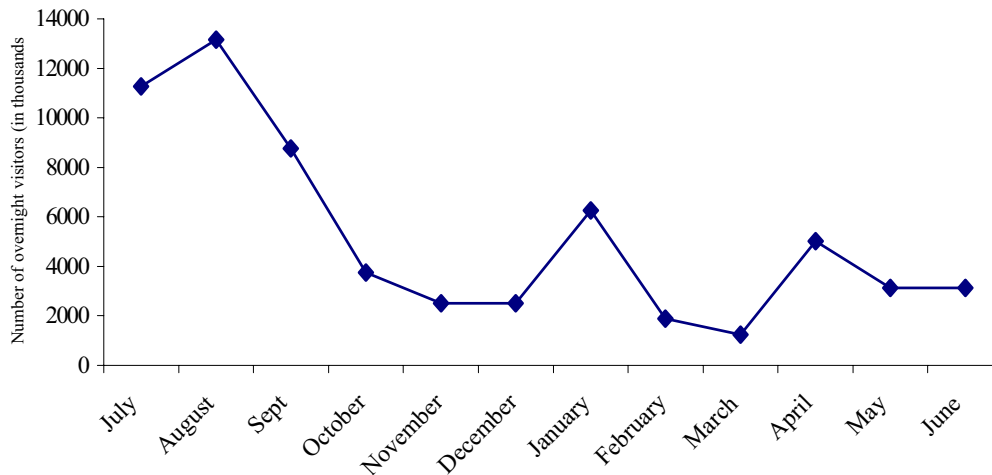


**Figure 15.2** Number of domestic visitor nights in the Snowy Mountains region per quarter for 1998–2001 (data from the Bureau of Tourism Research 2002)



Data from the visitor survey for the BTR for just the year ending June 2001 (Figure 15.3) highlights the episodic nature of visitation to the park, with the highest visitation during the ski season, and two lower peaks during the summer school holidays, and at Easter.

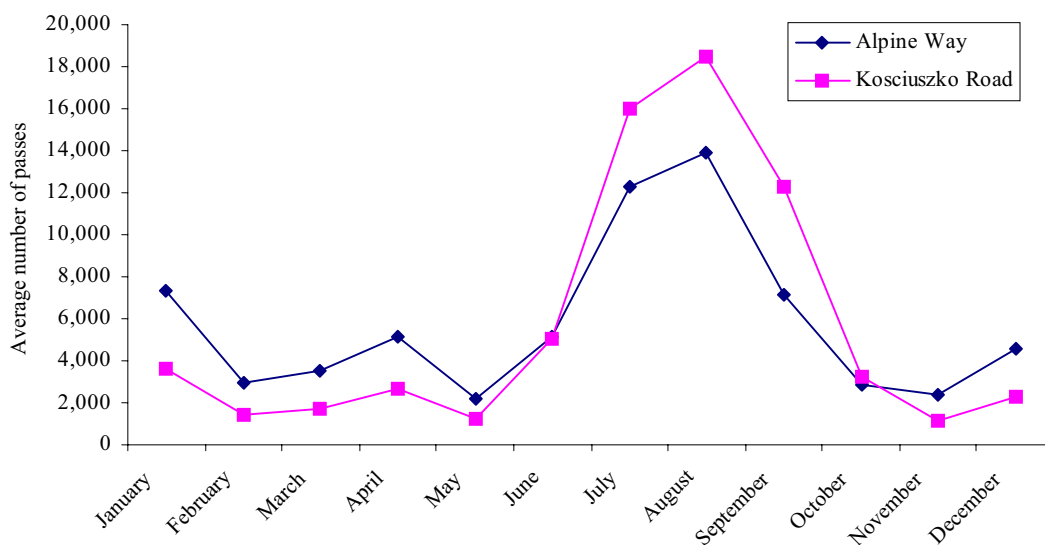
**Figure 15.3** Number of domestic overnight visitors to the Snowy Mountains Region by month for year ending June 2001 (data from Tourism New South Wales 2001, based on BTR, National Visitor Survey)



In addition to data from the BTR, the NPWS collects data from entry gates on two roads within the southern end of the park, the Alpine Way (a through road for most of the year, but closed at Thredbo Village during winter), and the Kosciuszko Road (which terminates in the park at Charlotte Pass, but is closed above Perisher Village in winter). This data shows the same seasonal pattern of visitation, with winter the peak period (Figure 15.4). For example, 70% of passes for vehicles are issued from June to October (inclusive, 96,426 tickets out of total of 138,619, average 11 years of data<sup>1</sup>).

Data from a survey conducted by the Centre for Tourism Research at the University of Canberra (Chapter 17) indicates that winter tourism accounts for some 65% of the annual total visitation to the park.

**Figure 15.4** Number of vehicle passes (averaged over 11 years, 1989 – 1999) issued (sold or exemption) per month from the entry gates to Kosciuszko National Park along the Alpine Way and Kosciuszko Road (data from NPWS)



<sup>1</sup> Number of vehicle passes sold or exemptions issued. Does not include people using the Skitube to enter the park or repeat entry by vehicles with existing pass (e.g. annual passes etc).

Most winter tourists visit one of the four ski resorts in Kosciuszko National Park (Table 15.1). The resorts provide a range of facilities for winter visitors, including accommodation, lifts, bars and restaurants. They are increasingly relying on snow manipulation including of artificial snow making to ensure an even cover of snow during the season (Pickering and Hill, In press).

**Table 15.1 Information about facilities at ski resorts in Kosciuszko National Park**

Ski Resort	Maximum altitude (m)	Artificial snow area (ha)	Down hill ski area (ha)	Capacity skiers/hr (x1000)	Cross country trails (km)
Perisher Blue <sup>2</sup>	2054	34.5	1,245	47.6	100
Thredbo	2037	70	175	18	12
Charlottes Pass	1980	0.5	50	2.5	1.8
Selwyn Snowfields	1601	36	45	9.5	45
<b>Total NSW</b>		<b>141</b>	<b>1520</b>	<b>77.6</b>	<b>15.8</b>

Estimates of visitation to individual ski resorts include around 650,000 skier days per year for Perisher Blue (NPWS 2001c<sup>3</sup>), and 700,000 visitors for Thredbo Village from June to October<sup>4</sup>.

By far the most popular activity in winter is down hill skiing (23.6% of all people visiting the park) and snowboarding (8.4%), with lower numbers engaging in cross-country skiing (5.0%) and other activities (Chapter 17<sup>5</sup>). Some ski resort visitors do not engage in outdoor winter recreation activities but participate in the social life of the resorts. About 5% of visitors engage in activities away from ski resorts, mainly for snowboarding or ski-touring, either on day trips (often from resorts) or camping overnight in snow caves and/or tents. Relatively few engage in snow and ice climbing or snow shoeing (Virtanen 1993; see also Chapter 17).

Although ski resort based skiing is clearly the most popular tourism activity, non-snow based tourism (November to May), is also important and appears to have grown steadily over the past 25 years, from a minimal base. For example, non-ski season tourism now accounts for around 30% of the visitation to Thredbo Village (300,000 visits<sup>6</sup>), and 30% of the passes issued at the entry gates on the Alpine Way and Kosciuszko Road (Figure 15.4).

When over 3000 visitors to the park were surveyed (mail in survey), walking was found to be the activity undertaken by the greatest range of people, (57.2% of annual visitors), while car touring and sightseeing (50.2%) and nature appreciation (46.1%) were also popular (see Chapter 17). Other popular non-snow-based activities are camping (15.6%), fishing (11.6%), four-wheel driving (8.8%), mountain bike riding (6.1%) and horse riding (5.3%, Chapter 17). These results are similar to those obtained in a survey of 300 park visitors in NSW, the Australian Capital Territory (ACT) and Victoria (Worthington and Di Marzio Pty Ltd 1999). In this study, walking was the most popular activity among visitors to the Australian Alps national parks. Ninety-three per cent of visitors had gone walking in a park, with 47% going to the region specifically to walk (highest listed activity). Other popular activities and motivations were 'peace and quiet' (94%), picnicking/barbecues (88%), 'enjoying nature and natural environments' (87%), scenic driving (84%) and 'to see specific sites' (83%).

Summer visitation to the small alpine area of the Main Range (as estimated by on site visitor surveys) appears to have increased during the last 25 years. A survey in 1978 estimated that there were 20,000 summer visitor to the alpine area (Worboys 1978). By the early 1980s the number had increased to 36,000 people per summer (quoted in Virtanen 1993). The most recent estimate for the snow-free period of 1999–2000 is 64,000 people (Johnston SW and Pickering 2001). However, this survey finding is potentially contradicted by usage patterns recorded for the Thredbo chairlift, and park entry gate data which both indicate that summer usage has been fairly stable for the last decade (Denise Allardice, Kosciuszko-Thredbo Pty Ltd, pers. comm., September 2002, NPWS entry gate figures).

In the northern part of the park, ski tourism is popular at the family orientated Mt Selwyn ski resort. There is also extensive use of the north of the park for other types of tourism, particularly in the summer. Cave tourism is popular, with the Yarrangobilly Caves receiving around 24,000 visits, and 40,000 visits to the nearby thermal pools and picnic areas each year (NPWS, South West Slopes Region visitation figures 2001/2002, Mark Adams, NPWS pers. comm., 2003). The Tumut Regional Visitors Centre received around 33,500 visits from July 2001 to June 2002.

<sup>2</sup> Perisher Blue Resort was formed by the merger of Perisher-Smiggins and Blue Cow-Guthoga Resorts in 1995. Sources: Web sites for each of the resorts and personal communication by Wendy Hill, Griffith University with resort snow managers June 2001.

<sup>3</sup> Annual skier visitation for years 1989 to 1999, Figure 2.7 from Perisher Range Resorts Master Plan, 2001.

<sup>4</sup> Number likely to be based on skier days or overnight visits, Data from Thredbo Village Web Site, Facts and Figures.

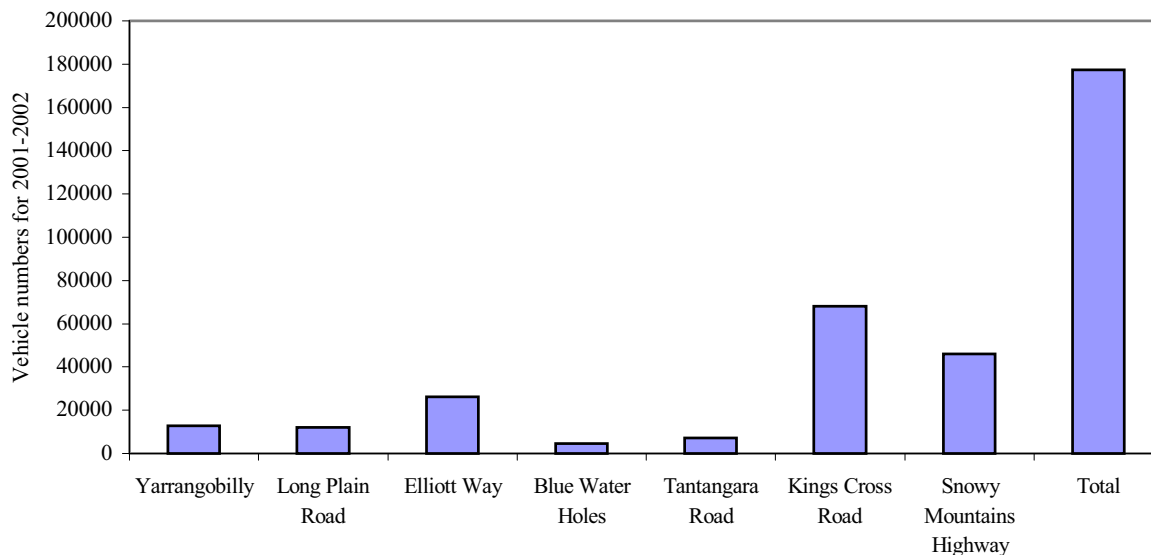
<sup>5</sup> NB This is activities undertaken by different people who visit the park and hence differs from measures based on visitor days or nights.

<sup>6</sup> Number likely to be based on number of visits to resort, Data from Thredbo Village Web Site, Facts and Figures.



Other popular areas include Long Plain, Elliot Way and Tantangara (Figure 15.5). Horse riding is also common in the north of the park with an estimated 1,140 commercial and private horses in the Northern Plains region between October 2001 to April 2002 (Mark Adams, NPWS, pers. comm., 2003).

**Figure 15.5** Number of vehicles July 2001 – June 2002 on roads in the northern part of Kosciuszko National Park (data from NPWS).



Most visitors to Kosciuszko National Park and the Snowy Region are domestic tourists and less than 3% are international visitors (TNSW 2001, see also Chapter 17). Most domestic overnight visitors come from Sydney (49%), regional NSW (23%) or the ACT (11%), with low numbers from Victoria (7%) and Queensland (7%) (TNSW 2001). Nearly all visitors come for holidays or leisure (78%) rather than to visit friends or relatives or for business.

By far the largest market segment of domestic visitors are families with dependent children (46%). The other 54% of the market comprises young solos (4%), single adults (18%), young couples without children (19%) and older couples (17%) (TNSW 2001). There are some ecotourists, with this niche market having the potential to grow.

As mentioned above, few international visitors travel to the Snowy Mountains. In the year ending June 2000, there were 23,000 international visitors to the region out of 2.5 million international visitors to NSW (TNSW 2001). Most (73%) came from the United Kingdom (27%), Germany (19%), other countries in Europe (33%) and the United States (10%). Public access opportunities to the park and lack of knowledge about the destination appear to be factors contributing to the low levels of international visitation (TNSW 2001, see also Chapter 17). There are strong links between the community and the tourism and recreation industry in the area.

### 2003 Fires

The bushfires, in the summer of 2003, are natural phenomena that had an immediate effect on tourism and recreation in the park. The fires resulted in the closure of the park for several weeks, with obvious impacts on summer visitation to the region. The uncertainty over the duration of park closure and other fire issues, along with perceived changes to the natural values of the park caused by the fires, resulted in a dramatic post fire drop in tourism. This helped to crystallise, for the tourism industry and the region the importance of the natural and cultural heritage values of the mountains as the principal tourism value of the area. The fires also reinforced the need to account for natural events in tourism business planning. For example the historical proposals to located potential new ski resorts at Tantangara Mountain and Twin Valleys immediately above alpine ash forests (with a high fire potential) would have proven difficult to protect from fire. Fire as a natural event in Kosciuszko National Park and tourism needs to be planned carefully.

Active information campaigns by the NPWS and local tourism organizations are likely to help result in a recovery of non-snow based tourism after the 2003 fires, as people recognise the attraction of post fire landscapes. Winter tourism is likely to be less affected by the fires, and may benefit in the short term from the decline in overseas travel by Australians associated with SARS and terrorism.

## Visitor awareness and satisfaction with Kosciuszko National Park

At least among people who visit protected areas, awareness and satisfaction with Kosciuszko National Park is high. Worthington and Di Marzio Pty Ltd (1999) found that 98% of surveyed visitors to national parks were aware of Kosciuszko National Park. This recognition was higher than for any of the other 25 parks listed on their survey, including Kakadu, Uluru (Ayers Rock), the Blue Mountains or the other parks in the Australian Alps (Worthington and Di Marzio Pty Ltd 1999). Kosciuszko National Park was also a very popular park, with 52% of the 300 respondents having visited the park. There were high levels of satisfaction with facilities in the Australian Alps national parks, including Kosciuszko National Park (92%). There was high satisfaction (greater than 80%) with toilets (80% totally satisfied), short walking tracks (86%), picnic and barbecue areas (86%), car parking (89%), scenic driving (93%), visitor information centres (92%), information display boards (89%), roads within national parks (94%) and direction and information signs (81%). The main areas of dissatisfaction were the number of parks (with 33% wanting more), availability of water (9%), understaffing (7%) and poorly signposting of tracks (6%).

## Tourism and recreation values of Kosciuszko National Park

### The concept of tourism and recreation values

Kosciuszko National Park has long been an important destination for a large number of visitors. What are the values that underpin this visitation? There are a wide range of activities undertaken within the park, from sightseeing, bushwalking, snow boarding down hill and cross-country skiing to adventure sports such as ice climbing and white water rafting (Attachment Two, Part B). The concept of values, for essentially natural lands such as Kosciuszko National Park, are briefly discussed here as part of establishing the concept of tourism and recreation values for the park.

In modern industrialised Australia, human and natural environments are starkly contrasted with natural environments, such as Kosciuszko National Park, often having great cultural and spiritual value, for both indigenous and non-indigenous Australians. For indigenous Australians, natural landscapes and natural sites are of immense cultural significance. Likewise, for non-indigenous Australians, there are strong connections to the bush. Historical events and life experiences since 1788 have made many sites and landscapes particularly significant for individuals and families. Connections to nature may also be spiritual. Thus conserving natural areas which provide opportunities for self-reliant recreation is important. Recent wilderness legislation has recognised this by reserving areas of natural lands for opportunities for solitude and self-reliant activities (Worboys et al. 2001).

Kosciuszko National Park also has intrinsic values. The 1993 Convention on Biological Diversity, ratified by Australia, affirmed the concept of the intrinsic value of biodiversity. The 1982 World Charter for Nature, adopted by over 100 countries, stated:

*Every form of life is unique, warranting respect regardless of its worth to man, and, to accord other organisms such recognition, man must be guided by a moral code of action.*

Many people hold ethical, religious and cultural beliefs, and feel strongly about their relationship with other life forms (Worboys et al. 2001). Human-centred values of Kosciuszko National Park may be recognised as 'use' and 'non-use'. Non-use values include *option values* (natural systems have not been exploited and may be valuable in the future), *existence values* (enjoyment people get from knowing an area has been conserved, whether or not they use it) and *bequest values* (derived from the belief that natural resources should be retained for future generations to appreciate and enjoy). Use values are, where humans benefit directly from using natural living resources. Biodiversity is important, for example, for medicine and agriculture and for ecosystem services. Natural areas are also becoming increasingly important for tourism and recreation (Worboys et al. 2001). Chapter 16 has further details of use and non-use values of the park. The tourism and recreation values of Kosciuszko National Park described in this report are focused on 'use values', that is, how the park is valued by users as a tourism and recreation opportunity.

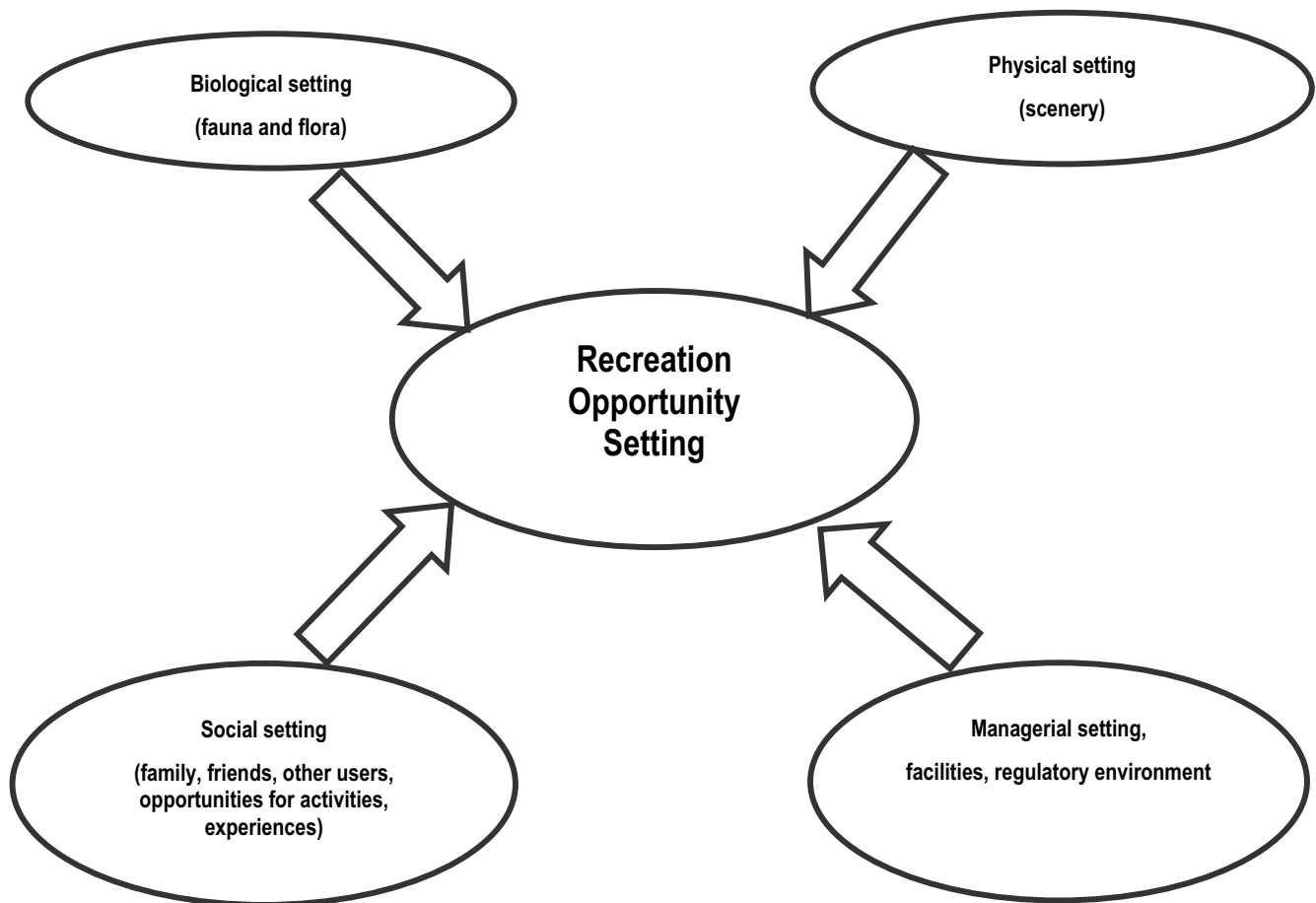
### Describing tourism and recreation values for the park

The tourism and recreation use values of Kosciuszko can be described in terms of 'opportunity settings' found within the park. According to Clarke and Stankey (1979), recreation opportunity settings can be defined as the combination of physical (such as scenery), biological (such as native plants and animals), social (such as family, friends and/or other visitors) and managerial (such as the facilities and regulations imposed at a setting) conditions that give value to a place (Figure 15.6; see also Table 15.2). They are what we usually visualise when we think about a destination before a visit. Clark and Stankey (1979) further explain the concept:

Recreation opportunity settings imply a choice for recreationists; people must be aware of the opportunities, and the opportunities must be comprised of conditions desired by recreationists. The recreational value of an opportunity is a function of the perceived ability of that opportunity to provide certain activities and experiences.

The definition of recreation opportunity settings used in this chapter focuses on the social, physical and managerial attributes of settings, but not on the psychological/spiritual experiences that may be derived.

Figure 15.6 Elements contributing to a recreation opportunity setting



It should be noted that Clarke and Stankey described visitor experience in terms of the opportunities for experiences, rather than becoming embroiled in complexities surrounding the visitor experience (psychological state) of individuals. However, the relationship between the opportunity and the experience is important; as opportunities lead to experiences, so it is important to briefly introduce this area of theory.

Tourism and recreation opportunities are means by which a visitor acquires experiences and fulfils aspirations; it has been argued that these experiences fulfil psychological needs and motivations (Ryan 1991). Described in a general way for tourism, some of these needs and aspirations include the escape motivation, relaxation and play, strengthening family bonds, prestige, social interaction, sexual opportunity, educational opportunity, self-fulfilment, wish fulfilment and shopping (Ryan 1991). Beeton (1994) extends this discussion to protected areas. Some relevant extracts of his work are:

*Motivation to travel, or to participate in recreation activities, results from the set of needs and attitudes which predispose individuals to act in specific goal oriented ways. Motivation is therefore an inner state which directs behaviour to achieve specific goals.*

*Natural areas such as national parks play an important role in both tourist and excursionist satisfaction by providing areas which can potentially offer experiences of challenge, escape, relaxation, self-discovery and spiritual awareness.*

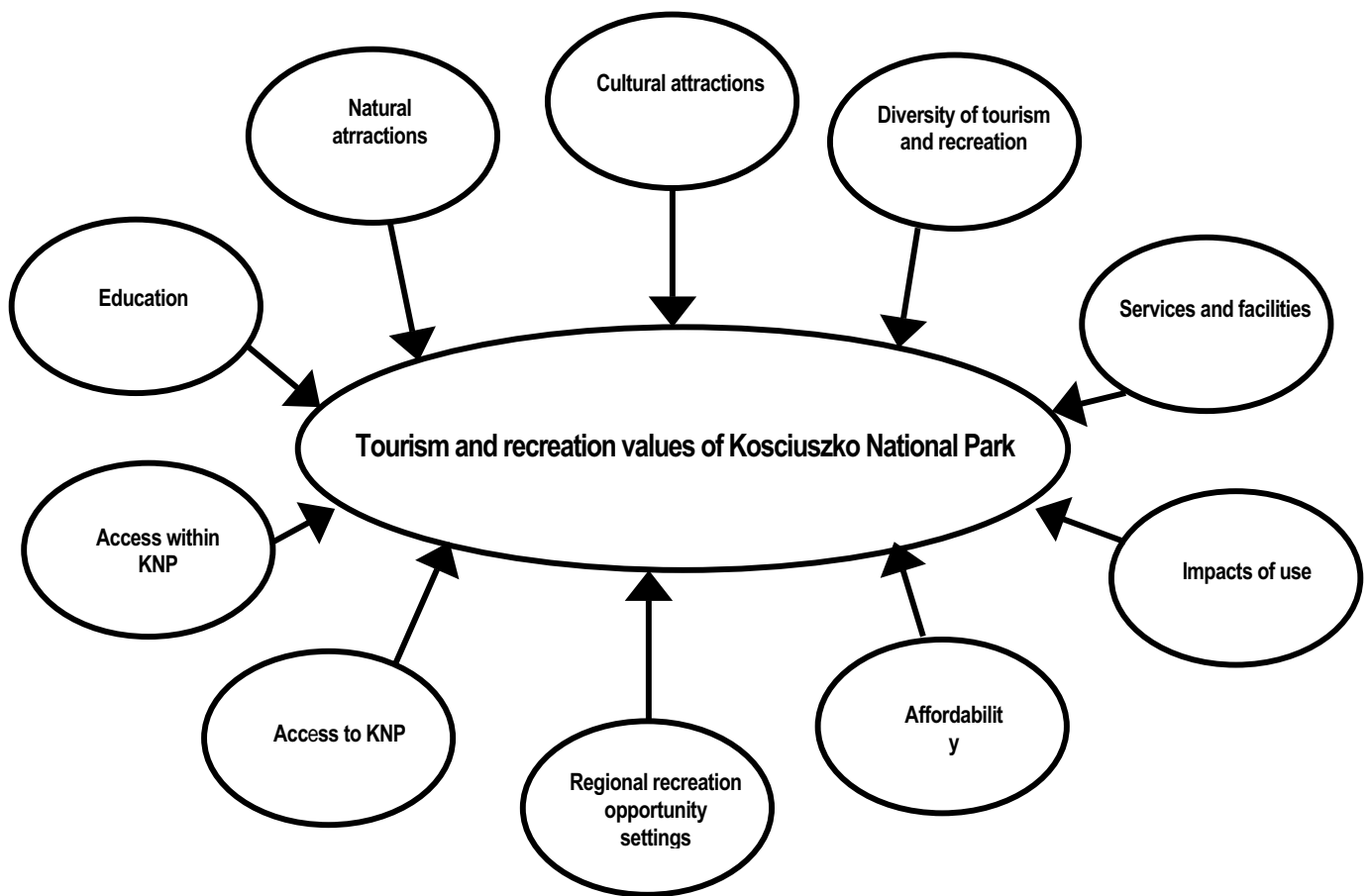
*Protected landscapes can provide the matrix for a wide range of tourist experiences involving the utilisation of attraction and facilities in a particular landscape.*

*All the elements involved in a traveller's visit and the psychological benefits obtained from these activities constitute the recreation/tourist experience ..... the destination, or on-site experience incorporates all aspects relevant to the destination and the recreationists state of mind. The area, including area design, setting, activities engaged in, proximity to and number of other recreationists and their behaviour, the facilities available, and inter-area travel nodes, will all contribute to the on-site experience.*

The tourism and recreation value of Kosciuszko National Park is influenced by a number of geographical, social, managerial and intrinsic factors, including geographical proximity to markets, accessibility to markets, cultural links, availability of services, affordability, peace and stability, positive market image, pro-tourism policies and availability of attractions (Weaver and Opperman 2000). Visitor attractions, in the case of Kosciuszko National Park, are seen as an important component of the tourism sector; and they may incorporate specific features such as natural destinations (such as the alpine area with its summer wildflowers and the mountain scenery ) through to destinations with more sophisticated services that support recreation and tourism, such as ski resorts, and limestone caves. Artificial attractions or high impact, derived activities that may change the core or natural or cultural heritage values of the park are not considered to be consistent with most important tourism and recreation values of the park. This paper describes further describes this position.

This chapter identifies 10 attributes of tourism and recreation opportunity settings that underpin the tourism and recreation value of Kosciuszko National Park. They are shown in Figure 15.7. Management of the attributes is a contribution to the management of the tourism and recreation values of the park.

**Figure 15.7 Importance of some attributes that underpin the tourism and recreation values of Kosciuszko National Park**



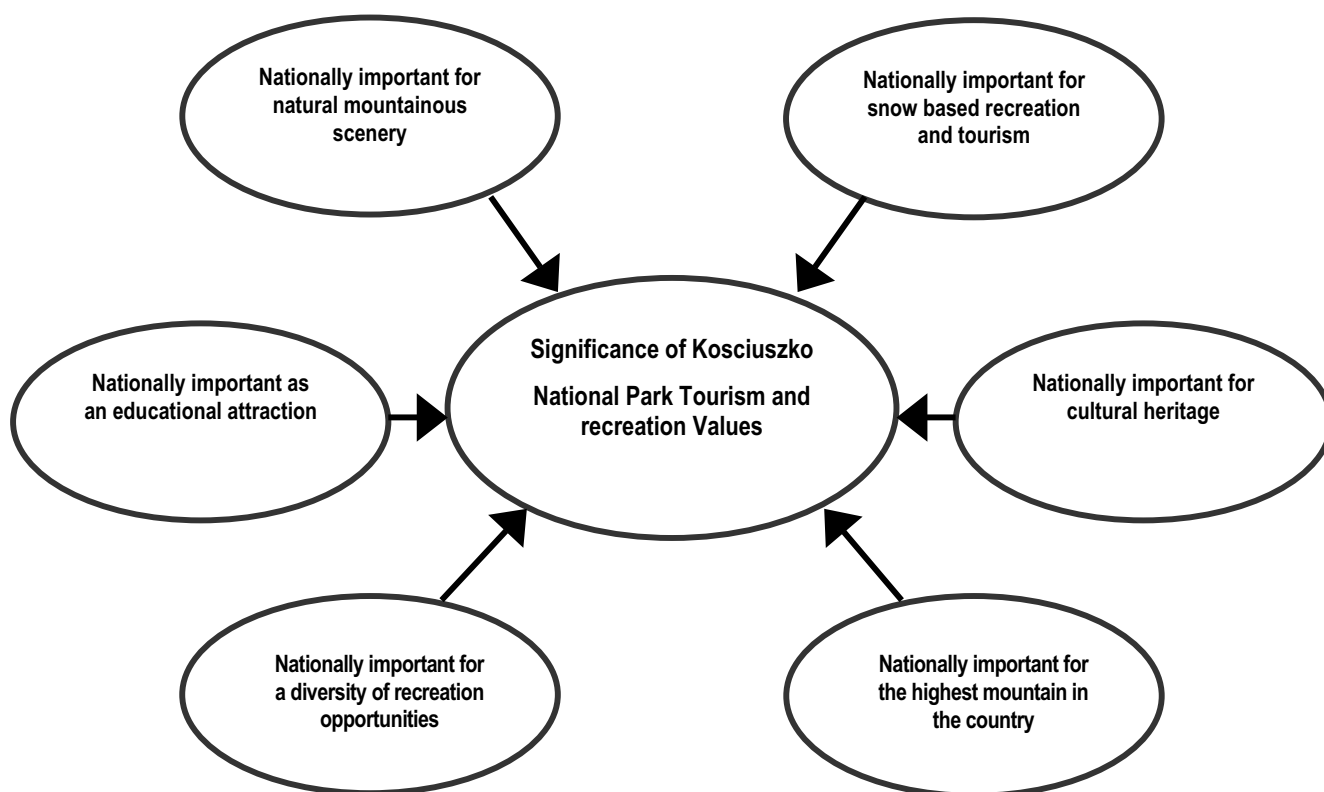
The ten attributes have been developed specifically for Kosciuszko National Park, and conform with the six management factors identified by Clarke and Stankey (1979) (see Attachment one). The attributes have been selected following evaluation of tourist motivational behaviour theory as described by Beeton (1989) and Ryan (1991), as well as taking into account the geographical, social, managerial and intrinsic factors associated with the recreation opportunity setting, as outlined by Clark and Stankey (1979), Beeton (1989), Eagles et al. (2002) and Weaver and Opperman (2000). The attributes determined have been evaluated by park staff and some members of the Kosciuszko National Park Plan of Management Community Forum.

The next section assesses these attributes using the following criteria: the significance of the attribute, dependence of the attribute on the park, condition of the attribute, trend in condition, pressures on the attribute, knowledge gaps, and opportunities to improve the attribute. The order in which each attribute is presented does not reflect its relative importance.

**Significance of Kosciuszko National Park tourism and recreation values**

Kosciuszko National Park is considered to have nationally significant tourism and recreation values. The importance of the ten attributes is discussed further in the following sections. This importance of some of these attributes to visitors is illustrated in Figure 15.8.

**Figure 15.8 Importance of some attributes that underpin the Tourism and Recreation Values of Kosciuszko National Park**



## Attribute 1: natural attraction

The extraordinary aesthetic scenic and natural qualities of Kosciuszko National Park are one of the primary factors contributing to the high tourism and recreation values of the park. The natural attraction of a protected area such as Kosciuszko National Park can provide opportunities that cater to visitors' needs for play, self-fulfilment, educational opportunity, relaxation and escape (Beeton 1989). In a survey of park visitors in NSW, Victoria and the ACT, and rural residents, 96% of park visitors and 85% of rural residents believed that conservation of natural heritage was the most important reason for the existence of these national parks (Worthington and Di Marzio Pty Ltd 1999). Natural attraction was also a major motivation for 68% of summer visitors surveyed while visiting the alpine area of Kosciuszko National Park (Figure 15.9).

The natural condition of the park contributes to visitor satisfaction by providing opportunities for challenge, escape, relaxation, self-discovery and spiritual awareness. The park features a diversity of natural settings, including the highest mountains on the Australian continent and the highest peak, natural mountainous scenery of high aesthetic quality and appeal, snow-covered landscapes, clear air, mountain streams, glacial lakes, waterfalls, limestone caves, thermal springs, alpine wildflowers, subalpine snow gum woodlands, montane forests, native pine communities, endemic plants and animals and open space. The park is a World Biosphere Reserve, in part due to the international recognition of the natural values of the park.

### *Importance of the park as a natural attraction*

Kosciuszko National Park as a natural attraction is nationally important. The natural scenic qualities of Kosciuszko National Park, its mountainous landscapes, its size and its diversity of natural settings and the presence of snow are paramount in what is valued as a tourism and recreation attraction by visitors.

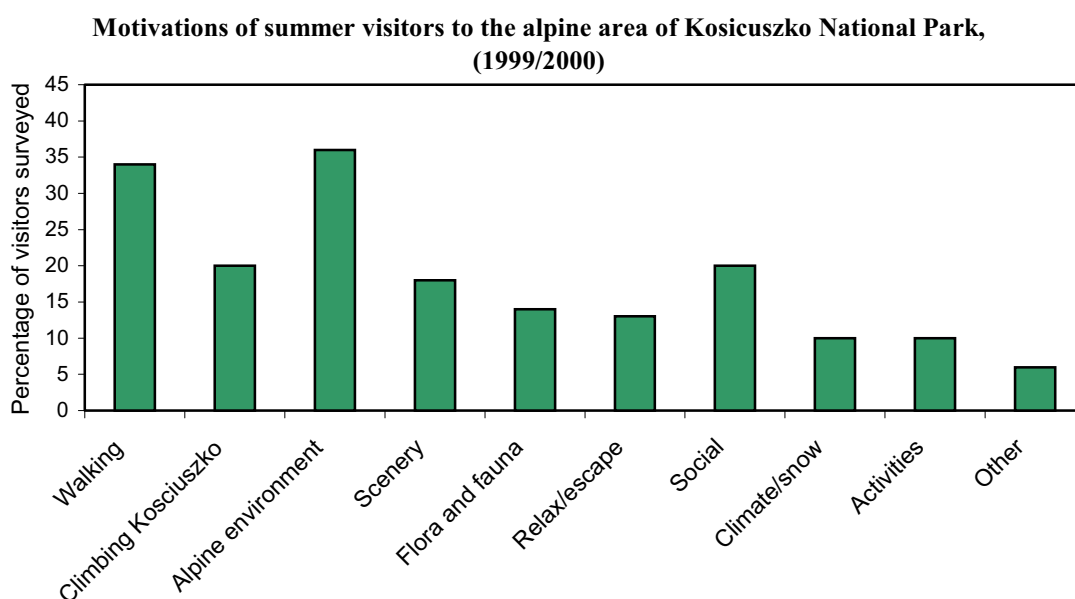
### *Dependence on the park*

The opportunity to experience natural attractions such as alpine landscapes that include the summit of Mount Kosciuszko and the Main Range, large, natural wilderness areas such as Jagungal, Pilot, Byadbo, Bogong Peaks and Bimberi in sub-alpine and montane ecosystems is available only in Kosciuszko National Park. For other tourism and recreation opportunities, such as to experience the natural attraction of the snow country and frost hollow grassy valleys, there is partial dependence on the park, as there are similar opportunities in Victoria and Tasmania.

### *Condition and trend in condition*

The extraordinary aesthetic, scenic and natural heritage of Kosciuszko National Park is one of the primary tourism and recreation attributes of the park. Table 15.2 describes the condition and trend in condition of these attributes.

**Figure 15.9 Motivations of summer visitors to the Kosciuszko alpine area (McMaster 2000)**



**Table 15.2 Condition and trend in condition for natural tourism and recreation attraction aspects of Kosciuszko National Park**

Natural attraction	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread
Natural scenery <sup>a</sup>	Undisturbed; no human structures		■		□			□		□	
Native wildlife <sup>b</sup>	Presence of native fauna; absence of introduced fauna			■					■	□	
Native plants <sup>c</sup>	Presence of native flora; absence of non-native plants and pathogens			■						■	
Limestone caves <sup>d</sup>				■					■		
Soils	Non-eroding; non-compacted/disturbed		■		□			■		□	
Water quality <sup>e</sup>	Unpolluted streams			■	□				■	□	
Air quality <sup>f</sup>	Unpolluted air; greenhouse gas emissions minimised		■		□				■	□	
Natural noise <sup>g</sup>	No artificial noise		■		□				■	□	
Natural light <sup>h</sup>	No electric lights; natural darkness; opportunity to see stars without light pollution		■						■		

■ Overall status for Kosciuszko National Park; □ Relates to parts of Kosciuszko National Park

<sup>a</sup> The park is scenically very diverse. There are many large natural areas where the natural scenery is in very good condition. Some other areas are impacted by power lines, urbanised areas and car parks within the ski resorts and many features of the Snowy Scheme. Some areas are degraded including the nation's highest peak, Mount Kosciuszko, where further rehabilitation works are required. Natural scenery is very important for tourism and recreation.

<sup>b</sup> Impacted by tourism and recreation. Habitats of endangered species have been modified in the ski resorts. There are road kills, and many species are influenced by visitors throughout the park. Bats may be disturbed in caves, breeding populations of snakes and other species may be disturbed by walkers. Special management is needed for the ski resorts including aquatic organisms.

<sup>c</sup> Slashing of native vegetation in the ski resorts and trampling of alpine area plants are two impacts that need managing. Control of alien plants in the park should be a continuing priority.

<sup>d</sup> Access to the caves in the park is by permit system or by ranger guided tour. This system appears to be working satisfactorily.

<sup>e</sup> There are water quality issues for streams downstream from urbanised facilities with sewage and other discharges and run-off into the park. There are other streams which may include water borne parasites. Water quality management needs action to help maintain minimum standards of water quality, especially for remote areas.

<sup>f</sup> Generally this is very good for the park, however, air quality for the ski resort areas diminishes at peak times.

<sup>g</sup> This is usually very good, but it is an issue which may affect visitors within the ski-resort areas, near the major dams and transmission lines of the Snowy Scheme and along the highway routes. The NPWS helicopter and other management helicopters may be an issue in remote areas.

<sup>h</sup> This feature is usually very good, with the exception of the ski resort areas.

### Pressures

A range of pressures may influence the natural attraction of Kosciuszko National Park, including threatening processes, incidents, and planning and management decisions. Such pressures on protected areas are described in more detail in Worboys et al. (2001) and Newsome et al. (2002). The evaluation of the natural values presented in other chapters of this report, including flora, fauna, geomorphology, water quality, wilderness and natural aesthetics, highlights the range of pressures operating on the natural attraction of the park.

Tourism, recreation and park facilities and services can directly impact on the natural attraction of Kosciuszko National Park unless they are managed carefully and strategically. Any impact on the park's natural values is an impact on its tourism and recreation values. There are specific pressures on natural scenery, wildlife, native plants, soil, water quality and air quality. Pressures include feral animals and plants, non-natural noise, non-natural light and climate change.

Many parks zone recreation opportunity settings to ensure that a range of recreation opportunities are provided. The 1982 Kosciuszko National Park Plan of Management does this in part with the recognition of the Ski Resort Management Units and Wilderness areas. Management theory that underpins the concept of recreation opportunity setting classes and a Recreation Opportunity Spectrum was developed by Clarke and Stankey (1979). (Attachment Two). The methodology could be usefully applied in Kosciuszko National Park. Generally speaking, the more developed end of the Spectrum recognises that specific areas ("developed" setting class) are more intensively used and that greater levels of noise, activities and infrastructure and services may be expected. Thresholds for disturbance are applicable for a national park environment, but may be different to other setting classes. For the more natural end of the Spectrum ("primitive" setting class), opportunities for recreation in a more natural setting, opportunities for quiet solitude, and no-non-natural noise are expected. Such "primitive" setting classes are a diminishing resource for recreationists in NSW. High standards would be typically established for thresholds of disturbance for such settings.

#### *Natural scenery*

There are areas in the park where structures detract from the natural scenery (see Chapter 11). These include the unrehabilitated summit road; the disturbed Rawson Pass car park area; old Snowy Hydro-electric Scheme work sites; unfinished Jounama rehabilitation site; erosion at Coleman, Nungar, Tantangara Dam, Kiandra and Ravine; transmission lines through the park (including unlawful clearing works); some unaesthetic urbanised landscapes at the ski resorts; alpine area multiple tracking; eroding access tracks, including those in the northern section of the park; fire trails and introduced plants (Grenier 1992, Mosley 1992, Buckley et al. 2000, NPWS 2000, Johnston, FM and Pickering 2001, Worboys and Pickering 2002, Pickering et al. 2003). Further rehabilitation work is required in many areas of the park, including the summit area.

#### *Wildlife*

Feral horses, foxes, cats and pigs impact on streams, natural grasslands and native fauna (Chapter 10). Such introduced species are considered to diminish the natural values and therefore the tourism and recreation experiences (Mosley 1992). The loss of the corroboree frog from some areas and pressures on the habitat of the mountain pygmy-possum are further examples of the pressure on native animals. The loss of wildlife through road kill is also of concern.

#### *Native plants*

The spread of weeds is strongly associated with tourism infrastructure, and other types of disturbance, and detracts from the natural attraction of the region (Johnston FM and Pickering 2001, Worboys and Pickering 2002). The alpine area is one area of concern: trampling of native vegetation is creating disturbed areas – for example, multiple tracking – which provide opportunities for the spread of weeds (Worboys and Pickering 2002, Pickering et al. 2003). Similar impacts in other high-use areas in the park are of concern.

#### *Soil*

A range of areas within the park are subject to high-frequency visitor use, including horse riders and walkers. This has caused soil compaction and erosion, in some cases to the level of bedrock (Virtanen 1993, Arkle 2000). There is the potential for serious erosion at these sites (Virtanen 1993, Arkle 2000; see also Chapter 6).

#### *Water quality*

Large numbers of visitors to the park place pressure on catchments, which brings potential issues for water quality (see Chapter 8). Water in most streams in the park is likely to be contaminated by pathogens such as Giardia (Cullen et al. 1992, Good 1995, AALC 2000, Buckley et al. 2000). The release of treated sewage waters to subalpine streams at the very headwaters of Australia's principal river system catchments, including the Snowy River at Spencers Creek, the Snowy River at Perisher Creek, the Thredbo River at Thredbo, and possibly Rules Creek at Yarrangobilly Caves, places additional pressure on rivers, creeks and streams (Cullen et al. 1992, Good 1995; see also Chapter 8). All sewage treatment operations in the park are licensed by the NSW Environment Protection Authority to meet stringent water quality requirements. Nevertheless, there is and will continue to be pressure on the health of streams and rivers in the park.

#### *Air quality*

Pressures occur during periods of controlled burning (and wildfires), from smoke pollution from lodge fires and heating combined with atmospheric inversions, and locally from motor vehicle exhausts at resort car parks (Buckley et al. 2000).

#### *Non-natural noise*

Pressures occur, especially in the urbanised ski resorts, which can have a high latent noise level (Buckley et al. 2000) from sources such as lodges, restaurants, entertainment centres and visitor services. This is part of the tourism and recreation activities for such "Developed" Recreation Setting Classes within the park (Attachment Two). In principle, it is understood that the minimum acceptable defined levels of noise generated at such centres would generally mean higher permitted noise levels (for a national park setting) than "Primitive" areas. Noise pollution and noise management, including monitoring, for such areas are an important management input.



Increased use of machinery such as snow guns, snow grooming vehicles and over-snow transport, which may occur as a result of additional facilities and services in the resort areas, will add to the non-natural noise in these areas. There is a need for acceptable limits to be defined and managed for.

For areas of the park within the more natural end of the Spectrum, including wilderness areas, the use of vehicle access to remote areas (skidoo, four-wheel drive, helicopter, low-flying aircraft) can be an issue. Maintenance of fire trails, and other management programs are potentially an issue. The Sydney–Melbourne and Canberra–Melbourne flight paths lie over the northern sections of the park, creating additional noise (and visual) impact for wilderness areas. In the long term, such flight routes could well be influenced by a policy.

### *Non-natural light*

Pressures mainly occur in the urbanised areas of the park, with some light spill into adjacent areas. As urban areas expand and as countries develop globally, there are fewer and fewer areas where electric lighting does not exist. Protected areas, especially in intensively settled areas, are some of the few opportunities remaining where a natural night sky can be observed. Light pollution impacts had occurred for the Mt Stromlo Observatory (prior to its destruction by fire in 2003) near Canberra and may have an influence on the what is rebuilt. Management at the Siding Springs Observatory near the Warrumbungles National Park have sought minimum use of light within the park. Light can be managed (through good design) within the resorts to ensure that the destinations are safe for visitors and that light pollution is minimised.

### *Climate change*

Snow cover in the Australian Alps is predicted to decline within the next 70 years with global warming (Whetton et al. 1996, Whetton 1998). As a result, there are likely to be wide-ranging changes to the ecology of the system, including changes in the distribution and abundance of species, water catchments and fire regimes (Green 1998).

### **Effect of 2003 fires on natural values of Kosciuszko National Park**

Although fires (even fires as intense as those in January-February 2003) are a natural part of the ecosystem, they change the nature of the landscape in the short term. Fires may alter the visual appeal of some areas to some tourists. The government has, however, provided information to the public and the tourism industry to promote Kosciuszko National Park to visitors. Post fire vegetation is different and provides starkly beautiful scenery, with more open and exposed landscapes revealing different vistas and geological profiles than before. Wildlife is more easily observed post fire. The phoenix like regeneration of the vegetation will, over time, provide new attractions as a green cover comes to black landscapes. All of these elements are of interest to visitors.

In terms of specific aspects of the natural attraction, the potential negative impacts of how tourists may perceive the quality of the natural attraction are likely to be on:

- native wildlife (reduced numbers of some animals, potentially greater numbers of feral animals in remaining unburnt areas);
- native plants (lack of native vegetation cover around areas of high attraction);
- water quality (short term as runoff occurs, long term with soil erosion etc changing stream quality);
- air quality (short term impacts of such as smoke, and latter ash and dust); and
- soil erosion.

### **Knowledge gaps**

Additional information is required on water quality management and noise quality management. There is a need for detailed measurements of the impacts of feral animals and weeds on natural attractions. The impact of the fires on visitors' perceptions of the natural attraction of the region is not clearly understood. Knowledge of this could also contribute to the management of tourism post fire in this and other parks.

### **Opportunities**

There are a number of opportunities for improved management, including the establishment of baseline levels of environmental management performance in natural settings for operations within the park and establishment of a monitoring system that maintains a minimum level of environmental performance for operations.

### **Attribute 2: cultural attraction**

The park has a rich and diverse cultural setting (Good 1992, Chapter 13 and 14). It is especially important to local communities for its Aboriginal and historical heritage. There is archaeological evidence of Aboriginal use and there continues to be Aboriginal use. There is evidence of early mining, forestry, tourism and grazing – for example, historic chalets, old ski lodges, mountain huts, old mining debris and sawpits (see Chapters 13 and 14). Scientific discovery of the natural heritage of the park is also important, and has contributed to our understanding of geology, ecology and evolution (Good 1992). The Snowy Mountains Hydro Electric Scheme, with its dams, villages and power stations, is a significant cultural feature, recognised internationally as an engineering marvel (Good 1992).

The cultural heritage of Kosciuszko National Park enhances visitors' cultural links, an important component of visitor satisfaction (Beeton 1989, Weaver and Opperman 2000). Experiencing the cultural heritage of Kosciuszko National Park may also assist visitors in fulfilling needs for social interaction, education, self-fulfilment, relaxation, play and strengthen family bonds (Ryan 1991).

**Importance of the park as a cultural attraction**

Kosciuszko National Park has a rich and varied cultural heritage (Good 1992) and is considered to be nationally important. It is highly valued by Aboriginal people, artists, scientists, tourists and locals. Historical artefacts within the park include paintings, poems, legends and bush folklore, all help to underpin its nationally important cultural values (see Chapters 13 and 14).

**Dependence on the park**

The intrinsic and historic and cultural heritage values of Kosciuszko National Park are completely reliant on the park setting for their context and importance.

**Condition and trend in condition**

The cultural heritage sites of Kosciuszko National Park are generally in a satisfactory condition. There have been some instances of damage to sites, including Aboriginal sites, during fire operations. Interpretation and preservation are poor at some specific sites, including Kiandra. At this and some other sites, the status of the cultural heritage are considered poor and declining (see Chapter 13). Table 15.3 describes the condition and trend in condition for cultural attractions. Regrettably, a number of cultural heritage structures, (including 19 huts), were lost during the 2003 fires. The sites where these structures had been located, will be important to park visitors in the future. The 2003 fires and the way in which the community responded is likely to become a key part of the history of the park, and hence part of the cultural attraction.

**Table 15.3 Condition and trend in condition for cultural attraction aspects of Kosciuszko National Park**

Cultural attraction	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Conserved status of Aboriginal cultural heritage sites <sup>a</sup>	Sites adequately protected; absence of vandalism			<input type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>		
Conserved status of historic cultural heritage sites <sup>b</sup>	Sites adequately protected; absence of vandalism			<input type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>	<input type="checkbox"/>	

■ Overall status for Kosciuszko National Park □ Relates to parts of Kosciuszko National Park

<sup>a</sup> Many Aboriginal heritage sites are in the same locations as visitor use sites and need careful management. Some sites need repair. Others are in a satisfactory condition. Damage from 2003 fires will need to be evaluated.

<sup>b</sup> Many historic sites within the park need constant work. The Kosciuszko huts are maintained through voluntary work with the Kosciuszko Huts Association. Caves House has been renovated and repainted. Locations such as Kiandra need work to conserve heritage features. Damage to historical cultural heritage sites from 2003 fires will need to be evaluated and decisions concerning the appropriate response undertaken in consultation with stakeholders.

## **Pressures**

The pressures on cultural attractions include issues associated with access, use, maintenance, and interpretation. For example, there is continued need for maintenance of some cultural heritage structures and sites (for example, some Aboriginal sites, mining and grazing sites including Kiandra, and many of the huts). The Kosciuszko Huts Association has played an important on-going role in the conservation of the mountain huts. There are strong pressures from specific groups for recognition of their cultural links to the park. These groups are seeking greater access to and use of sites. While there has been a decline, within the general community, of knowledge of cultural events associated with the mountains, (e.g. early tourism, mining and the Snowy Mountains Hydro Electric Scheme), there can also be pressures associated with conflicting messages invoked by different aspects of the park's cultural heritage (e.g. scientific conservation and 'Man from Snowy River', Aboriginal heritage and some early grazing practices).

## **Knowledge gaps**

More knowledge is needed about many aspects of the cultural history of the park, including detailed local history. We need to develop greater understanding of the importance of the park to the Aboriginal community. We also need greater understanding of the importance of park's cultural history, since European settlement, to other sections of the local community.

## **Opportunities**

Opportunities for management improvements include further recognition and appreciation of Aboriginal cultural heritage, including full collaboration with the Aboriginal community. There is also a need to work with the local community more broadly to understand the diversity of cultural values and strategies to ensure that they are acknowledged in the management of the park. There could be an expansion of cultural tourism to the region, particularly for schoolchildren (see educational activities) and the over-50 market. This could be undertaken as part of a package of regional tourism opportunities in collaboration with local tourism organisations, educational institutions and organisations such as the Snowy Hydro Limited. There are also opportunities for more interpretation of the cultural values in the park and at visitor information outlets and for cultural heritage audio tours. Working with volunteers could be further developed to help protect tourism and recreation values while enhancing a sense of involvement and ownership of the interpretation of the cultural values of the park.

## **Attribute 3: educational activities**

Kosciuszko National Park provides rich opportunities for informal experiential learning and for education through formal classes, study groups and major conferences. Aspects of the park and its heritage are part of the national educational curriculum. Natural, cultural and managerial education themes are important, as are the pursuit of the arts through painting, poetry and literature. The work of the NPWS Educational Centre at Sawpit Creek, and the occasional hosting of important conferences and seminars in the mountains provide quality experiences. The NSW government Department of Sport and Recreation and Department of Education have important programs related to the park. In addition, guided walks at Thredbo, the NPWS discovery ranger program and cave tours at Yarrangobilly all add to the educational activities in the park.

Education is a major motivator for visitors, whether it concerns the natural or cultural heritage of the park or the recreational activities themselves. The high-quality experience that can be achieved enhances visitor satisfaction. The benefits of enhanced educational activities in the region are recognised by local tourism organisations (TSM 2001). Yet the full potential of Kosciuszko National Park as an educational destination has not been realised.

## **Importance of the park for educational activities**

Kosciuszko National Park is considered to have national importance as an educational opportunity.

## **Dependence**

The park plays an important (if not essential) role in setting the scene for educational opportunities. Many aspects of the educational experience are park dependent.

## **Condition and trend in condition**

Table 15.4 describes the condition and trend in condition of educational activities.

**Table 15.4 Condition and trend in condition for educational activity aspects of Kosciuszko National Park**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
<b>Educational activity</b>	Educational opportunities available <sup>a</sup> to school groups to adult education groups for university training to aboriginal groups			<input type="checkbox"/>	■			■			
	Depth of education opportunities potentially available and utilised, <sup>b</sup> learning from the elders, learning from the locals learning from the tourism industry learning from alpine sports medicine learning from the arts learning from managers learning from international conservation experience			<input type="checkbox"/>	■				■		

■ Overall status for Kosciuszko National Park  Relates to parts of Kosciuszko National Park.

<sup>a</sup> Whilst there is a range of educational programmes linked to the park, there could be far more. The park has unique infrastructure, which could be used more in facilitating education programmes. The resorts have advised that they are interested in playing a greater role in the future (Resorts Group submission).

<sup>b</sup> The range of potential educational opportunities available are considered to be poorly adopted.

**Pressures**

Pressures on educational activities include poor knowledge of the intrinsic values of the park; inadequate knowledge of cultural heritage values; too few opportunities for education for the growing numbers of visitors; lack of diversity in the educational experience; and the fact that there is no system for establishing a minimum standard for educators in the park.

**Knowledge gaps**

More knowledge is needed on educational use of the park. There should also be further market research into opportunities for educational use and the types of education experiences that currently attract visitors.

**Opportunities**

Management opportunities include facilitating use of the park for education, with interpretation centred around themes such as: Aboriginal culture, the Snowy Hydro-electric Scheme, and the scientific exploration of the park. This could involve the provision of a range of educational activities, including activities prior to arrival at the destination (e.g. visitor centres and websites). There should also be research on visitor needs for educational activities. Expansion of educational activities could also involve further collaboration with commercial operators to assist with the educational experience.

Following the 2003 fires, the educational potential of the park is, if anything, improved, in that it provides a living laboratory showing the role of fire in the ecosystem, and its role in the culture of the region. Again, implementing a program of educational both directly to visitors and more broadly to the community will enhance the park as an educational destination.

#### Attribute 4: diversity of tourism and recreation opportunities

The park encompasses a range of tourism and recreation setting classes (as developed by Clarke and Stankey 1979) from wilderness (“primitive”) to the more urban environments of ski resorts (“developed”). The park has a managerial environment supportive of a range of tourism and recreation experiences, and managerial setting classes either without tourism support infrastructure or with a range of infrastructure (Attachment Two). Kosciuszko National Park caters for a wide diversity of recreation activities based on these settings. It is an important destination for snow-based recreation activities. It is also very important for wilderness or remote area recreation opportunities. The quiet and peaceful atmosphere and scenic qualities of many parts of Kosciuszko are regarded by many visitors as the most important characteristic of the park (Mackay and Virtanen 2001).

#### Importance of the park for diversity of tourism and recreation opportunities

The park is considered to be nationally important for the diversity of its recreational opportunity settings. Snow and mountains are rare phenomena in a continent dominated by arid and flat lands. Access to snow and the possibility of participating in snow-based activities (e.g. downhill skiing, snow boarding, cross-country skiing, snow sports, tobogganing and snow play) in a natural Australian snow setting complete with ski lifts and visitor services, are opportunities valued by Australians. Therefore this is a very important tourism and recreation attribute of Kosciuszko National Park. The park offers outstanding opportunities for self-drive site-seeing, picnicking and camping. This is especially important for disabled visitors, and many vehicle destinations and scenic outlooks have been equipped to assist disabled visitors. It is especially valuable for its large areas of natural lands, which offer opportunities for solitude and self-reliant recreation. It is the exceptional variation of recreation opportunity settings within one park that establishes its national significance. The diversity of recreation setting classes that are applicable for Kosciuszko National Park and the types of activities that may be linked to them are presented in Attachment Two.

#### Dependence on the park

Many of the opportunity settings of Kosciuszko are unique in an Australian context and thus totally dependent on the park. Kosciuszko National Park is one of the very few remaining areas in NSW where there are opportunities for self-reliant activities in remote lands. In NSW, snow-based recreation is totally dependent on the park.

#### Condition and trend in condition

Table 15.5 describes the condition and trend in condition of diversity of tourism and recreation opportunities.

**Table 15.5 Condition and trend in condition for diversity of tourism and recreation opportunities in Kosciuszko National Park**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Diversity of recreation settings	Wide range of appropriate recreation facilities and services including a strong NPWS policy for minimising the provision of infrastructure for wilderness areas <sup>a</sup>			■				■			
	Recreation opportunity settings are actively managed to maintain a diversity of settings <sup>b</sup>				■				■		

■ Overall status for Kosciuszko National Park □ Relates to parts of Kosciuszko National Park

<sup>a</sup> There is a diversity of recreation opportunity settings for the park. Recent (2002) expansion of wilderness areas has consolidated this diversity with the additional protection of the most vulnerable recreation opportunity setting type, the facility free, disturbance free areas (Attachment Two).

<sup>b</sup> There is no active management planning guidance and policy controls by the NPWS to control the nature of facilities provided at particular settings. There is a strong probability of incremental hardening of sites over time in the absence of such guidance.

## Pressures

There are a number of pressures (including unsustainable and inappropriate use) that apply in managing a diversity of opportunities. For example, the environmental impacts of a diversity of activities at a given site can be an issue. Developing pressures include impacts associated with increasing visitor numbers and new activities. Climate change is likely to produce new pressures associated with decrease in snow cover and potential increase in summer tourism. Impacts of tourism activities and infrastructure combined with changes in tourism activities could have negative synergistic effects, such as the spread of weeds (Scherrer and Pickering 2001). There is also potential for conflict between visitor groups and within groups (Table 15.6). Conflicts may be minimised through careful management practices, visitor education and clear management of recreation opportunity setting classes (Attachment Two).

**Table 15.6 Personal experience conflicts that affect tourism and recreation values in Kosciuszko National Park (after Eagles et al. 2002)**

Conflict	Nature of the conflict
Visitor–manager	Managers may be required to regulate visitors closely to protect environmental values. A visitor's experience may be impacted by the regulatory environment.
Visitor–visitor (single activity)	Conflicts may occur within one recreational activity. They may occur when there are: <ul style="list-style-type: none"><li>• inappropriate visitor behaviours</li><li>• different skills and experience levels of visitors</li><li>• different expectations of social behaviour.</li></ul>
Visitor–visitor (different activities)	Conflicts may occur between different visitor activity groups. This may occur between: <ul style="list-style-type: none"><li>• motorised and non-motorised recreation</li><li>• active recreationists (e.g. cyclists) and passive recreationists (e.g. nature study)</li><li>• active recreationists (e.g. downhill skiers) and active recreationists (e.g. snowboarders)</li><li>• active non-assisted recreationists (e.g. bushwalkers) and active assisted recreationists (e.g. horse riders).</li></ul>
Visitor–management operations	Conflicts may occur when a recreational experience is impacted by management operations. This may occur when: <ul style="list-style-type: none"><li>• low flying aircraft are required for management duties over remote areas</li><li>• motor vehicles (over snow, over water, over land) are used in remote areas</li><li>• controlled burning introduces smoke and creates poor visibility</li><li>• incidents involve multi-agencies and media operations.</li></ul>

## Knowledge gaps

Knowledge gaps include an absence of a recreation opportunity setting management model for tourism and recreation within the park and an absence of information about activities and use, including trends.

## Opportunities for tourism and recreation opportunities

Opportunities for management include establishment of NPWS competency and capacity to manage for recreation opportunities and supply and demand, and the detailed mapping of recreation opportunity settings. It is important to ensure that activities foster appreciation and enjoyment of natural and cultural heritage and their conservation, and that there is more user-group liaison.

There is also an opportunity to continue the process of refining a tourism and recreation strategy for the park in conjunction with those developed by the local tourism authorities and commercial operators in and adjacent to the park. There is recognition among tourism operators of the need to diversify recreation opportunities both in the park and outside the park (SGS 2001). This is, in part, driven by the recognition of the volatility of winter tourism, which is strongly affected by the quality of the snow season (SGS 2001). Tourism opportunities outside the park that have been identified include: coach tours, scenic drives, hiking, water sports (Lake Jindabyne, Lake Eucumbene), horse riding, four-wheel driving, golf, fishing and mountain biking (SGS 2001). Use of areas outside the park for activities requiring considerable infrastructure (e.g. golf courses, tennis courts, and sporting fields) would complement the strategy of providing recreation opportunities within the park that are based on natural and cultural values.

## Effect of 2003 Fires on recreational opportunities

The NPWS may need to take some short-term protection actions to aid recovery from the 2003 fires. Recreational opportunities most affected (relatively speaking) are considered to be at the “primitive” and “remote” ends of the recreation opportunity spectrum (Clarke and Stankey 1979; Attachment Two).

For these opportunities new (temporary) controls or management interventions may be required. These actions reflect the large area of Kosciuszko National Park which was burnt during the summer of 2003. Only small areas of the “Developed” end of the spectrum were burnt, and recreation opportunities such as skiing are not expected to be affected. Vehicle access for car-based touring is essentially intact for car-tours of the park. Descriptions of how individual recreation opportunity setting classes may be affected by the 2003 fires are described below.

For wilderness/remote recreation opportunity settings, tourism/recreation opportunities may be affected by the;

- Continued closure of some areas
- Requirement to remain on certain routes;
- Requirement to register for use and obtain permits for use, with quotas for use being established;
- Requirements for the cleaning and sterilisation of boots/ hiking gear.

For semi-remote non-vehicular access areas tourism/recreation opportunities may be affected by the;

- Continued closure of some areas;
- Requirement to remain on certain routes;
- Requirement to register for use and obtain permits for use, with quotas for use being established;
- Requirements for the cleaning and sterilisation of boots/ hiking gear.

For natural with hardened roads access areas tourism/recreation opportunities may be affected by the;

- Continued closure of some areas, especially remote picnic and camping areas due to fire damage to facilities or access;
- Requirement to remain on certain routes;
- Requirement to register for use and obtain permits for camping use, with potential quotas for use being established.

For developed areas tourism/recreation opportunities may be affected by the;

- Closure of some areas (e.g. geotechnical advice for steep slope environments that have been burnt);
- Requirement to remain on certain routes/access roads;
- Pavement damage and repairs required to roads;
- Requirement to register for use and obtain permits for camping use, with potential quotas for use being established.

Special care may need to be exercised in managing activities in unburnt parts of the park, so that undue pressure is not placed on these locations.

## **Attribute 5: access to Kosciuszko National Park**

Access to recreation opportunity settings within Kosciuszko National Park are fostered by an all-weather, bitumen-sealed highway system within NSW. The park is readily accessible by road from the major urban centres of Sydney (six hours drive), Melbourne (eight hours) and Canberra (three hours). Approximately 50% of the Australian population lives in these three centres.

Air services take tourists to Canberra (from where it is a three-hour drive to Kosciuszko National Park) or to Cooma airport (a one-hour drive to the park). Planes can land at Tumut airport and Khancoban airstrip, just outside the park. Although these air services are relatively close to the park, they are further from the ski fields than are the airfields at the Victorian ski fields on Mount Hotham, which are serviced by the adjacent Dinner Plain airfield. The Jindabyne airstrip is not suitable for visitor access to the mountains.

### ***Importance of access to the park***

Access to Kosciuszko National Park (as a destination) is a very important attribute, as is access to recreation opportunity settings within the park. The main access routes to the park are by the main roads through the region (e.g. Monaro Highway, Snowy Mountains Highway and Kosciuszko Alpine Way), although access on gravel roads and walking tracks and by other means (e.g. horse, bike, ski tube etc.) is also available. See Map 15.1 for details.

### ***Dependence on the park***

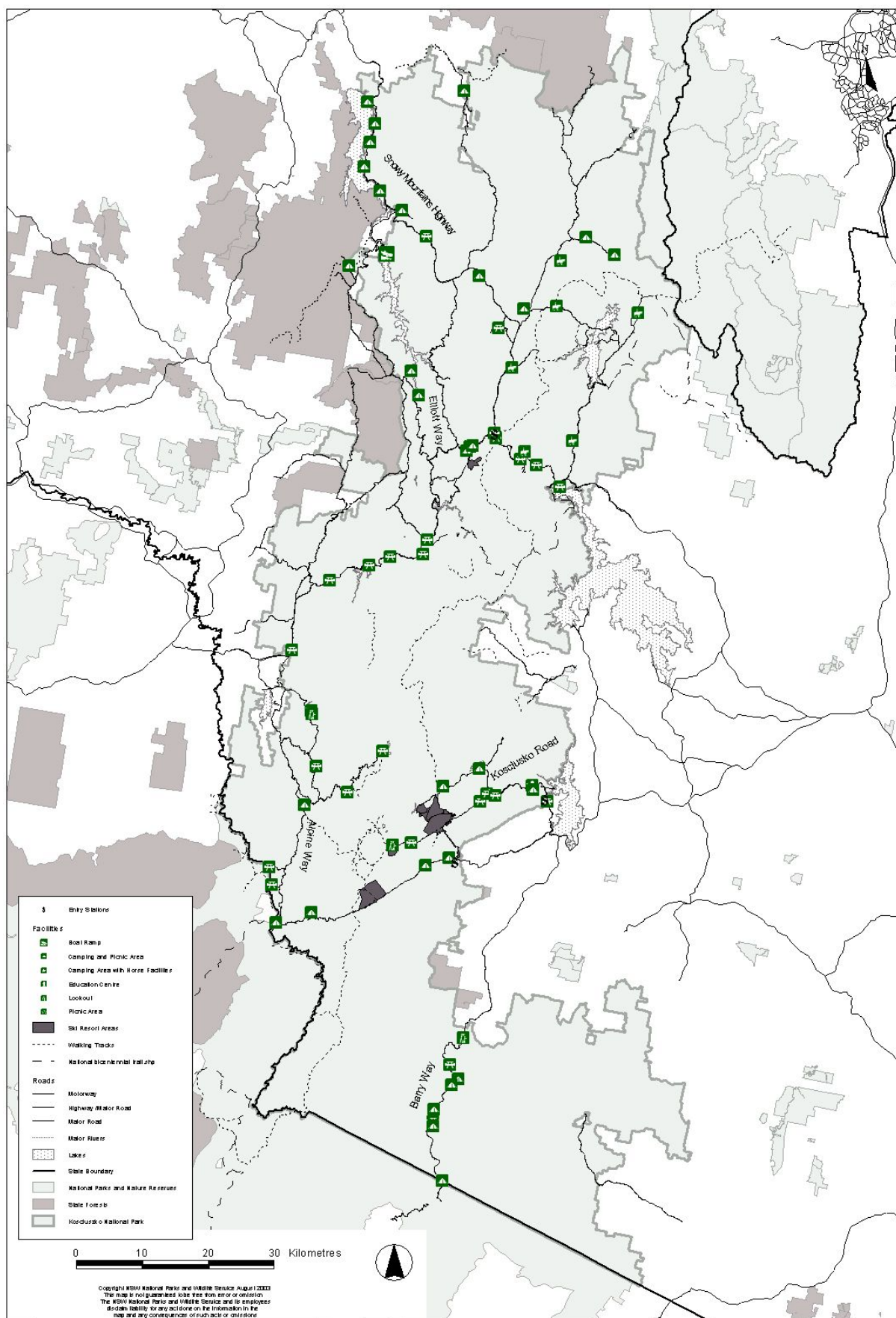
Access to the park and the availability of public transport, including air access, are not dependent on the park.

### ***Condition and trend in condition***

Upgraded highways between Sydney and Kosciuszko National Park, and recent improvements to the Kosciuszko Alpine Way, have reduced travel times and made travel safer. Access by air is somewhat diminished by the infrequency and uncertainty of the regional air service to Cooma, and the distance from Cooma airport to Kosciuszko National Park. The competitive advantage achieved at Mount Hotham ski resort in Victoria, as a result of the Dinner Plain airfield adjacent to the snowfields, has placed some competitive pressures on NSW ski resort operators. The absence of regular bus services to many areas in the region particularly in summer, detracts from low cost access to the park and the region.

Table 15.7 describes the condition and trend in condition of access to Kosciuszko National Park.

Map 15.1 Main access routes into Kosciuszko National Park





**Table 15.7 Condition and trend in condition for access to Kosciuszko National Park**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Access to Kosciuszko National Park	Access to Kosciuszko National Park is maintained through road-based services and air services. <sup>a</sup>		■		□		■			□	
	Access to region, skifields and other areas in Park by low cost and/or public transport. <sup>b</sup>				■					■	

■ Condition status for access to Kosciuszko National Park □ Condition status for some aspects of access to Kosciuszko National Park

<sup>a</sup> The highway system servicing the park has been improving with time. Travel times to the snow fields are consistently being reduced through better road systems. Air services to Cooma have been less than satisfactory in recent times.

<sup>b</sup> Public transport systems to the snowfields and the park are generally less than satisfactory.

**Pressures**

Pressures in relation to access to the park include high maintenance costs for road systems to the park; extreme weather conditions, with ice on roads and poor visibility affecting road safety and consuming large resources to maintain access; pressures for easy and faster access to ski resorts; and traffic congestion in peak use periods in the southern parts of the park.

**Knowledge gaps**

Knowledge gaps include the carrying capacity of key access roads to the ski resorts; the life-expectancy of access arrangements in their current form; and alternative access opportunities for the park.

**Opportunities**

Opportunities include dealing with limitations associated with air access and other forms of public transport in cooperation with industry and local government; and the need to improve transport from gateway towns to the ski resort areas of the park.

**Attribute 6: access within Kosciuszko National Park**

Within the park, there is a major high-quality north–south highway system, the Snowy Mountains Highway. The gravel-surfaced Barry Way connects Jindabyne to Victoria in another north–south route suitable for the majority of weather conditions. Running east–west, the Alpine Way provides all-season bitumen sealed vehicular access, though heavy snows in winter may disrupt this from time to time. The Alpine Way is an important tourism link with Victoria for most of the year. The Kosciuszko Road provides all-season vehicular access to Perisher Valley and seasonal access to Charlotte Pass, and the Khancoban to Cabramurra road provides bitumen non-snow season vehicular access across the Great Dividing Range.

The Long Plain Road also provides north-side summer access for the park. In addition, a large number of public-access bitumen and gravel roads provide vehicular access (often seasonal) to multiple locations within the park, such as the Tantangara road, the Island Bend road, the Little River track; the Murray Gates track, the Grassy Flats track, the Geehi Dam road, the Elliot Way, the Lobbs Hole to Ravine road, the Goobaragandra road, the Broken Cart track and the Blue Waterholes track. A large part of this vehicle access system is a legacy of the Snowy Mountains Hydro Electric Scheme.

The public road system provides ready access to a wide range of recreation opportunity setting classes (Attachment Two) within Kosciuszko National Park. The perimeters of all wilderness areas are readily accessed. This public vehicle accessibility is also used by cyclists, bushwalkers, horse riders and commercial tour groups. The extensive road network provides access for alpine skiing opportunities; bushwalking track heads; camping sites; picnic sites; white-water rafting and horse riding drop-off/pick-up points; cross-country skiing commencement points; adventure activity sites; and cultural heritage sites.

**Importance of access within the park**

Access to tourism and recreation opportunities within Kosciuszko National Park is a very important attribute. The NPWS determines the types and ease of access within the park (for example, roads, tracks and cross-country travel), the means of conveyance (for example, cars, four-wheel drives, horses and by foot), the sophistication of the access type (for example, high-standard fire trails) and the maintenance regime for access tracks. Access decisions determine the diversity of recreation opportunity settings maintained for visitors.

A policy change to permit vehicular access to a remote area, for example, reduces the diversity of recreation opportunity settings unless there are mitigating circumstances. Access opportunities are provided for disabled visitors.

### Dependence on the park

The access system within the park is dependent on the park.

### Condition and trend in condition

Recent improvements to the Alpine Way and the generally consistent maintenance to the gravel public access roads within the park have contributed to quality and reliable access for tourism and recreation. The absence of regular bus services within the park, particularly in summer, detracts from low cost access to the park and region. The Snowy Mountains Hydro Electric Scheme has provided visitors to Kosciuszko National Park with an outstanding public road access system. More recent access facilities, such as the ski tube, have considerably assisted skier access to snow.

Table 15.8 describes the condition and trend in condition for access within the park.

**Table 15.8 Condition and trend in condition for access to tourism and recreation destinations within Kosciuszko National Park**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Access within the park	Access to the skifields within the park is maintained through vehicle access from dormitory towns, snow clearing services and the Skitube <sup>a</sup>		■						■		
	Access to natural attractions and diverse recreation opportunity settings within the park is maintained through a network of public access roads. Provides opportunities for activities <sup>b</sup> such as bushwalking, canoeing, cross-country skiing, ski-touring, horse-riding, cycling, swimming, picnicking, photography, painting and camping	■			□		■				

■ Condition status for access within Kosciuszko National Park □ Condition status for some aspects of access within Kosciuszko National Park

<sup>a</sup> Access to the ski fields is generally acceptable to better than satisfactory. Poor weather conditions and icy roads easily disrupt traffic flows. Ski tube provides an alternative service.

<sup>b</sup> Access to recreation opportunity settings is excellent for the park. Recent policy decisions have reduced the number of areas that are readily available for horse riding and this has been recognised. The same decisions have provided protection for further areas, providing opportunities for self-reliant recreation and solitude.

### Pressures

Pressures on access within the park include high maintenance costs for the park road and track system; extreme weather conditions and ice on roads, with poor visibility, reducing the quality of a visitor's experience and affecting safety on roads, a periodic demand for upgrading some gravel roads within the park; public risk associated with verge parking and pedestrian access in certain areas of the park, such as the road below the turning circle at the Charlotte Pass road head; car parking problems in the ski resort areas during peak periods, with spill-over onto adjacent roads; and pressure for access to the same areas of the park for different activities such as bushwalking, horse riding, four-wheel drive use and trail bike use.

### Effect of 2003 Fires on access within Kosciuszko National Park

Access to some parts of the park may be affected post fire. During the short term:

- Vehicle access to some remote areas may be prohibited or impractical for a number of reasons including:
  - Temporary closure of roads for practical or safety reasons (tree falls, burnt bridges etc.);
  - Bridle trails that are closed until they are declared safe from the potential of tree falls, unstable slopes;
  - Damage created to access tracks due to bulldozer works or heavy equipment use during fire operations;
- Bushwalker access may be restricted or subject to increased controls for the remote areas for a range of management reasons.

### Knowledge gaps

Knowledge gaps include visitor use profiles for the different forms of access provided for the park; cost-benefit analyses of investments in the provision and maintenance of access for tourism and recreation; and the environmental effects of the provision of access.

### Opportunities

Opportunities include improvements in transport efficiencies from gateway towns to resort areas of Kosciuszko National Park, including innovations such as increasing the capacity and extent of the Skitube by connecting it to the dormitory town of Jindabyne; and definition of limits of use for access to the summit of Mount Kosciuszko. In addition, there is an opportunity for the provision of vehicle-based touring circuits within the region, including within the park. The over-50s self-drive market is a demand that could be met by the provision of self-drives within the region, and several such circuits have been identified by Tourism Snowy Mountains (TSM 2001). The provision of roadside interpretation and car based picnic facilities enhances such car touring experiences.

### Attribute 7: services and facilities

The availability of services and facilities is considered to be an important aspect of the attraction for tourists (Weaver and Opperman 2000). In Kosciuszko National Park, a range of facilities and services may attract visitors, including no services or facilities; picnicking and camping in mountainous settings; restaurants in a snow environment; ski lifts; managed ski slopes; high-quality walking tracks suitable for people with limited mobility; visitor centres; ranger walks; and signage. Map 15.1 shows the location of NPWS facilities in the park. The importance and sophistication of the current ski resorts in providing services for visitors to facilitate skiing and snow sports are recognised. Services and facilities provided need to be consistent with the status of Kosciuszko National Park as a protected area.

#### Importance of the park for services and facilities

The park is seen to have state level of importance for the provision of services and facilities. Within the park, the high-quality facilities for visitors range from basic picnic and camping sites in scenic locations to more sophisticated skiing resorts.

#### Dependence on the park

The facilities and services are dependent on the park and its management as licensed, serviced facilities approved by the NPWS consistent with the plan of management.

#### Condition and trend in condition

There is a high diversity of recreation facilities and services within the park. The 1982 Kosciuszko National Park Plan of Management provides a detailed inventory of those facilities. Table 15.9 describes the condition and trend in condition of recreation services and facilities.

**Table 15.9 Condition and trend in condition for service and facilities in Kosciuszko National Park**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Services and facilities	The nature and sophistication of visitor services and facilities are appropriate to the recreation opportunity setting <sup>a</sup>			■	□				■		
	There is no unplanned or inconsistent incremental hardening of visitor destination settings <sup>b</sup>				■					■	
	There is a diversity of visitor services and facilities for the park <sup>c</sup>		■						■		
	Visitor services and facilities provided are designed to reflect the limits of sustainable visitor use for recreation opportunity settings <sup>d</sup>				■				■		
	The nature of the visitor services and facilities provided are safe, and are designed to deal with natural and human caused incidents including fire, geological phenomena, and weather extremes including blizzards and wind storms <sup>e</sup>			■				■			

■ Overall status for Kosciuszko National Park; □ Relates to parts of Kosciuszko National Park

<sup>a</sup> The literature describing recreation opportunity settings describes certain services and facilities that are appropriate to different recreation opportunity setting classes (Clarke and Stankey 1979, NPWS 2002) (Attachment Two). The NPWS currently lacks a formal system for dealing with this in Kosciuszko National Park.

<sup>b</sup> Incremental hardening of visitor sites is a potential management problem. Good planning can overcome this (Worboys et al. 2001).

<sup>c</sup> The diversity of settings in Kosciuszko National Park ranges from ski resort areas with urban style facilities to wilderness areas with no facilities.

<sup>d</sup> Limits of visitor use reflect that there are only so many people a site or area can accommodate at any given time. There are only so many people that can fit into a theatre. There are only so many people that can fit onto a boat. The same applies for destinations within the park. Planning frameworks are available to provide a rationale and process for such decision making (Worboys et al. 2001).

<sup>e</sup> This simply reflects an appraisal of whether managerial processes and systems are in place to ensure that public safety is managed as part of the provision of services and facilities.

The 2003 fires highlighted problems with some tourism infrastructure in the park. The behaviour and extent of the 2003 fires is reported to be very similar to the extreme fires of 1939. The difference now is that the natural fire paths have coincided with the location of tourism infrastructure. This infrastructure constructed post the 1939 fires was built with regard to weather conditions (cold and snow). There was limited consideration of once in a hundred years fire event. During the 1950s and 1960s, when a lot of ski resort construction took place, only a few of the older locals, fire management professionals and ecologists would have had an appreciation of the potential effects of a 1939 type fire on the mountains. A large amount of this infrastructure has been based on the Snowy Mountains Hydro-electric Scheme developments (from 1949 to the late 1970s). This has been effectively a 52-year fire free period for such tourism infrastructure. Care needs to be taken in the planning for tourism infrastructure to take into account fire issues in Kosciuszko National Park.

The 2003 fires may result in the provision of new services and facilities. They will also result in additional tourism and recreational service operational tasks for the NPWS. This has the potential lower the quality of service at visitor destinations for the medium term (due to work overload and budget constraints). Potential new services may include:

- New signs;
- Replacement infrastructure;
- New educational information;
- Potential new access permit systems;
- Weed and feral animal management systems/services; and
- Visitor help/information desk/web service.

### **Pressures**

Pressures include the unsustainable overuse of facilities; the high cost of maintenance; poor-quality maintenance and services; inconsistent design and poor design of facilities; and increased demand for additional facilities and services.

### **Knowledge gaps**

Knowledge gaps include visitor feedback on existing services and facilities and unmet needs; supply and demand management; trends in visitors' expectations of services and facilities; and visitor movements in the region and the park.

### **Opportunities**

Opportunities include introducing a framework for sustainable management and visitor use limits; designing environmentally sustainable facilities and services which meet visitor expectations; asset management systems; supply and demand management; visitor satisfaction surveys; partnerships with local governments and the tourism industry to provide a range of recreation and tourism services that are not park dependent; and better opportunities for access to facilities for people with limited mobility.

## **Attribute 8: degraded destinations (impacts of use)**

Human use of resources inevitably results in impacts, and tourism and recreation is no exception (Worboys et al. 2001, Eagles et al. 2002, Newsome et al. 2002). Impacts of use in the context of tourism and recreation values must be considered relative to the desired opportunity and subsequent impacts on visitor experiences (Clarke and Stankey 1979). Garbage-strewn picnic areas, vandalised facilities and polluted streams are just some impacts arising from visitor use that which can impact a recreation opportunity setting. Generally, recreationalists have greater tolerance towards impacts (ecological, social or managerial) in modified recreation opportunity settings, (such as the ski resort management units), than towards impacts in remote areas (such as the designated wilderness areas) (after Clarke and Stankey 1979) (Attachment Two). There are no excuses, however, for visitor use impacts that detract from the natural attributes of Kosciuszko National Park. Natural attributes are the most important attribute underlying the tourism and recreation values of the park. The World Conservation Union (IUCN) World Commission on Protected Areas (Eagles et al. 2002) described the types of risks to protected areas from tourism activities, infrastructure, services and facilities. This includes the provision of accommodation within a park (Table 15.10).

This assessment is based on their global experience and input from protected area management experts from around the world. If not managed adequately, visitor use impacts can be a threatening process to the natural values of Kosciuszko National Park.

**Table 15.10 Environmental risks to protected areas from tourism (after Eagles et al. 2002)**

Element	Examples of risk from tourist activities
Ecosystems	The construction of accommodation, visitor centres, infrastructure, and other services has a direct impact on the environment, by vegetation removal, animal disturbance, elimination of habitats, impacts on drainage etc. Wildlife habitat may be significantly changed (travel routes, feeding areas, breeding areas, etc) by all kinds of tourist development and use.
Soils	Soil compaction can occur in certain well-used areas. Soil removal and soil erosion also occurs, and may continue after the disturbance is gone.
Vegetation	Concentrated use around facilities has a negative effect on vegetation. Transportation may have direct negative impacts on the environment (eg vegetation removal, weed transmission, animal disturbance). Fire frequency may change due to tourists and park tourism management.
Water	Increased demands for fresh water. Disposal of sewage or litter in rivers, lakes.
Air	Motorised transportation may cause pollution from emissions. Energy consumption and green house gas emissions
Wildlife	Fishing may change population dynamics. Fishers may demand the introduction of foreign species, and increased populations of target animals. Impacts occur on insects and small invertebrates, from effects of transportation, introduced species etc. Disturbance by visitors can occur for all species, including those that are not attracting visitors. Disturbance can be of several kinds: noise, visual or harassing behaviour. The impact can last beyond the time of the initial contact (eg until heart-rate returns to normal, or until birds alight, or mammals resume breeding or eating). Habituation to humans can caused changed wildlife behaviour, such as approaching people for food.

Impacts do occur, but impacts caused by use of Kosciuszko National Park must be acceptable relative to its status. Contemporary management authorities can use a number of techniques to minimise impacts, including making management judgments and defining limits of visitor use for destinations by policy (as distinct from the less practical limits of acceptable change theory), managing supply and demand, managing resource capabilities (such as site hardening) and managing the impact of use by modifying the type and nature of use (Worboys et al. 2001, Eagles et al. 2002). All require active tourism management by the NPWS. Banff National Park in Canada has introduced visitor use limits, with its planning of destinations. Montague Island Nature Reserve, off the south coast of New South Wales, and Macquarie Island have also introduced visitor use limits to guide their operations (Worboys et al. 2001).

Modifying the type and nature of use is an important opportunity for Kosciuszko National Park. A new trend in industry accountability for environmental management performance has slowly emerged from the tourism industry in the last decade. This reflects a sharing of the accountability for environmental management performance by industry. It would be a new paradigm for Kosciuszko National Park. Some background about this opportunity is provided here.

Following the Rio De Janeiro Earth Summit in 1992, the World Tourism and Travel Council, the World Tourism Organisation and the Earth Council published (in 1994) 'Agenda 21 for the travel and tourism industry, towards environmentally sustainable development'. This document recognised 10 key areas for environmental and social management performance by the tourism industry. It was a basis for a minimum level of environmental and social management performance by the travel and tourism industry. A certification standard was developed based on the document. Other certification standards have subsequently been developed.

In 2001, the World Tourism Organisation released a global code of ethics for travel and tourism. The Asia Pacific Economic Cooperation (APEC) and Pacific Asia Travel Association (PATA) released a code for sustainable tourism in 2001, and encouraged industry to adopt and promulgate its principles. (Attachment Three).

The international APEC-PATA and World Tourism Organisation codes also strongly encourage individual industry members and companies to be accountable for environmental management performance. The voluntary certification schemes are a practical means of demonstrating such performance.

Sustainable tourism is now strongly advocated by the travel and tourism industry globally. The term is based on the environmentally sustainable development (ESD) outcome arising from the Rio De Janeiro Earth Summit and its famous Agenda 21 ESD document. It has been recently defined by the Queensland Government (1997) as follows:

- Sustainable Tourism is the development of an internationally competitive ecologically sustainable and socially responsible tourism industry based on the integration of economic, social and environmental objectives.
- This approach is consistent with recommendations made to the World Summit on Sustainable Development in Johannesburg in September 2002 by the United Nations Environment Programme Global Environment Outlook Report (GEO 3). This report made a number of recommendations to the summit (UNEP 2002), including the following:
- Reinforce the linkages between global and local levels and ensure that implementation and capacity (for environmental improvement) are passed on to local authorities wherever possible;
- Support private sector initiatives on environmental performance standards and reporting, such as voluntary disclosure on progress in stemming pollution, protecting environmental assets and promoting sustainable development;
- Take active measures to stimulate sustainable consumption and production practices;
- Provide incentives for eco-efficient (cleaner) production and innovation; and
- Encourage further adoption of voluntary initiatives such as commitments by companies to achieve additional environmental targets; codes of conduct for sectoral industry associations regarding environmental responsibility; environmental performance targets agreed between government; and, a company or sector legally binding covenants.

Sustainable tourism is appropriate for Kosciuszko National Park as a tool to help maintain tourism and recreation values. Such an approach brings with it a sharing of the accountability for environmental management performance. It is unnecessary and unwise for the NPWS to have the sole accountability for determining environmental management performance. Certification schemes introduce individual accountability for environmental management performance reporting. The schemes also recognise environmental performance areas (WTTC et al. 1996, APEC–PATA 2001, De Lacy et al. 2002) that respond to global environmental issues as well as park-specific issues. It is a more appropriate and holistic approach to environmental management for the park, a very relevant point given that environmental issues such as global warming are directly influencing the future of snow tourism in the park.

New environmental benchmarking tools developed by the Cooperative Research Centre for Sustainable Tourism have established environmental performance indicators (Earthcheck indicators) and a system of quantified environmental performance for these global and local environmental issues for the travel and tourism industry (De Lacy et al. 2002). Such cutting edge, quantified, environmental management performance could be used at Kosciuszko National Park. The important environmental management system initiative underway in Perisher Valley could be extended to include benchmarking of performance, with the system being used elsewhere in the park. Independent (third party) assessment of performance would provide confirmation of the performance.

#### ***Importance of impacts of use of the park***

This is a very important attribute in influencing the tourism and recreation value of Kosciuszko National Park. Impacts of use need to be managed to retain the tourism and recreation value of the park. Tourism and recreation needs to be sustainable and based on environmental performance that meets agreed performance targets. Quantified environmental management performance improvement outcomes (and targets) are possible under a benchmarking system.

#### ***Condition and trend in condition***

The condition and trend in condition of degraded destinations (impacts of use) for Kosciuszko National Park can be expressed relative to the global environmental criteria identified by Agenda 21 for the travel and tourism industry (WTTC et al. 1996) and subsequent work by the Cooperative Research Centre for Sustainable Tourism (De Lacy et al. 2002).

Table 15.11 indicates how well the particular environmental management performance criteria are managed to minimise either primary or secondary impacts of visitor use on the park. The table shows that impacts of use can be better managed for the park.

**Table 15.11 Condition and trend in condition for impacts of use of Kosciuszko National Park**

	Criteria for assessment of condition (These broad criteria are being used with the Perisher Valley EMS system).	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Impact of use <sup>a</sup>	Energy consumption <sup>b</sup>				■					■	
	Green house gas reduction <sup>c</sup>				■					■	
	Solid waste reduction <sup>d</sup>				■				■		
	Liquid waste reduction <sup>e</sup>				■				■		
	Potable water use reduction; disposal standards met <sup>f</sup>				■					■	
	Social criteria <sup>g</sup>			■					■		
	Noise reduction <sup>h</sup>				■				■		
	Biodiversity conservation <sup>i</sup>				■				■		
	Kosciuszko specific criteria <sup>j</sup>				■			■			

■ Condition status (how well the environmental performance criteria are managed for the park) for 'impacts of use' criteria

<sup>a</sup> Earthcheck environmental performance management criteria from De Lacy et al. (2002), and environmental performance criteria adopted for Perisher Valley, Kosciuszko National Park.

<sup>b</sup> Energy consumption is relatively high for snow based tourism which is underpinned by snow making. Transport to and from visitor destinations within the park consumes energy, as does the special heating required for accommodation and energy consumed in sewage treatment. Electricity energy consumption, where it is based on coal-fired power stations is a contributor to green house gases and global warming. Reduction targets for the park in tonnes of carbon per annum may be possible. There are currently no known tourism strategic energy conservation schemes in place for the park. Energy reduction means cost savings for companies and authorities.

<sup>c</sup> Greenhouse gas reductions can be achieved by lowering energy consumption in all aspects of travel and tourism operations. Examples include: less potable water used means less use of pumps and less energy used; less sewage water created means less treatment needed and less energy consumed; and, less garbage generated and sent to landfill means less transportation and less energy used. There is no known programme in place for the strategic reduction of greenhouse gases for the entire park.

<sup>d</sup> Solid waste reduction means less waste going to landfill, through systems that minimise waste generation, recycling, reuse. This means less pollution of the planet at the landfill, less greenhouse gases generated through energy consumed in managing the waste. Less waste means cost savings for the managing authority. There is no known programme in place for the strategic reduction of solid waste generated for the entire park.

<sup>e</sup> Liquid waste reduction means less waste waters to be treated. Reduction in inputs through reduced water use is one tool that is available. Licensed disposal standards being met reflects on the quality of treatment achieved. All ski resorts discharge into sub-alpine streams within the park. Some discharges have not met licensing performance standards. There have been some pollution incidents associated with ski resort management. There is no known programme in place for the strategic improvement of liquid waste generated for the entire park.

<sup>f</sup> Reduction in potable water use will benefit the natural flow regimes of the mountain streams that provide water supplies to service visitor use facilities. There is no known programme in place for the strategic reduction in potable water use for the entire park.

<sup>g</sup> Social criteria currently focuses on local employment created through travel and tourism. This criterion is considered satisfactory, and there are active programmes of employment generation locally through tourism.

<sup>h</sup> Noise reduction. There is no known program in place for the strategic reduction of non-natural noise within the park.

<sup>i</sup> Biodiversity conservation. There are a number of biodiversity conservation programmes and specific species conservation initiatives within the park. There is no known programme in place for the entire park for the strategic improvement of biodiversity conservation developed as a joint initiative with the travel and tourism industry.

<sup>j</sup> Supplementary indicators. There are no known supplementary (Kosciuszko National Park specific) indicators in place within the park for the strategic improvement of 'impacts of use' developed with the travel and tourism industry. Such indicators could monitor large scale changes reported to be occurring in the northern end of Kosciuszko National Park due to horse riding activities, as a basis for action.

### Pressures

Pressures that contribute to degraded destinations (impacts of use) largely relate to the absence of relevant management frameworks, such as the lack of: visitor and recreation management programs; limits of visitor use programs; monitoring programs for visitor use and environmental performance. There are no active and applied tourism and recreation research programs and consequently no adaptive use of research findings. There is often poor management of services and facilities; and overcrowding. Strategic planning of tourism and recreation can deal with these pressures.

### **Knowledge gaps**

There is a need for quantified environmental performance baseline levels for key criteria specific to Kosciuszko National Park and for supplementary indicators for monitoring.

### **Opportunities**

Strategic planning of tourism and recreation opportunities will help to minimise impacts. There is also an opportunity to introduce a new system for managing tourism and recreation at Kosciuszko National Park, based on environmental management performance and minimum performance levels. It would include:

- quantified environmental management performance monitoring;
- global and local environmental management performance criteria;
- individual company environmental performance;
- minimum (annual) environmental performance standards for companies and communities;
- strategic environmental performance criteria and incremental improvements;
- adaptive research;
- continuous improvement in environmental performance;
- limits of use for destinations; and
- active, continuous, professional management of travel and tourism.

### **Attribute 9: affordability of tourism and recreation in Kosciuszko National Park**

Competitive, low-cost accommodation, services, transport, lift and ski facilities and entry fees, relative to other tourism destinations, are considered to be an important consideration for visitors (TSM 2001).

Competition for visitors between the Snowy Mountains region, the northern parts of Kosciuszko National Park and other tourism regions, as well as competition for visitors within the region, provides a low-cost basis for visitors to come to the area. There is also a range of low-cost tourism opportunities within the park, particularly for summer activities. Pricing competitiveness of the ski lift companies is influenced by the limited supply of ski facilities and relative high demand for these facilities. Some resorts, such as the Mt Selwyn snowfields, have positioned themselves as providers of low-cost family holidays, providing additional opportunities for an affordable snow holiday, low cost resort based snow play and cross country skiing. As a result there are high-cost, high-status, luxury tourism opportunities centred around the resorts; lower cost, resort based accommodation; and affordable basic holiday options in and around the park, particularly in the summer, including camping trips and back-country walking and camping. The diversity of holiday costs, including the option of affordable holidays, is seen as a major asset for the region.

Kosciuszko National Park has a \$15 per day entry fee and an \$80 annual pass. Fees are collected at the Kosciuszko Road, Alpine Way, the Elliot Way (in winter) and, (when it is cost effective to do so) at the Yarrangobilly Caves. These fees help the NPWS to maintain the extensive access system, utilities, customer service and facilities across the park. However, the park entry fees and fees for services and utilities paid by ski resorts do not cover the costs of administering tourism and recreation in the park. This cost is subsidised by the NPWS and the NSW Government (Applied Economics 1998). The subsidy facilitates the retention of a decentralised and vibrant tourism and recreation industry (predominantly based on snow) and the economic benefits this brings to the region.

#### **Importance of affordability in the park**

The affordability and diversity of costs of recreational and tourism opportunities within the park are important at the regional level.

#### **Dependence on the park**

The affordability of Kosciuszko National Park as a destination for visitors is influenced by a range of costs, including those directly associated with and dependent on the park. These include the cost of park entry. Most park facilities are free, except for entrance to Yarrangobilly Caves and the use of accommodation at Currango Homestead.

Costs associated with the use of commercial facilities in the park, which are charged to visitors by concessionaires, are independent of the park. They are influenced by competitive forces, park use fees, rents and charges for the provision of municipal services administered by the NPWS.

#### **Condition and trend in condition for affordability**

Table 15.12 describes the condition and trend in condition of affordability.



**Table 15.12 Condition and trend in condition for affordability of tourism and recreational activities in Kosciuszko National Park**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving	Stagnating	Declining	Widespread decline	
Affordability	Competition for the provision of services and facilities for visitors is effective.			■	□				■		
	Demand and supply is carefully managed, consistent with the sustainable limits of visitor use established for recreation settings for Kosciuszko National Park.				■				■		

■ Overall status for tourism and recreation for Kosciuszko National Park; □ Relates to components of tourism and recreation for Kosciuszko National Park.

### Pressures

Pressures include the high cost of maintaining tourism and recreation facilities and services within the park; limits on the budget of the NPWS and other government organisations that restrict their capacity to provide the most appropriate facilities (social and environmental). There are pressures on the NPWS to limit the cost of entry fees and to provide more efficient ways of collecting fees at peak times. There is also pressure from the increasing costs of winter skiing, including lift tickets and accommodation.

### Knowledge gaps

Knowledge gaps include detailed information about the actual cost to the NPWS and the NSW government of providing services and facilities for tourism and recreation.

### Opportunities

Opportunities include:

- recognition of the actual costs borne in the provision of tourism and recreational opportunities by the NPWS and the NSW government, the local community and the tourism industry;
- the continued provision of low-cost tourism and recreation opportunities in summer, including family camping and back-country walking and camping options as part of the recreational opportunity spectrum (where environmentally appropriate);
- the provision of additional facilities that enhance visitors' experience of the park and their aid their understanding of how the entrance fee is spent;
- improved options for the collection of entry fees (in a user friendly manner), to the park to reduce congestion at entry gates during peak periods.

### Attribute 10: regional recreation opportunities

Surrounding regional towns, such as Adaminaby, Batlow, Bombala, Jindabyne, Khancoban, Talbingo, and Tumut, provide recreation services and recreation opportunities (TSM 2001). At a regional scale, important centres such as Cooma and Canberra have a key role. These, together with the diversity of tourism and recreation opportunities within the park, increase the attraction of the region for tourists (TSM 2001). Lands outside the park with a different status from the park provide complementary recreational opportunity settings.

Public lands managed by the forestry industry provide many recreation opportunities. Map 15.1 illustrates the other land tenures in the region. Some freehold lands with natural settings provide opportunities for horse riding and other activities. If we review this even further a field, the pattern of land use reflects essentially cleared lands, with other protected areas providing protection to the remaining natural lands around the park, and some state forests. In south-eastern Australia, there are few options for natural land tourism and recreation outside the public reserve system. This reinforces the need to carefully manage the tourism and recreation values of the park.

The road approaches to the park are also important as a tourism and recreation setting. The eastern approaches to the park are under pressure from small subdivisions, potentially leading to an urbanised strip near the approaches to the park. Cooperative planning with local governments can help to prevent this. Urbanised lands on the boundary of the park are not a satisfactory model.

### Importance of recreation opportunities in the park's region

The region surrounding the park, when combined with the park, is very important and of national significance.

### Dependence on the park

The region complements the park. There is interdependency.

### Condition and trend in condition

Major improvements for a cooperative and integrated approach to tourism management for regions surrounding the park (the Greater Snowy Mountains Region) and the park itself are considered essential for the improvement of tourism and recreation values of the area (SGS 2001). Also, continued active involvement in the Australian Alps Liaison Committee will facilitate cooperative management of the Australian Alps national parks and provision of a diversity of recreation activities across these parks.

Table 15.13 describes the condition and trend in condition for regional recreational opportunities.

**Table 15.13 Condition and trend in condition for recreation opportunities in the Kosciuszko National Park region**

	Criteria for assessment of condition	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Regional tourism and recreation opportunities	Snowy Mountains regional tourism resources are managed in an integrated way <sup>a</sup>			■					■		
	More sophisticated tourism and recreation facilities and services such as golf courses, swimming pools, theme parks, vehicle based adventure sports, horse riding and other intensive impact sports are developed outside the park <sup>b</sup>			■					■		
	Opportunities to facilitate new markets such as the education based market are developed cooperatively <sup>c</sup>										

■ Overall status for the region; □ Relates to parts of the region

<sup>a</sup> This evaluation relates to the greater area surrounding the park. It reflects that there is a greater opportunity for an integrated approach to managing the tourism and recreation values of the area.

<sup>b</sup> This evaluation reflects that there is a greater opportunity for more sophisticated, urban style facilities for the greater region outside of the park.

<sup>c</sup> This evaluation reflects that initiatives to develop the education market are only satisfactorily.

### Pressures

Pressures include demands for more facilities in national parks (often reflecting a lack of understanding of the tourism and recreation values of the parks); increased tourism use, placing increased pressures on existing recreational opportunities; changes in land use in areas adjacent to the park (e.g. rural residential developments in the Thredbo Valley); and demand for more commercial opportunities in the park.

### Knowledge gaps

Knowledge gaps include information about the diversity of recreation opportunities and visitor activities across the region and how the park contributes to these.

### Opportunities

Coordination and integration between the NPWS, local government and private tourism organisations should be further enhanced to develop a clear whole of park regional tourism strategy, including building on the Snowy Mountains Region Tourism Plan fostering a diversity of tourism opportunities in the region within and external to the park. This would facilitate the marketing of the region as a distinctive destination. The NPWS can play a leadership role.

## Summary of findings

Kosciuszko National Park has nationally significant tourism and recreation values. These national values are underpinned by 10 key attributes. In this chapter, we have evaluated these attributes relative to their condition and trend in condition and the pressures to which they are exposed. Here, we present some findings from the analysis.

ATTRIBUTE	FINDINGS
Natural attraction	<p>The natural quality of Kosciuszko National Park is the most important attribute underpinning the tourism and recreation value of the park; and</p> <p>The importance of this attribute will increase with time as the area of natural lands and the availability of recreation opportunities in natural lands outside of protected areas decrease.</p>
Cultural attraction	<p>The cultural heritage of Kosciuszko National Park is a very important attribute underpinning the tourism and recreation value of the park.</p>
Education	<p>Educational opportunities within Kosciuszko National Park are an important attribute underpinning tourism and recreation value. There is potential for education to be more important as a market niche for tourism and recreation services in the future.</p>
Diversity of tourism and recreation opportunities	<p>The diversity of recreation opportunity settings is a very important attribute underpinning the tourism and recreation value. Recreation opportunity settings appropriate to the tourism and recreation value of the park includes:</p> <ul style="list-style-type: none"> <li>▪ large, remote and unmodified settings;</li> <li>▪ remote areas with minor facilities;</li> <li>▪ natural areas providing motorised access and basic visitor facilities;</li> <li>▪ areas of relative naturalness with recreation facilities evident and all weather motorised access; and</li> <li>▪ major visitor facility areas which may include ski facilities, picnic areas, camping grounds, information centres and car parks.</li> </ul> <p>Maintenance of the diversity of recreation opportunity settings requires active management including:</p> <ul style="list-style-type: none"> <li>▪ planning and identification of recreation opportunity settings;</li> <li>▪ maintaining an absence of facilities and non-natural disturbance to the most vulnerable lands – the large natural areas; and</li> <li>▪ diligence, quality planning, and quality managerial systems to ensure the nature of visitor services and facilities provided are suitable for the recreation opportunity setting.</li> </ul> <p>Opportunity for tourism and recreation experiences requires constant management to maintain the tourism and recreation value of Kosciuszko National Park including:</p> <ul style="list-style-type: none"> <li>▪ planning for tourism recreation including establishing visitor use limits for destinations and active supply and demand management within such limits;</li> <li>▪ active management to minimise and prevent inter-activity social conflict; and</li> <li>▪ active management to prevent over-crowding.</li> </ul>
Access to Kosciuszko National Park	<p>Access to the park is a very important attribute underpinning the tourism and recreation value.</p>
Access within Kosciuszko National Park	<p>Access within the park is a very important attribute underpinning the tourism and recreation value.</p> <p>There is a comprehensive and adequate vehicle-based access system to recreation opportunity settings within the park.</p>
Services and facilities	<p>The diversity of tourism and recreation services and facilities suitable within a national park is a very important attribute underpinning the tourism and recreation value.</p> <p>Urbanised facilities are in conflict with the most important tourism and recreation value of Kosciuszko National Park, its natural qualities.</p> <p>Urban facilities that service skiing such as access, car parks, food and shelter, ski lifts and utility and safety support services are necessary to underpin skiing recreation opportunities within designated areas of the park. For skiing areas, it is critical that the natural qualities of the park are protected.</p> <p>Urban style tourism and recreation facilities such as accommodation, golf courses, tennis courts, swimming pools, theme parks recreation within the park are unnecessary to underpin skiing recreation opportunities within the park. They are inconsistent with the principal tourism and recreation attribute of the park.</p>

ATTRIBUTE	FINDINGS
cont'd ...Services and facilities	<p>Given legal requirements for Perisher Valley which permit, urban expansion, a basic requirement for any new urban facilities is that they have no detrimental impact on the natural and cultural heritage attributes of the park and that this is demonstrated by annual environmental management performance monitoring systems and defined minimum environmental standards of management. The additional accommodation is a commercial subdivision of the national park. The full cost of ensuring that there are no impacts to the national park and the long term monitoring needs will need to be built into the cost of the approved subdivision.</p> <p>Services and facilities within Kosciuszko National Park need to be actively managed including:</p> <ul style="list-style-type: none"> <li>▪ the suitability of services and facilities for recreation opportunity settings;</li> <li>▪ competent facility maintenance and service delivery.</li> </ul>
Degraded destinations	<p>Tourism and recreational use of Kosciuszko National Park needs to be actively managed so that it is not a threatening process to the tourism and recreation value of the park.</p> <p>Cutting edge sustainable use management of the park needs to be introduced including:</p> <ul style="list-style-type: none"> <li>▪ individualising accountability for environmental performance for companies, communities and authorities operating within the park;</li> <li>▪ strategic and quantified environmental performance improvements established against global environmental issues as well as specific Kosciuszko National Park environmental issues; and</li> <li>▪ recognition of visitor use limits and frequency of use limits by informed policy for sites or areas within the park.</li> </ul>
Affordability	<p>The affordability of tourism and recreation services provided in support of activities within the national park is an important attribute underpinning the tourism and recreation value.</p>
Regional recreation opportunity settings	<p>The diversity of tourism and recreation services and facilities within the greater Snowy Mountains Region is a very important attribute underpinning the tourism and recreation value of the park.</p>

## Future Management

### A proposed Tourism and Recreation Strategy for Kosciuszko National Park

Management of the tourism and recreation values of Kosciuszko National Park needs to be planned. Outputs for such a **Strategic Plan** could include:

- the NPWS achieving a capacity and competency to proactively manage for tourism and recreation values and sustainable use;
- the conservation and protection of the most important tourism and recreation attribute, the natural intrinsic qualities of the park;
- the professional management of other attributes which underpin the tourism and recreation values;
- identification of the nature and spatial arrangement of recreation opportunity setting classes for the park;
- the definition of a sustainable tourism and recreation operational framework for the park in the context of global and local criteria;
- active management for sustainable tourism and recreation, including supply and demand management, and addressing unacceptable impacts of use;
- active management of the ramifications of global warming and reducing snow cover with time, especially lease management;
- the establishment of policy 'limits of use' figures for destinations to achieve sustainable use, including the summit of Mount Kosciuszko;
- the introduction of a quantified environmental performance management system which underpins sustainable tourism and recreation management, especially for leases and licenses;
- the introduction of quantified environmental improvement targets for tourism and recreation for the park with a performance monitoring system; and
- working with the community and the tourism and recreation industry at a park and regional scale to manage for tourism and recreation values.

Such a strategic plan should be developed in consultation with the local community, particularly in regard to the development of policy decisions for visitor use limits for destinations and environmental performance management baseline standards for the park.

### **Sustainable use: strategic environmental management performance**

Tourism and recreation management performance and monitoring indicators should target global and local environmental improvement performance outcomes. Environmental management performance baseline standards should be developed for the park against these criteria. Monitoring of the acceptability of environmental performance for individual organisations would then be against these standards.

### **Strategic information and research**

Improvements in information availability are required to adequately manage for tourism and recreation values. There is a need for information for the establishment and management of baseline environmental management performance; data for supply and demand management, including visitor use numbers, visitor use by market segments (survey information), demand forecasts for market segments, and supply limits for recreation opportunities (tourism resource management information); visitor experience information; visitor impact information; economics of visitor use information; and visitor facilities and services information.

### **Strategic research and adaptive management**

An active research program focusing on the key tourism and recreation issues facing Kosciuszko National Park is critical. Management mechanisms for determining research priorities and mechanisms for implementing the results of research in an adaptive manner are considered important.

### **Leadership in regional sustainable tourism management**

There is a strong, and perhaps unrealistic expectation that the park should provide all the tourism services for the regional economy. It can and will play an important role, but it should not be an exclusive role. There is a need for a leadership role in working at a landscape scale with tourism and recreation management. This would be in close cooperation with Planning NSW for the ski resorts, local authorities for regional tourism management, the Australian Alps Liaison Committee for whole of Alps approaches, and with the NSW tourism industry. This will help achieve sustainable tourism and recreation outcomes for Kosciuszko National Park.

### **Conclusion**

The tourism and recreational value of Kosciuszko National Park has been assessed as significant at a national level. The tourism and recreational value of an opportunity setting has been defined as a function of the perceived ability of that opportunity to provide certain activities and experiences. This chapter identifies 10 attributes that underpin tourism and recreational values for Kosciuszko National Park. They have been evaluated and are found to be in a varied condition and subject to various pressures. To manage for the tourism and recreation values of the park, active, competent management of tourism and recreation is advised at a park and regional level, supported by an approach to management that focuses on strategic planning and environmental performance outcomes focused on sustainable use. The tourism industry is a vibrant industry of great significance to the regional economy and heavily dependent on Kosciuszko National Park. This chapter suggests the introduction of new approaches to tourism and recreation management by the NPWS. This includes continued positive working with the tourism industry as well as professionally managing tourism on a full time basis to protect the most important tourism and recreation values of the park in the long term interests of tourism. Techniques including sustainable use management, limits of use management, environmental performance management and individual company, community and authority accountability for environmental performance outcomes would be important.

### **Acknowledgements**

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## Attachment 15.1

The theoretical link between Attributes underpinning the tourism and recreation values (described by this chapter) and Clarke and Stankey's 1979 Management Factors are presented here. This is an important link, given that the Management Factors underpin the concept of recreation opportunity classes. Recreation opportunity classes are considered to be a fundamental planning tool for the spatial management (or zoning) of tourism and recreation opportunities within the park in the future (Newsome et al, 2002, p.161).

### Tourism and recreation opportunity setting management factors (after Clarke and Stankey 1979) and attributes of Kosciuszko National Park

Management Factor (Clarke and Stankey 1979)	Notes (after Clarke and Stankey 1979)	Attributes underpinning the tourism and recreation value of Kosciuszko National Park (this paper)
Access	<p>Management defines the ease of access eg roads, tracks, cross-country travel; the means of conveyance such as cars, four-wheel-drives, horses or on foot; the sophistication of the access type, such as high-standard fire trails; and the maintenance regime.</p> <p>Research identifies what recreationists prefer for access.</p>	<p>Access to Kosciuszko National Park.</p> <p>Access within Kosciuszko National Park.</p> <p>Affordability.</p>
Other non-recreational resource uses	<p>This factor considers the extent to which non-recreational uses of a park are compatible with various opportunities for outdoor recreation.</p> <p>Operations of electricity authorities, Snowy Hydro Limited operations, police, NPWS and others fit into this consideration for Kosciuszko National Park.</p>	
On-site management	<p>This includes site modifications such as facilities, exotic species of vegetation, vegetation management, landscaping, traffic barriers etc (the extent of the modification is important); the 'apparentness' of the modification; the complexity of the modification; and the nature of the facilities (if any).</p>	<p>For Kosciuszko National Park, naturalness is considered a major tourism and recreation attraction that is directly influenced by on-site management.</p> <p>For cultural attractions, cultural heritage infrastructure and sites are an important tourism and recreation attraction for Kosciuszko National Park.</p> <p>Services and facilities are the critical facilities and services to assist visitors.</p>
Social interaction	<p>The appropriate amount of social interaction is an important characteristic of different recreational activities.</p> <p>In more remote settings, low levels of interaction are appropriate and expected.</p> <p>In more modern settings, interaction can rise to very high levels.</p> <p>Natural terrain and management activities can greatly influence the level of contact of people.</p> <p>Social carrying capacity is an important management consideration.</p> <p>The type of use for a setting is important.</p>	<p>Educational activities within the park may be formal and informal. Social interaction is an important part of the learning experience, as is the opportunity setting.</p>
Acceptability of visitor impacts	<p>Human use of resources inevitably results in impacts.</p> <p>The level of impact that is consistent with the type of opportunity setting (and the status of the lands as a protected area) is important.</p> <p>Generally the tolerance of recreational users for impacts (ecological, sustainable, managerial) is greater among 'modern' recreation opportunity settings than among 'primitive' recreation opportunity settings.</p>	<p>The attribute 'Impacts of use' considers visitor use impacts,</p> <p>Sustainable use and environmental performance management and monitoring.</p>
Acceptable level of regimentation	<p>The nature, extent, and level of control over recreational use are important factors characterising different opportunity settings.</p> <p>A continuum of controls can be described, from subtle to regulatory.</p> <p>'Modern' settings are generally more highly organised and regulated than 'primitive' types.</p>	<p>Diversity of recreation opportunities is the range of tourism and recreation opportunities in the context of the park.</p> <p>Regional recreation opportunity settings are also important.</p>

## Attachment 15.2 (Part A)

Different combinations of the Management Factors (Attachment One) were used by Clarke and Stankey (1979) to derive recreation opportunity classes. They recognised a range of classes that may exist on a landscape. These “classes” have been widely used by recreation planners to ensure that a diversity of recreation opportunities can be maintained for protected areas (Newsome et al, 2002, p 159). Interestingly, the hardest areas to sustain are the areas with the least modification.(Class 5). The setting classes are described here (in Part A), and some indicative activities associated with the classes are described in Part B.

Recreation opportunity setting classes (Modified from Clarke and Stankey, 1979), description of attraction-landscape-managerial settings and potential visitor opportunities and experiences (NPWS 2002<sup>7</sup>). These are indicative setting classes which could be used at Kosciuszko National Park.

	<b>Destination Attraction/Landscape/Managerial setting</b>	<b>Visitor Opportunities/ Potential Experience</b>
<b>Class 1</b>	<p>Large area.</p> <p>Very high natural values.</p> <p>Negligible evidence of non-traditional human activity.</p> <p>No formed access or alien tenures.</p> <p>“Ideally a totally natural landscape that has not been affected by modern technological landuse”.</p> <p>Principle purpose preservation of wild values or significant natural values.</p> <p>May provide low intensity self reliant recreation.</p> <p>No facilities provided or structures of any description present.</p>	<p>Isolation from the sights and sounds of people.</p> <p>Opportunities for independence, solitude, closeness to nature, tranquillity and self reliance through the application of outdoor skills in an environment that offers a high degree of challenge.</p>
<b>Class 2</b>	<p>Generally remote areas with conservation significance.</p> <p>Only minor evidence of human activity including management trails and walking tracks.</p> <p>Principle purpose the conservation of significant natural and cultural values.</p> <p>Natural landscape with only minor recreation and management structures. Ideally no alteration to skylines and escarpments.</p> <p>Essential basic management structures, walking trails and management trails may be evident.</p> <p>Basic visitor facilities only provided for public safety, health and environmental protection.</p>	<p>General isolation from people though minimal contact with other visitors may occur.</p> <p>Opportunities for independence, solitude, closeness to nature, tranquillity and self reliance in an environment that offers a high degree of challenge.</p>
<b>Class 3</b>	<p>Natural area providing motorised and walking access and low to moderate intensity recreation with some facilities.</p> <p>Natural landscape with minor works and structures that support management and recreation are evident.</p>	<p>Most visitors will use this zone to explore the park either by car or on foot.</p> <p>Low frequency of contact with other visitors.</p> <p>Opportunities for closeness to nature, tranquillity and some self reliance may be required through the application of outdoor skills (inc 4W driving) in a natural environment.</p>

<sup>7</sup> Recreation Management Classes are a modification by the NPWS of Clarke and Stankey’s original recreational opportunity classes (after NPWS 2002).

	<b>Destination Attraction/Landscape/Managerial setting</b>	<b>Visitor Opportunities/ Potential Experience</b>
<b>Class 4</b>	<p>Includes areas of relative naturalness with recreation facilities evident. All weather motorised access is usually provided.</p> <p>A natural appearing landscape where the built environment has infrastructure for management and recreation but is not dominated by it.</p> <p>Provides for moderate intensity facilities based recreation in a natural setting.</p> <p>Cognisant of the need to protect natural (especially landscape) and cultural values.</p> <p>Predominantly natural appearing environment.</p> <p>Some modifications will be evident at specific sites.</p> <p>Medium scale camping and picnic facilities, good all weather road access, walking tracks and safety structures are provided.</p>	<p>Opportunities to interact with the natural environment while still having access to visitor facilities.</p> <p>Some social interaction with other visitors is likely.</p>
<b>Class 5</b>	<p>A modified landscape with natural elements. The built environment is a major component of the landscape character.</p> <p>Includes major visitor facilities such as picnic areas, camping grounds, scenic drives and major access routes, information centres and carparks.</p> <p>High level of site hardening and provision of facilities is evident.</p> <p>A natural, although modified setting with moderate to low conservation values.</p>	<p>Medium to high levels of recreation and social interaction in a natural setting.</p> <p>Opportunities of social interaction with other users of the site.</p> <p>Group or family activities are an important part of the recreational experience.</p> <p>A natural setting is important but in the security of a safe and managed environment.</p> <p>Ski Resort infrastructure, access services, accommodation, food, shelter and information services may be present.</p> <p>Well developed picnic and camping areas.</p> <p>Good all weather roads, graded walking tracks, safety structures provided.</p>



## Attachment 15.2 (Part B)

### Indicative tourism and recreation activities undertaken for Recreation Opportunity Classes 1 to 5 (A Theoretical Guide for the Plan of Management review, Modified from NPWS 2002).

Activity	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Alpine skiing					■
Snow boarding					■
Cross country skiing	■	■	■	■	■
Ice Climbing	■	■	■	■	■
Picnicking (facility based)			■	■	■
Camping (no facilities)	■				
Camping (facility based)		■	■	■	■
Scenic driving			■	■	■
4wd driving and registered trail bike riding on road			□	□	
Nature study or cultural awareness	■	■	■	■	■
Horse riding		□	□	□	
Canoeing/ kayaking/white water rafting	□	□	■	■	■
Boating (motorised)		□	■	■	■
Sailing/sail boarding		■	■	■	■
Adventure activities	□	□	□	□	
Fishing	■	■	■	■	■
Non-powered flight: hang-gliding, hot air ballooning, paragliding		□	□	□	□
Powered flight: low altitude			□	□	□
Cycling (on existing roads and trails)		□	□	■	■
Bushwalking (on formed tracks, not overnight)	□	■	■	■	■
Bushwalking (remote areas or long distance trails)	■	■	■		
Orienteering / rogaining		□	□		
Cross-country running			□	□	
Caving	□	□	□	□	□
Organised Mountain biking				□	□

■ Activity permitted

□ Activity may be permitted subject to certain conditions such as designated sites only, or subject to consent

## Attachment 15.3

### **Pacific Asia Travel Association – Asia Pacific Economic Co-operation Code for Sustainable Tourism 2001**

The Code for Sustainable Tourism has been adopted by both the Pacific Asia Travel Association (PATA) and the Asia Pacific Economic Co-operation (APEC) as a reflection of their strong commitment to tourism growth, across the Asia and Pacific region, that is viable and sustainable over a long-term future.

PATA was established in 1951 as the body for national tourist offices, airlines, hotels, tour operators, travel agencies and other firms active in tourism to promote travel to and within the Pacific Asia region. Its charter sets out its fundamental commitment to what is now called sustainable development:

*...to encourage and assist in the development of travel industries throughout Pacific-Asia in a manner which recognises the urgent importance to practice an environmental ethic that supports responsible conservation and restoration of Pacific Asia's unique combination of natural, social and cultural resources.*

PATA has maintained that commitment for over 50 years through numerous publications, conferences and workshops, and through its consistent promotion of heritage conservation, cultural tourism and eco-tourism. PATA first adopted a code for environmentally sensitive tourism at its 40<sup>th</sup> annual conference in 1991.

APEC was formed as a high level forum for the leaders of Asia Pacific economies in 1989. It has a particular commitment to opening the region to the freer flow of trade in goods and services, which includes tourism, and to co-operation across its economies on a wide front.

APEC established a Tourism Working Group in 1991 and convened the first meeting of Asia Pacific Ministers of Tourism in Seoul in 2000. At that meeting APEC adopted its Tourism Charter, which sets out the goal to 'sustainably manage tourism outcomes and impacts.' This expresses APEC's clear commitment to ecologically and culturally sustainable tourism development.

Reflecting these commitments, APEC and PATA, at a meeting of the APEC Tourism Working Group and at the Fiftieth PATA Conference respectively, both in Malaysia in April 2001, adopted the Code for Sustainable Tourism to guide their own activities and for promotion to their members and affiliates.

The code is designed for adoption and implementation by a wide range of tourism-related organisations and companies. By adhering to it they will be showing their commitment to the vision of tourism growth that is fully responsible in its approach to natural environments, to social needs and to cultural sensitivities. By following the Code, organisations will also be positioning themselves to deal with environmental regulation, environmental accounting, environmental standards such as ISO, and accreditation schemes requiring reporting on environmental and social impacts.

#### **Code for sustainable tourism**

The PATA/APEC code urges PATA Association and Chapter members and their industry partners and APEC Member Economies to:

#### **CONSERVE THE NATURAL ENVIRONMENT AND ITS ECOSYSTEMS**

CONTRIBUTE to the conservation of any habitat of flora and fauna affected by tourism

ENCOURAGE relevant authorities to identify areas worthy of conservation and to determine the level of development, if any, which would be compatible in or adjacent to those areas

INCLUDE enhancement and corrective actions at tourism sites to conserve wildlife and natural ecosystems.

#### **RESPECT AND SUPPORT LOCAL TRADITIONS, CULTURES AND COMMUNITIES**

ENSURE that community attitudes, cultural values and concerns, including local customs and beliefs, are taken into account in the planning of all tourism related projects.

PROVIDE the opportunity for the wider community to take part in discussions and consultations on tourism planning issues where these affect the tourism industry and the community.

ENCOURAGE an understanding by all those involved in tourism of each community's customs, cultural values, beliefs and traditions and how they relate to the environment.

CONTRIBUTE to the identity and pride of local communities through providing quality tourism products and services sensitive to those communities.

## **MAINTAIN ENVIRONMENTAL MANAGEMENT SYSTEMS**

ENSURE that environmental assessment is an integral step in planning for a tourism project.

ENCOURAGE regular environmental audits of practices throughout the tourism industry and to promote desirable changes to those practices.

ESTABLISH detailed environmental policies and/or guidelines for the various sectors of the tourism. Industry.

INCORPORATE environmentally sensitive design and construction solutions in any building or landscaping for tourism purposes.

## **CONSERVE AND REDUCE ENERGY, WASTE AND POLLUTANTS**

FOSTER environmentally responsible practices for: reducing pollutants and greenhouse gases conserving water and protecting water quality managing efficiently waste and energy controlling noise levels promoting the use of recyclable and biodegradable materials.

## **ENCOURAGE NATURAL AND SOCIAL ENVIRONMENTAL COMMITMENT**

ENCOURAGE those involved in tourism to comply with local, regional and national planning policies and to participate in the planning process.

FOSTER, in both management and staff of all tourism projects and activities, an awareness of environmental and cultural values.

ENCOURAGE all those who provide services to tourism enterprises to participate through environmentally and socially responsible actions.

SUPPORT environmental and cultural awareness through tourism marketing

## **EDUCATE AND INFORM OTHERS ABOUT LOCAL ENVIRONMENTS AND CULTURES**

SUPPORT the inclusion of environmental and cultural values in tourism education, training and planning.

ENHANCE the appreciation and understanding by tourists of natural environments and cultural sensitivities through the provision of accurate information and appropriate interpretation.

ENCOURAGE and support research on the environmental and cultural impacts of tourism.

## **COOPERATE WITH OTHERS TO SUSTAIN THE ENVIRONMENT**

COOPERATE with other individuals and organisations to advance environmental improvements and sustainable development practices.

COMPLY with all international conventions and national, state and local laws which safeguard natural environments and cultural sensitivities.

## Attachment 15.4

A joint workshop between representatives of the Independent Scientific Committee and the Kosciuszko National Park Plan of Management Community Forum, held on 5<sup>th</sup> September 2002, generated information which summarises, in their view, the condition and trend in condition of the ten tourism and recreation attributes considered in this chapter. The condition and trend in condition are considered indicative, not definitive (Attachment Four).

### Evaluation of the condition and trend in condition of ten tourism and recreation attributes of Kosciuszko National Park (input provided by representatives of the Kosciuszko National Park Community Forum)

Attribute	Category	Condition					Trend in condition				
		Excellent	Very good	Satisfactory	Poor	Very poor	Improving generally	Improving slightly	No net change	Declining in some areas	Widespread decline
Natural	Mount Kosciuszko				■			■		□	
	Snow		■					■			
	Valleys				□					■	
Cultural	Kiandra					■		■			
	Snowy Scheme		■					■			
	Aboriginal					■		■			
	Huts		■					■			
	Mining/grazing			■				■			
Education				■				■			
Diversity		■					■				
Activities		■					■				
Facilities	Ski resorts		■					■			
	Other				■					■	
Access	Mass transport				■			■			
	Road			■				■			
Scarcity			■							■	
Costs				■				■			
Regional opportunities				■				■			

■ Strong correlation with the level of condition or trend in condition status; □ Some correlation with the level of condition or trend of condition.

Note: Concepts such as 'condition' and 'trend in condition' can mean many things and apply to the attributes in many ways. For the purposes of this planning exercise and the workshop which derived this table, these terms have been generally used to refer to the principal components of the attribute determined as being significant (eg, for natural values, the summit of Mount Kosciuszko) and an interpretation of the condition status of those attributes. The trend in condition simply refers to whether the attribute condition is static, improving or declining in its condition.



# Chapter 16 economic evaluation

Doug Young

A growing environmental awareness and the development of environmental and ecological economics over the last three decades have led to an increasing understanding that the economic values of environmental attributes are considerably wider than just the dollar values they generate.

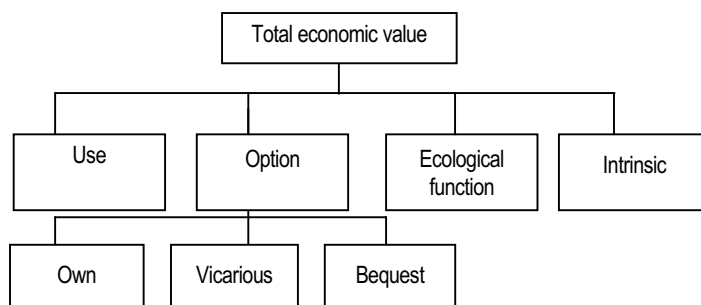
The studies in this report examine different aspects of Kosciuszko National Park. The economic study in this chapter attempts to combine the financial, social and environmental values to give a broad perspective of how the park contributes to the state and to the nation. Such an attempt at valuation is not easy, and its comprehensiveness has been limited by the available time and resources. By no means have all the economic values of the park been valued here.

To a large degree this assembly of data that are readily available in the public domain should be viewed as a first, preliminary step in a more detailed economic evaluation that will need to be completed should significant changes to the management of the Park be considered. Such an evaluation would require the extra level of detail that can best be pursued once details of various options for changes to park management are known. The evaluation would need to consider the impact of the various management options on the value of the future stream of goods and services provided by the Park. Such an evaluation would need to be conducted against an estimate of how the value of that stream could be expected to change in the absence of such management changes. It would also need to consider the distributional effects of those changes ie how the management changes could be expected to affect those who gain benefits from the goods and services provided by the Park. Such an evaluation would also need to consider how the different values could be expected to change over time. For example, the relative value of environmental attributes could be expected to increase as a result of increasing demand and increasing relative scarcity.

## Valuation methodology

The IUCN World Commission on protected Areas has recommended the use of Total Economic Value as a framework for the economic evaluation (WCPA 1998). The concept of Total Economic Value has been described in various ways by various authors (e.g. Young, R 1991; Pearce and Turner 1990). While there are similarities in the general concepts, there are differences in the details and underlying assumptions of the various approaches. Figure 16.1 shows the approach reported here, which is adapted from M D Young (1992)<sup>1</sup>.

Figure 16.1 Model for environmental valuation



<sup>1</sup>One common community view is that environmental attributes have value in their own right (that is, in the absence of humans they would still have value). The approach taken in this report is that environmental attributes have value because they are important to people. In many cases these values can be related to aspects of irreversibility, uncertainty and uniqueness.

*“A growing environmental awareness and the development of environmental and ecological economics over the last three decades have led to an increasing understanding that the economic values of environmental attributes are considerably wider than just the dollar values they generate.”*

In the above diagram 'Use values' are values that people gain from using the environmental attribute. This category includes a diverse range of values such as the value of water provided, power generated and crops produced, as well as the value of recreation experiences and the enjoyment that people gain from viewing environmental attributes in photographs or television documentaries.

'Option values' are values held by people who want the resource to be there in the future for their own personal use or the personal use of others. Following Pearce and Turner (1990), both 'bequest values' and 'vicarious values' have been included in this category<sup>2</sup>.

'Ecological function' values are benefits that humans derive directly or indirectly from the habitat, biological or system properties or processes of ecosystems. It includes such functions as flood control, regulation of the atmosphere's gases and the waste assimilation capacities of river systems. This type of value has received widespread interest since 1997, when Costanza and others published a paper in *Nature* (Costanza et al. 1997). While research in this area is progressing, there are currently insufficient relevant data to assign monetary estimates to these types of values for the Kosciuszko National Park<sup>3</sup>. Significantly, a number of these values are likely to take the form of services, like water supply, delivered to other parts of New South Wales (NSW), Victoria, the Australian Capital Territory (ACT) and South Australia.

'Intrinsic values' are values that people attribute to the knowledge that the environmental attributes exist. According to Pearce and Turner (1990), they reflect people's preferences and include concern for, sympathy with and respect for the rights or welfare of other organisms, not related to their use by humans. For example, people gain value just from knowing that the Corroboree Frog exists.

Use and non-use values are strongly related to cultural values. Many cultural values (such as aesthetic, historic, scientific and social values) are part of use and non-use values. These are examined in depth elsewhere in this report (e.g. Chapters 13 and 14). However, one source of difficulty is the significant difference between what Adamowicz et al. (1998) call 'held values' and 'assigned values'. Held values are the ethical beliefs that individuals or groups share concerning how one should live one's life. They involve concepts that go well beyond the standard economic concept of a good that can be exchanged or traded. Assigned values are defined by the relative worth of things. Held values tend to be relatively stable over time but assigned values reflect adaptations to changing conditions (CSIRO 2000).

When objects, practices or places are considered sacred, revered or taboo, conventional decision-support techniques have little application. Typically, held values are sacrosanct and non-negotiable. They are not considered tradeable. No monetary amount or preference ranking can be assigned (CSIRO 2000). Hence, these values can be above and beyond any values described in this chapter.

## Values attached to Kosciuszko National Park

Examples of the types of values associated with the Kosciuszko National Park are presented in Table 16.1. These types of values were largely derived from information provided to the members of the Independent Scientific Committee (ISC) and they fit most neatly into use and ecological function values. However, there are also significant option and intrinsic values. The table shows that there is considerable overlap among different types of benefits; they are not additive.

**Table 16.1 Examples of values associated with Kosciuszko National Park**

Use values	Ecological function values
Irrigation	Atmospheric gas regulation
Urban water use	Flood mitigation
Power generation	Genetic resources
Recreation (including bushwalking, sightseeing and skiing)	Pollination
Photography	Waste assimilation
Education	Nutrient cycling
Health	Pharmaceuticals and other products
Research	Water supply

<sup>2</sup>'Bequest values' are concerned with the value that people place on preserving the environment for future generations. 'Vicarious values' refers to the pleasure that people obtain from observing others derive use values.

<sup>3</sup>Costanza et al. (1997) provided broad estimates for a range of values derived from the literature available at the time. For example, the waste treatment functions of rivers and lakes were valued at \$695 per hectare per year when expressed in 1994 US dollars. Further examples of the values derived by Costanza et al. are presented later in this report.

Generally, it is much easier to gain data for values related to the direct use of an environmental attribute, such as value of water supplied to irrigators.

Without conducting specific studies, it is difficult to gain estimates for many other values of Kosciuszko National Park. For example, robust estimates of the values of specific ecological functions or intrinsic values would need further study. Although it is usually possible to quantify environmental benefits in physical terms, it is much harder to place monetary values on environmental benefits without substantial effort. Briefly, there are three main ways to estimate the value of environmental benefits:

- 'Environmental valuation' estimates the specific benefit and costs for a given project through various environmental economic approaches (such as contingent valuation, choice modelling, hedonic pricing or travel cost method).
- 'Benefits transfer' involves transferral of values obtained from other economic environmental valuations if they meet some prior criteria.
- The 'threshold approach' provides a figure for what the minimum value of environmental benefits has to be in order to justify the existence of a project.

Much of the new work on the value of ecosystem services seeks to identify opportunity cost. Environmental valuation is generally expensive and resource intense. Although many projects may have several unpriced benefits and costs associated with them, a choice needs to be made on when and how values are attributed to the environment. Such unpriced benefits or costs are referred to as 'externalities'. A first best policy is always to try and accurately estimate the value of all externalities, but in reality this is rarely possible. This is why many economic analyses will employ the method of benefits transfer. In some cases, it is possible to provide a broad order-of-magnitude estimate by reference to the values derived in other studies.

For such a transfer of values to be valid, the following criteria need to be met:

- the primary study cannot be fundamentally flawed;
- the study site and the policy site need to be similar;
- the environmental change at the policy site needs to be similar to the environmental change at the study site; and
- the socio-economic characteristics of the populations affected by the environmental changes at the two sites need to be similar.

These criteria are very restrictive and consequently are rarely met. New developments in environmental valuation have increased the probability of benefits transfer.

Recently, another technique for valuing changes to environmental attributes has been developed and trialed. This approach is termed 'choice modelling'. Respondents evaluate a number of different options or scenarios that have varying levels of attributes, taken from a common set, and express their preference by making a choice between options. Given the wide-ranging design of choice modelling, early indications are that it has the potential to satisfy benefit-transfer rules; therefore, some carefully planned choice-modelling studies could be used to transfer benefits from one study to another. If the review of the management plan for the Kosciuszko National Park indicates major changes to costs of managing the park, then a choice-modelling approach could help to gain an understanding of the values that people place upon changes to various attributes of the park. Not all values would be covered by this technique. In fact, there is no known simple technique that is capable of estimating all values. Normally, a suite of techniques needs to be used with careful design to avoid double counting and the summing of inconsistent numbers.

If conditions for benefits transfer are not satisfied, then the threshold approach could be used. This approach provides a figure for what the minimum willingness to pay for the environmental benefits would need to be, to warrant the change in expenditure. This figure is then presented to the community and to government and they are asked whether this figure seems reasonable given the presence of environmental improvements and costs. It should be emphasised that the value of the extra information gained through either application of the threshold approach or through a separate non market valuation is significantly greater once any potential changes to park management have been more clearly specified.

The following section presents publicly available information on aspects of use values associated with Kosciuszko National Park. The economic impact on the New South Wales and regional economies of tourism expenditure in Kosciuszko National Park is presented in Chapter 17.

## **Use values**

### **Irrigated agriculture**

Some indication of the contribution of the waters sourced from the Kosciuszko National Park to the value of irrigated agriculture can be gained from the following. The annual value of irrigated products from the Murray-Darling Basin is approximately \$3.5 billion. Under the Snowy Water Licence, Snowy Hydro Limited is required to provide minimum annual releases of 2088 GL to the Murray and Murrumbidgee rivers - ie 1062 and 1026 GL respectively (Carol Bruce, Snowy Hydro Limited, pers. comm., 14 August 2002). Scoccimarro et al. (1997) report that these releases represent long-term average contributions of approximately 5% to the Murray system and 14% to the Murrumbidgee system.



They further report that in years when downstream water supplies are reduced by low rainfall, the relative importance of the contributions from the Snowy Mountains Hydro Electric Scheme increases significantly<sup>4</sup>. Adopting a conservative approach and using the long-term average contributions presented in Scoccimarro et al, the Snowy contributes at least 7% (\$245 million)<sup>5</sup> to the annual gross value of irrigated production in the Murray-Darling Basin. Based on an estimated, indicative value-added multiplier of 0.6 the annual value-added contribution to the regional economies associated with this level of irrigated production could be in the order of \$150 million. In traditional terms this is often described as the economic impact of the water provided for irrigation to regional economies. Of course, there are significant extra contributions to the regional economies from the further processing of these agricultural products.

### **Significance**

As described above, the contribution of the waters from the Snowy River to the value of irrigated agriculture in the Murray-Darling Basin is significant. It was estimated that in 1992, the Murray-Darling Basin contained about 70% of Australia's irrigated crops and pastures and accounted for approximately 40 per cent of Australia's total gross value of agricultural production (MDBC 2002). The contribution of the region's water to the national value of agricultural production is thus very important, though overall it represents only about 3% of the national total. The contribution to both the basin and the nation varies considerably, depending on seasonal conditions and world prices, but from a world perspective it could not be considered significant. It should also be noted that whilst irrigated agriculture provides significant benefits it also imposes costs through, amongst other things, its contribution to river salinity and the impact of altered flows on riverine ecosystems.

### **Trend in condition**

As discussed above, the annual value of irrigated agricultural production varies with seasonal conditions and world prices. Despite these variations, it could be expected that, in real terms, the value of production over the last few decades has probably increased due to improvements in production efficiency. For example, total factor productivity in the dairy industry increased by 1.6% per year for the 22 years to 1998–99 (Martin et al. 2000).

### **Pressures**

Significant pressures on the region's contribution to the value of irrigated agricultural production within the basin are likely to come both from diversions of extra water away from the Murray and Murrumbidgee systems as a result of the Snowy River Inquiry, and also from moves to increase the quantity of water retained within the River Murray to improve environmental flows within that system.

### **Domestic, industrial, stock and town water use**

In addition to its use by irrigators, water from the Snowy system is an important source of water for residential and industrial use in several major urban centres throughout the basin. For example, as cited above, long-term average water contributions from the Snowy River contribute approximately 5% to the Murray system and 14% to the Murrumbidgee system.

Table 16.2 illustrates that on average, between 1988 and 1993, 208 GL of water was used largely for urban and industrial purposes. Applying the above percentages results in an average contribution of the Snowy River to urban and industrial uses of about 13 GL.

Volumetric charges paid by residential users of this water vary between 28 cents per kilolitre (Lower Murray Water) and 97 cents per kilolitre (SAWater)<sup>6</sup>. On these figures, the relevant water authorities would gain about \$7 million each year for the provision of this water.

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<sup>4</sup> This point is supported by Carol Bruce (Snowy Hydro Limited), who reported that flows from the Scheme into the Murray River range from 5% of average annual flows in wet times to 33% in dry times and that for the Murrumbidgee the contributions of the flows range from 25% in wet times to 60% in dry times.

<sup>5</sup> Note that these values will be influenced by a range of factors, including, but not restricted to, seasonal conditions and world commodity prices. They are provided only to give an indicative estimate of the size of the possible values.

<sup>6</sup> Source: < [www.sawater.com.au](http://www.sawater.com.au) >

**Table 16.2 Average domestic, industrial stock and town water use, 1988–937**

River system and state	Water for domestic, industrial, stock and town use (GL)
<b>New South Wales</b>	
Murray	29
Murrumbidgee	19
<b>Victoria*</b>	
Murray	56
<b>South Australia</b>	
Murray	104

\* Includes Ovens and Kiewa river system

## Power generation

The Snowy Mountains Scheme has a generation capacity of 3756 MW and can provide up to 11% of the total power requirements of the mainland of eastern Australia at any one time. Over a 12-month period, the Scheme produces approximately 3% of the total energy in the National Electricity Market. The difference between capacity and production is due to limits on the amount of water that is collected, stored and released each year<sup>8</sup>. As electricity prices are now determined on the spot market, prices are calculated at half-hour intervals and reflect rapidly changing market conditions. Consequently, it is difficult to assign a value to the current level of power produced. However, Snowy Hydro Limited has estimated that in current prices, its business is valued at over \$300 million annually (Carol Bruce, Snowy Hydro Limited, personal communication, March 2003). Snowy Hydro Limited is one of the largest employers in the region, with approximately 400 full-time employees (Carol Bruce, Snowy Hydro Limited, personal communication, 14 August 2002).

In the absence of the Snowy Mountains Scheme, extra power would need to be generated from thermal plants. Snowy Hydro Limited estimates that it directly displaces 4.5 million tonnes of carbon dioxide emissions each year. If these emissions were valued at \$10 per tonne<sup>9</sup>, then the annual value of reduced emissions would be approximately \$45 million.

### Significance

Whilst the actual contribution of Snowy Hydro Limited to the National Electricity Market in the eastern states is not very significant, its actual contribution through its participation in the National Electricity Market is nationally significant because of the following factors:

- Its physical location within the electricity grid provides support to both northern and southern major centres of electricity demand. This provides the market with an ability to reduce transmission line losses when required to transport power produced in NSW to Victoria or from Victoria to New South Wales;
- Its major role in providing risk management contracts for other market participants including both generators and retailers;
- Its provision of ancillary services to support the network;
- The range of hedge and financial derivative contracts available to other players in the industry; and
- Its role as an important peak load and emergency supplier because of the speed with which it can respond to sudden demands for power.

From an international perspective the contribution to power generation could not be considered significant.

### Trend in condition

As discussed above, Snowy Hydro Limited now operates in the National Electricity Market in the eastern states of Australia. A key feature of this market is the variability of electricity spot prices, which are based on half-hour intervals and respond to rapidly changing market conditions. It is thus difficult to determine future trends in Snowy Hydro Limited's income from power generation.

### Pressures

The results of the Snowy River Inquiry and the subsequent increase in water flowing down the Snowy River are expected to have a significant impact on the value of power generated by Snowy Hydro Limited.

<sup>7</sup> Source: <[www.mdbc.gov.au](http://www.mdbc.gov.au)>

<sup>8</sup> Source: <[www.snowyhydro.com.au](http://www.snowyhydro.com.au)>

<sup>9</sup> The Australian Greenhouse Office (AGO 2001) cites recent predictions of permit prices in Australia ranging between \$10 and \$50 per tonne.

## **Recreation**

Estimating the recreational use value of the Kosciuszko National Park is difficult because the values that people gain are not usually exchanged through normal market processes. Therefore, alternative techniques are needed to gain an estimate of these values. One of the most common techniques for estimating the value of the recreation experience provided by national parks is the 'travel cost' method. In this method the costs of travelling to and from the recreation site as well as the value of the opportunity cost of the time spent travelling are used to estimate recreation use value. A draft travel cost study of the recreation use values of the Australian Alps has recently been completed (Mules et al. 2002). The study was based on the following recreational activities (in order of activities undertaken most by visitors to the New South Wales Alps): bushwalking/hiking; car touring/sightseeing; nature appreciation; downhill skiing; camping; fishing; four-wheel driving; snowboarding; mountain bike riding; horseriding/trailriding; cross-country skiing; canoeing; kayaking; white water rafting; orienteering; rock climbing/abseiling; and trail bike riding.

The study estimated the value of recreation in the New South Wales part of the Australian Alps ranged between \$102 million and \$458 million per annum. It should be noted that this estimate relates to the value that visitors to the Park gained from their use of the New South Wales part of the Australian Alps for recreation activities. It does not refer to the economic impact of Kosciuszko National Park. The economic impact of expenditure by visitors to the Kosciuszko National Park is presented in Chapter 17.

### **Significance**

From a regional perspective, the recreation use values presented in this report are significant. It is harder to classify the values from a national perspective, because there is little information on recreational value for Australia. From an international perspective, the values cannot be considered significant.

### **Trend in condition**

In the absence of other similar studies of the region it is difficult to determine a trend in the condition. It is, however, possible to identify pressures.

### **Pressures**

The value that individuals gain from a recreation experience is influenced by various factors and varies from person to person, so the pressures on recreation use values have different sources.

For some people, the value of the recreation experience is increased by a sense of isolation. Increased numbers of tourists and increased interactions with other people would decrease the value of the experience for these people. For others, the experience is dependent on social interactions with others. Below a certain threshold of congestion, the value of the recreation experience would in general be increased by more tourists. Beyond this threshold congestion level, the values that these people gained from their recreation experience would in general decrease. Yet another group of people will derive enjoyment from the state of the biological and geological attributes of the park. The recreation use value for these people would be diminished by deterioration of these attributes.

## **Recreational fishing**

Many of the values associated with recreational fishing in Kosciuszko National Park are captured in the estimate of the value of recreation above. However, Dominion Consulting Pty Ltd (2001) recently confirmed some of the recreational values cited above. It is important to note that the presence of some recreational fish (e.g. trout) can have a negative influence on native fish (see Chapter 8 for more detail).

The economic study of the Snowy Mountains trout fishery had three core elements: face to face fishing interviews in the Snowy Mountains region, the use of freshwater recreational fishing license records and the economic survey of businesses.

Results from the state-wide analysis of the recreational fishing licence records showed the popularity of inland native fish and trout fishing. The results suggest that \$46.5–70 million is spent annually on trout fishing in the Snowy Mountains region (Dominion Consulting Pty Ltd 2001).

### **Amenity migration**

There has been substantial migration to certain towns in the Snowy River Shire area because it is an amenity rich region; for example, the Snowy River Shire has had an average population growth of 1.6% over the last five years (Department of Local Government 2002).

Indeed, the Snowy River Shire spends a significantly higher amount per person on recreation and leisure services than the average in New South Wales (around 16% higher, Department of Local Government 2002).

Amenity migration has its own benefits and costs to individual council (and state) areas. If migration to a scenic rural area exceeds a certain threshold level, the social, economic and ecological resources of the area in question may be compromised through, among other things, congestion.

Although increased amenity migration may result in additional economic activity within the Snowy River Shire, this may result in a reduction in economic activity in another part of the state or nation. This could represent a redistribution of economic activity within the state or nation. However, if a considerable number of the immigrants have come from other countries, there would generally be a net economic development benefit to both New South Wales and Australia.

On the other hand, net welfare of the country is increased because of the increase in consumer surplus that arises from individuals choosing to move into amenity-rich areas. The enjoyment and pleasure that people receive from such a move increases society's overall consumer surplus.

Unfortunately, it has not been possible to quantify the benefits (or costs) associated with amenity migration to the Snowy River Shire within this report.

## **Intrinsic values**

As with the estimation of recreation use values, specific techniques are required to obtain estimates of the intrinsic values associated with specific environmental attributes such as national parks<sup>10</sup>. One of the most commonly used techniques has been the 'contingent valuation' technique. With this technique a sample of people are generally asked how much money they would be prepared to pay to achieve a specified change in a particular environmental attribute. For example, they could be asked to state how much they would be prepared to pay to increase the area of remnant native vegetation in a particular area.

The expense of these studies has been one of the key factors in limiting their wider use in decisions about the management of natural resources. Instead there has been a tendency to try to transfer the derived values from one study to another. As discussed above, there are criteria that need to be satisfied for such a transfer to be valid, and these criteria are rarely satisfied.

A review of the literature indicates that no specific contingent valuation studies have been completed for the Kosciuszko National Park. Lockwood et al. (1993) used the contingent valuation technique to estimate the willingness to pay of Victorian households to reserve unprotected East Gippsland national estate forests in national parks. Lockwood et al. (1993) estimated that the aggregate annual non-market value to Victorians was \$41 million when expressed in 1999 dollars. However, for the reasons given above, it is impossible to extrapolate this value to the Kosciuszko National Park case.

National Land and Water Resources Audit (2002) presented the results of another stated preference technique that appears to hold greater promise for the transfer of benefits from one study to another. As part of the National Land and Water Resources Audit, the choice modelling technique was used to estimate how non-market environmental and social values could be affected by land and water degradation. In these studies, households in various parts of Australia were asked how much they would be prepared to pay for changes in the following four attributes: species protection, landscape aesthetics, waterway health and social impact. The reports also recommended an approach for transferring these results to other situations. Therefore, if the review of the management of Kosciuszko National Park led to specific changes to the way in which Kosciuszko National Park was to be managed and, further, if it was possible to quantitatively specify how those changes would affect the number of species to be protected, the hectares of bush to be protected, the kilometres of waterways to be restored for fishing or swimming, and the number of people leaving country areas each year, it would be possible to estimate the non-market values associated with those management changes.

## **Ecological function**

There are many ways in which environmental attributes create values for society. For example, Kosciuszko National Park can increase the quality of water caught in catchments (and hence reduce water treatment bills) by providing filtering services. It also provides a wide diversity and stock of plants and other produce. As well as having current uses, plants provide future option values through new pharmaceuticals and other products.

Placing a value on such ecological functions is not easy. Each value needs a highly specialised study, and is above and beyond the requirements of the current report.

Table 16.3 presents the values developed by Costanza et al. (1997) for various ecosystem services that would be provided by biomes present in the Kosciuszko National Park. Again, for the reasons given above about benefits transfer, it would be inappropriate to expect that the values quoted would be relevant to the Kosciuszko National Park. Therefore no attempt has been made to multiply the unit values by the relevant areas of the Kosciuszko National Park. They are presented only to illustrate the types of values that the Costanza et al. study derived for these types of ecosystem functions. In all cases the unit values have been converted to the value of the Australian currency in 1999.

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<sup>10</sup> This is not to suggest that such non-market valuation techniques provide only estimates of intrinsic values. They can also provide estimates of the bundle of non-market values, including option values. Some of the more recent research also captures aspects of direct use values.

**Table 16.3 Summary of annual ecosystem function values (\$/ha), 1999**

Ecological function	Biome			
	Forest	Grass/rangeland	Wetland	Lake/river
Gas regulation		10	191	
Climate regulation	202			
Disturbance regulation	3		6506	
Water regulation	3	4	21	7804
Water supply	4		5447	3034
Erosion control	138	42		
Soil formation	14	1		
Nutrient cycling	517			
Waste treatment	125	125	5987	953
Pollination		36		
Biological control	3	33		
Habitat/refugia			436	
Food production	62	96	367	59
Raw materials	198		152	
Genetic resources	23			
Recreation	95	3	823	330
Cultural	3		1263	
<b>Total value</b>	<b>1389</b>	<b>333</b>	<b>21,191</b>	<b>12,180</b>

Economic reasons for conserving wild nature have also been presented by Balmford et al. (2002).

## Conclusion

This study has briefly described some of the considerable economic values (environmental, social and financial) associated with Kosciuszko National Park. Some of the values that have been able to be identified include irrigated agriculture, urban and domestic water use, power generation and recreation. In addition, there are large economic values attached to amenity migration, ecological functions and cultural values, but it has not been possible to quantify these.

# Chapter 17

## value of tourism

*Prof Trevor Mules*

### Description

Although the Kosciuszko National Park has been a key snow-skiing destination for generations of Australians, it is not a designated tourism destination for which data is compiled by tourism agencies such as Tourism New South Wales (NSW) and the Bureau of Tourism Research. Instead, such agencies designate the Snowy Mountains as a tourism region, coinciding with the Australian Bureau of Statistics' Snowy Mountains Statistical Division, which contains the Local Government Areas of Cooma–Monaro, Snowy River and Bombala.

Visitation data for domestic tourists to the Snowy Mountains tourism region are shown in Table 1 for the years 1998–2001. Although these figures do not relate exclusively to Kosciuszko National Park, the park is the major tourist attraction in the region. The visitation numbers do not display any discernible trend, but tend to vary from year to year in line with snowfall and the quality and length of the ski season. There may be some correlation with the general health of the economy, as domestic tourism tends to be income-elastic<sup>1</sup>.

**Table 17.1 Annual visitor numbers to Snowy Mountains region, 1998–2001**

	Overnight visitors ('000)	Day trip visitors ('000)
1998	647	195
1999	620	292
2000	689	260
2001	651	272

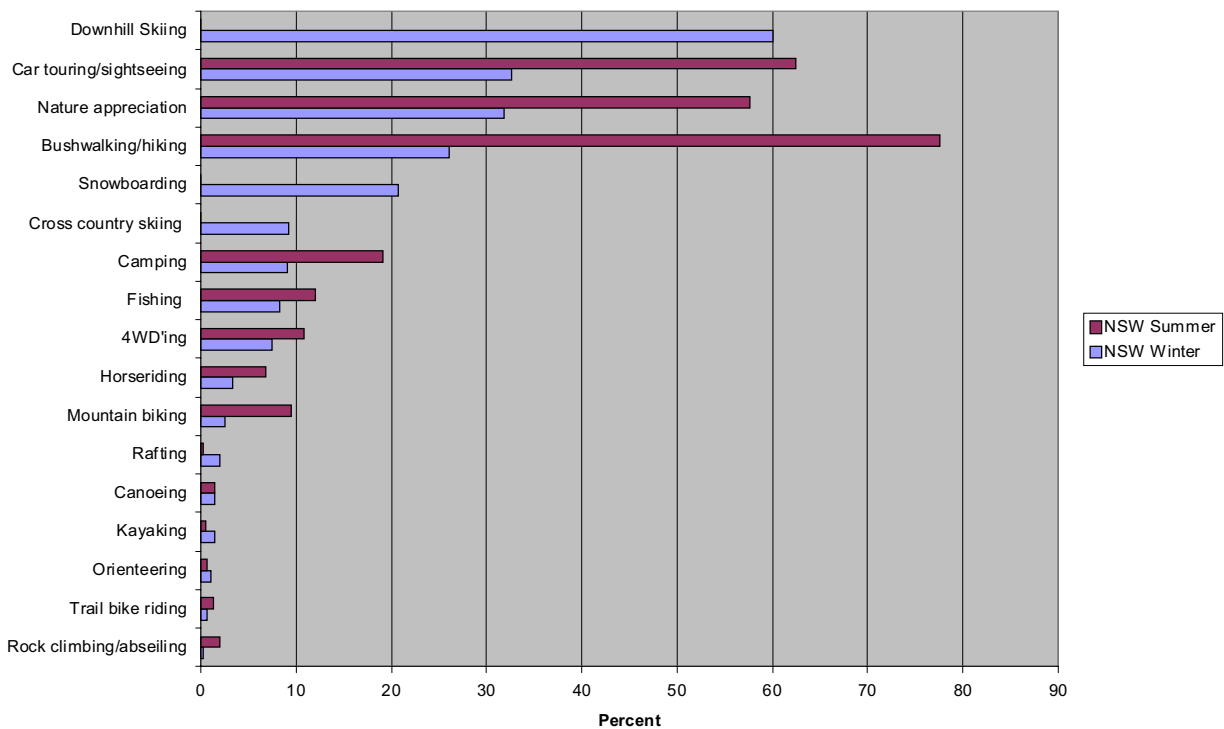
Source: Tourism NSW

While the park is closely associated with winter sports such as skiing and snowboarding, the 2001 Australian Alps visitor survey conducted by the University of Canberra's Centre for Tourism Research (Mules et al. 2002) showed that bushwalking, sightseeing and nature appreciation are undertaken by more people. Figure 1 shows the activities undertaken as reported in the survey. One possible reason for the fact that these activities outranked snow-based activities is that multiple responses were possible. This means that a winter visitor who ticked downhill skiing may also have ticked sightseeing. If a summer visitor also ticked sightseeing (but obviously not snow skiing) then overall, sightseeing would outrank skiing.

*“The recreational use value of the park is just under \$5 billion.”*

<sup>1</sup>Domestic tourism to Kosciuszko National Park would also be affected by the cost of visiting substitute mountain destinations, such as New Zealand and North America, where exchange rate movements play a part. While the exchange rate against the NZ\$ has been stable, the US\$ rate has declined markedly; given some degree of price response, this should have triggered an increase in domestic ski/snow based visitors to Kosciuszko National Park.

**Figure 17.1 Activities undertaken by visitors to the NSW Alps, 2001**



Note: Numbers do not sum to 100 because of multiple responses

Source: Centre for Tourism Research, University of Canberra (Mules et al. 2002)

There is some support for the finding that non-snow based activities are popular from the National Visitor Survey ending June 2002 which showed that for all visitors, “rest and relaxation” rated 45%, snow skiing and boarding 37%, and “national parks and forests” 32%. It should also be noted that the high proportion of bushwalkers in the sample which was used for Figure 17.1 may be partly a result of the data collection methods. Experienced regular skiers who had season passes may have missed many of the survey distribution points, thereby possibly under-weighting skiing in the sample.

Included in “sightseeing” in Figure 17.1 would be people who visited the Snowy Hydro Limited’s visitor facilities either within the Park or at Cooma. Data from Snowy Hydro indicate that some 30,000 people visited power stations within the Park in 2002, and 41,200 visited the Cooma Education and Information Centre.

The 2001 survey suggested that winter tourism accounted for some 65% of the annual total, down from 89% in a 1994 survey (KPMG Consulting 1994<sup>2</sup>). Clearly, the park is now an all-year-round attraction, in contrast to the situation in 1994, and the natural and scenic aspects of tourism in the park are rivaling the importance of the snow-based aspects.

## Significance

### International

The international tourism significance can be thought of in two streams:

- How important an attraction is Kosciuszko National Park to international visitors to Australia?
- How important is Kosciuszko National Park is keeping Australian travellers at home, rather than travelling overseas?

The top 10 places visited by international visitors to Australia are shown in Table 2. The popularity of Sydney and Melbourne is partly due to their gateway status, but international visitors clearly have a preference for capital cities, or non-capital city attractions that are in some way ‘special’; for example, tropical North Queensland. Kosciuszko National Park is not in the top twenty destinations for international visitors to Australia.

<sup>2</sup> Both surveys were comprehensive random samples, and so should provide estimates of parameters of the visiting population. The differences between the two samples are also too large to be explained by sampling variation.

While some may argue that Kosciuszko National Park is 'special' in an international setting, perhaps for scientific uniqueness, this does not translate into significance for international tourism. As a mountain destination, Kosciuszko National Park competes internationally with the Himalayas, the Southern Alps of New Zealand and various European and North American alpine regions. The height and extent of the Australian Alps pale by comparison with these international destinations. As a result, only 6% of the visitors to Kosciuszko National Park in 2001 were international tourists (Mules et al. 2002). Thus it cannot be argued that Kosciuszko National Park is of international tourism significance in terms of attracting visitors to Australia. This is a reflection of its relative insignificance on the world scale of mountain destinations, rather than an issue of cost, and it is difficult to imagine any level of promotion that would alter this situation.

**Table 17.2 Top 10 destinations for international visitors to Australia, 1999**

Destination	Percentage of international visitors
Sydney	55.5
Melbourne	24.4
Gold Coast	21.4
Tropical North Queensland	18.4
Brisbane	17.2
Perth	12.7
Adelaide	7.2
Petermann, Northern Territory (including Uluru and Yulara)	6.2
Alice Springs	5.5
Sunshine Coast	4.9

Source: Bureau of Tourism Research (2001)

Similar considerations apply to retaining Australians who might otherwise travel overseas. While there are no official data on outbound Australian travel to mountain destinations, there is anecdotal evidence that Australians do travel to New Zealand and to North America for skiing and hiking, and to the Himalayas for trekking and climbing.

The general impression obtained from talking to skiers and trekkers is that Kosciuszko National Park is not world class in terms of either mountain activities or facilities. Problems that are often cited with Kosciuszko National Park include:

- high cost of accommodation and ski lift tickets;
- lack of dependable snow;
- lack of developed walking/trekking trails;
- altitude (lack of).

There may be some 'cultural cringe' in Australians' attitudes to their own mountain destinations. Further research is needed into the outbound Australian travel market to determine the extent to which Kosciuszko National Park is seen as a potential substitute for travel to foreign mountain destinations.

### Domestic

Kosciuszko National Park and the Victorian Alps are the only two alpine tourism destinations in Australia. While parts of Tasmania may lay claims, only Kosciuszko National Park and the Victorian Alps have well developed ski fields with on-mountain accommodation and significant tourism visitation all year.

However, as is shown in Table 3, Kosciuszko National Park does not rate in the top 10 tourist destinations for Australian domestic tourism. Part of the reason for this is that business tourism is always going to be dominated by capital city visits; also, a lot of Australian holiday tourism is beach related - 38% of Australian domestic holiday travellers list the beach as a destination/activity and 11% list visiting a national park (Bureau of Tourism Research 2002).



**Table 17.3 Top 10 Australian domestic tourism destinations, 2000**

Destination	Percentage of domestic visitors
Sydney	11
Melbourne	8
Brisbane	6
Gold Coast	5
Hunter region	4
Adelaide	3
Sunshine Coast	3
Perth	3
South Coast NSW	3
Canberra	3

Source: Bureau of Tourism Research (2002)

In a tourism sense, it could not be said that Kosciuszko National Park is a destination of major national significance, at least in terms of the number of visitors. Estimates by the Centre for Tourism Research at the University of Canberra (Mules et al. 2002) put the total number of visitors in 2001 at 1,001,500<sup>3</sup>. By comparison, the south coast of NSW attracts 4,934,000 and the Hunter region attracts 8,332,000 visitors per year (Tourism NSW data). These figures include domestic overnight visitors, international visitors and day trip visitors.

The domestic tourism significance of Kosciuszko National Park lies not in the total number of visitors who are attracted to it, but in the uniqueness of the tourism experience. It is one of the few areas of Australia where people can experience the unique climate, scenery, history and danger of an alpine destination.

### Impact

As the previous section has shown, Kosciuszko National Park is primarily a domestic tourist destination. Of the one million annual visitors, some 335,000 are from interstate, and it is the expenditure of the interstate tourists that drives the economic impact of Kosciuszko National Park tourism on the economy of NSW. Expenditure by visitors who are NSW residents is transferred from elsewhere in the state and therefore provides no gain in state economic activity.<sup>4</sup>

Mules et al. (2002) estimated that interstate visitors' expenditure generated \$150 million of gross state product in 2001, and that this was responsible for 2300 jobs, in full-time-equivalent terms. Some 65% of this economic activity was generated by the expenditure of winter visitors. Thus, although snow-based activities were outranked by scenic attractions in the park, the winter expenditure was responsible for almost two-thirds of the economic impact.

The size of the impact of tourism on the state economy depends upon three factors:

- the number of non-resident visitors
- the total expenditure of the non-resident visitors
- the pattern of this expenditure.

The pattern of expenditure is important, because if visitors tend to spend money on goods that are produced outside of the state, the economic impact will be less than if the expenditure is on goods produced within the state. Table 4 below shows the estimated expenditure pattern from the 2001 survey (Mules et al. 2002). As is the case with most studies of tourism's economic impact, the largest expenditure item is accommodation. Because this item is site specific, it cannot be imported into the state, and this illustrates why tourism is generally very efficient at generating economic impacts.

<sup>3</sup> There is a conventional wisdom that the park attracts around 3 million visitors per year. However, this figure would seem to be visitor-nights rather than visitors, since Tourism NSW figures put the annual number of domestic visitors, including day-trippers and international visitors, to the Snowy Mountains region at 956,000 in 2001, and the average length of stay is 3.3 nights.

<sup>4</sup> This is a deliberately conservative position, since if New South Wales residents were to go interstate or overseas instead of to Kosciuszko National Park, state economic activity would decline.

**Table 17.4 Total expenditure by visitors to Kosciuszko National Park, 2001**

Expenditure item	Total visitor expenditure (\$ million)
Accommodation	28.05
Food and drink	15.73
Transport	11.91
Park entry fees	3.96
Lift tickets, fishing licences, etc	23.26
Shopping, ski hire	14.61
Entertainment, gambling	7.16
Other	6.03
<b>Total</b>	<b>110.73</b>

## Condition

The condition of the park as a tourist destination is difficult to assess, depending to some extent on the views of visitors on questions such as quality of accommodation, transport, signage, attractions (including scenery), accessibility, restaurants, shopping, and entertainment. The park may have some outstanding sites for tourists, but if they are difficult to find or access, or are poorly maintained, then the tourism condition would be given a low rating.

The park attracts a wide cross section of visitor types, from downhill skiers to back country hikers, and they are likely to have different views about the importance of the attributes that comprise a tourist destination. Research on such matters has never been carried out, with the past research emphasis in Kosciuszko National Park being scientific and ecological in its orientation. Now that the park is a year-round tourist destination, it is timely for more research to be done on the tourism attributes of the park.

Such research would yield information on the condition of both the human-made and natural features of the park, as perceived by park visitors. 'Condition' in a tourism sense is a relative concept, and tourists make destination choices between different destinations based on differences in the destinations' attributes. For example, the quality, modernity and price of accommodation are all part of the way in which tourists compare accommodation at different destinations. Similar considerations apply to other features such as roads, signs and picnic and camping areas.

One measure of condition where there has been some limited research is 'consumer surplus'. Each user of the park for tourism derives pleasure/satisfaction from their visit, and in most cases the value of the satisfaction exceeds the cost of visiting the park, where 'cost' includes not only entry fees, but also cost of travel to the park and return. This excess is the consumer surplus.

Economists use a method called 'travel cost' to derive the demand/cost relationship for visitors. From this relationship it is possible to estimate the annual dollar value of the consumer surplus for all Park users. If the assumption is made that this value will continue indefinitely, then a present value of the flow of consumer surplus can be calculated using a social discount rate. This value could be regarded as a monetary measure of the condition of the park, for if the condition were to deteriorate, so too would the consumer surplus.

Mules et al. (2002) estimated the consumer surplus under a range of assumptions about travel cost per person per kilometre, and for a range of different demand functions. The study's preferred range was between \$102 million per year and \$458 million per year, with the 'middle of the road' value being \$280 million. The present value to perpetuity of this annual flow, using a 6% social discount rate is \$4943 million. In round terms this means that the recreational use value of the park is just under \$5 billion.

## Trend in condition

According to the two studies that have been carried out into the economic impact of tourism in Kosciuszko National Park (KPMG Consulting 1994; Mules et al. 2002), the economic impact of tourism to Kosciuszko National Park has increased from \$137.3 million in 1994 to \$150.21 million in 2001 (in nominal terms). This represents a compound growth rate of 1.3% per year, which is less than the rate of inflation (around 3%) and below the general growth rate in the economy (around 4%), but is in line with the growth in Australian domestic holiday tourism (1.1% per year according to the Tourism Forecasting Council (2002).

The other trend that is observable from the two studies is that the seasonal pattern of tourism is changing from 89% winter in 1994 to 65% winter in 2001. This trend towards the park being an all-year tourism destination is partly due to the deliberate strategy of tourism operators to develop non-winter activities such as mountain bike competitions, mountain running competitions and jazz festivals. However, there has been a world wide increase in nature-based tourism over the past two decades, and the increase in summer tourism may be partly attributable to this trend.

The trend towards summer tourism has implications for the economic impact and commercial yield of tourism in the park. The 2001 study (Mules et al. 2002) estimated average expenditure per person by summer visitors to be \$268, and by winter visitors to be \$700. Thus, in economic terms, each winter visitor is worth almost three summer visitors. The two are not mutually exclusive of course, and it is possible for operators to even out their seasonal cash flow by developing summer tourism with no loss of winter tourism.

There are three trends in the Australian tourism industry that have implications for tourism in the park:

- International inbound tourism is the high growth area in Australian tourism, and is doubling in size every ten years. Kosciuszko National Park's low share of international tourists means that the park's tourism operators benefit very little from that growth.
- Kosciuszko National Park's current market segment is domestic tourism, which nationally is languishing. Its growth, approximately 1% per year, is slower than the rate of growth of population and the rate of growth of the economy.
- Australian outbound tourism is growing at approximately 6% per year. The mountain/nature oriented segment of this growth represents potential for Kosciuszko National Park tourism operators.

## **Pressures**

Pressures on a tourism destination may arise because of new competition from other destinations; from internal sources such as failure of the destination to keep pace with customer demand; or from changes in the external tourism environment. To our knowledge, there has been no research on visitors' satisfaction with aspects of their visit to Kosciuszko National Park, and so no conclusions can be drawn on the matter of customer perspectives.

There is clearly some tension between the conservation objective and the tourism use objective of the park, and decisions on park conservation may always have implications for the tourism use. However, the greatest pressure on the tourism industry in and around the park is from competition from other destinations, especially skiing and mountain destinations. There has been no competitor analysis research done, to our knowledge, for Kosciuszko National Park as a tourism destination.

Future snowfall, and how global warming will affect it, is clearly a threat to the tourism industry in the region. The response of the industry to date appears to be to invest in snow-making technology and infrastructure.

## **Opportunities**

The emergence in recent years of summer tourism in Kosciuszko National Park, and the plans by the operator at Perisher Valley for an all-year tourism village, indicate where the tourism opportunities lie in the near future. More research is needed on the capacity of the park to handle the various segments of the summer market (e.g. fishing, bushwalking, camping), and on the investment and infrastructure needed if that market is to develop further.

The great challenge for the tourism industry in and around the park is to develop a niche in the international visitor market in Australia. It is this market which is highest in yield and potentially highest in growth. Both Canberra and Kosciuszko National Park are similarly afflicted with their inability to attract a significant share of this market, and there may be synergies to be gained in marketing and travel logistics.

The same synergies may apply in the educational tourism market, where over 120,000 school children per year already visit Canberra on a school excursion. The park has numerous educational aspects, such as ecology, geology, history and science, which could form part of a linked educational excursion to Canberra, where the educational focus is civics and society.

# Part Three

## Chapter 18

# summary of significance

Lorraine Cairnes

### Introduction

When people describe the reason that a place is important to them they usually draw from many attributes and their descriptions are not specific. To most people, the significance of a place is a combination of many values — natural heritage, cultural heritage and other values derived from these qualities. However, management needs explicit information about each value and its significance so that important values can be conserved, and management effort can be targeted and prioritised.

The values of Kosciuszko National Park are of two types: the core values of natural and cultural heritage, and the derived values (e.g. social, recreational, tourism and economic) that depend on these core values.

The primary task of the Independent Scientific Committee (ISC) has been to analyse the specific values of the park and to state why they are important. In doing so, the ISC acknowledged and endorsed previous statements of the park's values such as the Schedule of Significant Features of the existing Plan of Management.

Some values are geographically based and can be assigned to a particular area or place (e.g. the Lower Snowy River) or group of places (e.g. karst areas) in the park; others are less place-specific, and may refer to a value held by the whole park but not to a specific place within it (e.g. recreation opportunities, the experience of remoteness).

There are overlapping or layered values in any part of the Kosciuszko National Park and most places have elements of natural as well as cultural values. Many values are interrelated or interdependent (e.g. soils and flora), and some are composites of other values (e.g. ecosystem services). Multiple values may build richness in some places, but they may also create conflict because a decision to conserve one value may contribute to degradation of another.

Thus, defining the values of such a large area as the park is not simple. As far as possible, the ISC members used consistent methodology to define and describe the different types of value. When this approach was not possible, they used methods for description and analysis that were appropriate to their discipline.

A large amount of detailed knowledge was available for some values (e.g. a recent cultural heritage study formed the basis of the cultural heritage analysis). In other cases, there are still many knowledge gaps.

In the individual topic chapters, the ISC addresses each of the value areas requested by the New South Wales National Parks and Wildlife Service (NSW NPWS) in the ISC's Terms of Reference. The scope of the values and issues addressed is not exhaustive; for example, the ISC identified small-scale issues such as the multiplicity of microclimates in the park, and large-scale issues such as climate change as deserving future review as individual topics. This statement is a contemporary view and may change with time, as knowledge and perception of the park's values changes. In the topic chapters, the individual authors have summarised the values in hierarchical order of significance, and ranked their attributes as far as possible, from international to local or park scale. This does not mean that values of local significance are not important.

*“The park’s importance is the sum of all the values of the park. All of these values are worthy of being conserved.”*

## Statement of significance of Kosciuszko National Park's values

The following statement of significance is in six parts, which were agreed by the ISC to be appropriate for the values examined:

- international recognition;
- internationally significant values of the park;
- significance of the park in its regional setting;
- significance of the park as a protected area;
- summary of significance related to the individual values and themes of the park; and
- expanded significance of the individual values and themes of the park. (This is in the topic chapters and is not repeated in this chapter).

The chapters on the individual values of the park provide detailed analysis.

### 1 International recognition

Two international environmental listings apply to Kosciuszko National Park: the whole park was listed in 1977 as a biosphere reserve under the United Nations Educational, Scientific and Cultural Organization (UNESCO) Man and the Biosphere Program, and part of the park (Blue Lake and its surrounding area) is a wetland of international importance listed under the Ramsar Convention.

The Australian Alps are recognised by the World Conservation Monitoring Centre (WCMC) as one of the 167 world centres of biodiversity; at 11%, endemism in the Australian Alps is as high or higher than other mountain areas around the world.

### 2 Internationally significant values of the park

In addition to the international recognition through the two international environmental listings described above, the park has numerous other values of international significance; most are related to its natural heritage. They include:

- the suite of karst areas, particularly Cooleman and Yarrangobilly Karst;
- soils that are of outstanding scientific value as examples of some of the great soil groups, both individually (the alpine humus soils) and in association with each other;
- fossil soils and remnants of fossil soils of high scientific value and practical importance;
- alpine areas that are of international significance as a prime global example of mid-latitude alps with attributes that include vegetation that includes at least 21 endemic species and 33 species that are rare in a total of some 204 species of flowering plants;
- subalpine ecosystems that provide habitat for a number of rare animal species (e.g. mountain pygmy-possum in podocarpus heath and corroboree frog in sphagnum bogs);
- probably the most outstanding development of subalpine treeless flats and valleys in the world (internationally significant ecophysiological work has been undertaken on the tree lines);
- populations of thirteen vertebrate taxa that are listed as threatened or near threatened by the World Conservation Union (IUCN), including the endangered mountain pygmy-possum, which has the longest life span of all known small terrestrial mammals;
- natural fire regimes, which are partly a function of climate, that have created subalpine, montane and lowland landscapes of international significance covered with a catena of eucalypts;
- a cultural heritage theme of science and conservation, with numerous places and associations with outstanding international ecological research and
- a claim to international significance by the Kiandra Ski Club (established 1861) which is the oldest in the world.

### 3 Significance of the park in its regional setting

Kosciuszko National Park forms the central segment of the Australian Alps bioregion that supports all the alpine endemic species found on the Australian mainland. The park forms about half of the area of the Australian Alps national parks system and is less fragmented than the dissected landforms of the alpine regions of Victoria. Because Kosciuszko National Park is large and contiguous with other natural areas, full life cycles and gene flow can continue in a regional context.

The park provides ecosystem services that are nationally valuable, including provision of clean water to southeastern Australia through the quality of the park's soils and catchment, and reduction in risk of climate change through large tracts of the park's forest sequestering carbon.

## 4 Significance of the park as a protected area

Very few large natural protected areas such as Kosciuszko National Park remain in temperate Australia, where the natural dynamics of ecological processes can still occur without significant human intervention, and where there are active policies to protect naturalness. Such areas are decreasing in number and area over time, and so are becoming more precious. Many of the park's other values depend on maintenance of the naturalness of the park setting; Kosciuszko National Park is a place where there can be prevention of the accumulating harmful effects of new and extended development such as light, air, water, and noise pollution.

Kosciuszko National Park conserves, in its landforms, a largely intact intrinsic record of past change of soils and vegetation, and has a scientific record that has monitored change over five or more decades. Because of these features, the park can play a major international and national role in monitoring and measuring ecological changes, particularly those associated with climate change. If climate change occurs, the large size of the park, its range of ecosystems, and its links with other natural areas will give species and communities the chance to adapt to this new situation.

Kosciuszko National Park is a place where all people can find solitude and the opportunity for spiritual experience, and a sense of remoteness in the natural setting. In the park, people can maximise the value that they gain from their park experiences without harming the attributes of the park.

The park conserves and demonstrates the setting for the sequence of its past human life and habitation, and the park's cultural heritage significance lies in physical evidence as well as in stories and traditions associated with the park. Many cultural heritage themes have extant evidence in the park.

## 5 Significance related to the individual values and themes of the park

### Geology

The park's geological significance includes features such as the Ordovician to Lower Devonian rocks that form part of the Lachlan Fold Belt; the dissection resulting from the Tertiary uplift, which has produced spectacular scenery (notably the mile-high drop from the summits of the Main Range to the Geehi Valley); evidence of the great climatic changes in the Pleistocene that produced glacial features (e.g. cirques, terminal and lateral moraines, lakes, erratics and ice-scratched surfaces) and extensive periglacial features and evidence; and Holocene features of the park (sediments and peats) that have given valuable information on vegetation changes associated with postglacial warming.

### Soils

The park's significance for soils relates to the great soil groups represented, particularly alpine humus soils, and the ecological services provided by the soils.

### Karst

The park's significance for karst relates to hydrological and geomorphological values, habitat for endangered species, and the cultural heritage of the past use of these sites.

### Aquatic ecosystems

The park's significance for aquatic ecosystems includes four small natural lakes (Albina, Blue, Club and Cootapatamba) that are the only lakes on the Australian mainland that were formed by glacial action. These are also the highest lakes (1890–2070 m) in Australia. There are significant lakes and subterranean water bodies associated with karst. Large rivers above altitudes of 900 m are considered an endangered habitat in the Snowy Mountains region. Undiverted, 'wild' river sections upstream of dams are the Upper Murray River to Murray Gates, Thredbo River down to the village, Goodradigbee River to Brindabella Station and Yarrangobilly River.

### Flora

The park's significance for flora includes the vegetation of the alpine and subalpine zones and the Lower Snowy River area, and the adaptation and dominance of a single genus (*Eucalyptus*) over the entire elevational range from the coast to the subalpine tree line — the only occurrence of this in the world. The alpine flora is of world interest as it is a mix of species of autochthonous (local) species and species of peregrine origins (from other continents). The significance lies in the many commonalities of the floristic groups and the affinities and differences between genera and species, compared with other Australasian alpine areas.

### Fauna

The parks significance for fauna includes the extent of its biological diversity. Terrestrial habitats and fauna of the alpine and subalpine zone (15% of area) support populations of 100 native species including endemic or alpine specialists: one mammal, four frogs, four reptiles and a range of invertebrates (e.g. 10 species of Orthoptera and 10 species of Megascolecid earthworms). The park provides the opportunity to study global declines in amphibians, particularly at high altitude, and restoration of the predator hierarchy in large conservation reserves.

The fauna of the alpine environment, and the alpine environment itself, is generally acknowledged as among the most vulnerable in Australia to future climate change caused by the enhanced greenhouse effect.

### **Natural landscapes**

The natural landscapes of the park underpin values related to wilderness, ecosystem processes at landscape scale, aesthetic values and cultural heritage.

### **Wilderness**

There are nine wilderness areas recognised under the NSW wilderness legislation, which constitute 346,257 hectares (50.15%) of the park. These wilderness areas are significant at national and international levels as part of the Australian Alps wilderness.

### **Ecosystem processes**

Ecosystem processes that are significant at the landscape scale include the natural fire regime on which many plant communities and species depend; the hydrological regime that is related to macroclimate and microclimate variations; soil formation; and the extreme seasonal variations including processes of snow fall, accumulation and melt, which are particularly critical in maintaining many of the most significant biological and aesthetic values of the park. The park contains the largest contiguous area of snow country in Australia, making it of national significance for this phenomenon.

### **Aesthetic**

Aesthetic values are found in the natural scenery of Kosciusko National Park; both its wildflower displays and its snow-garnished slopes and forests, exhibit aesthetic characteristics highly valued by a large proportion of the population. There is much steep country, sometimes juxtaposed to water, within the Kosciusko National Park, but the natural aesthetic qualities that make it an exceptionally beautiful place for many people lie in the pastel pastiche of eucalypts, cypress pines, scleromorphic shrubs and tussock grasses that clothe gently undulating hills and flat-floored valleys, and the mosaic brightness of flowering daisies on the rounded slopes within the alpine plateau.

### **Cultural heritage**

The cultural heritage of the park is found in many themes: Aboriginal use, pastoral, Kosciusko Huts, mining, water harvesting, conservation, and recreation.

### **Aboriginal use**

There is new archaeological evidence for Aboriginal use of the alpine country, which, as well as being significant to Aboriginal people, provides important information for non-Aboriginal Australians interested in the story of human adaptation to this ancient landscape. Further work on significance to Aboriginal people is being done, but was not available at the time of this report. There is evidence of a long history of Aboriginal occupation in the alpine areas of Australia, demonstrating successful adaptation to environments unique to Australia and having potential to provide important new information about the length and nature of Aboriginal occupation.

### **Pastoral use**

The pastoral theme, as it is expressed in the alps in general and Kosciuszko National Park in particular, represents montane pastoralism, a unique high country way of life representing a period of economic and social development which is of historic significance at a national level. Currango, built in 1850 and spanning 150 years of European occupation, is of national historic importance, being the largest and most intact example of pastoral settlement above the snowline. The whole Kosciuszko landscape has been affected by the pastoral phase and there is significant evidence of the pastoral era's impact on the landscape. Much of this evidence constitutes damage to the pre-European environment left by the Aborigines, but it also has significant historic value. The pastoral theme as expressed in Kosciusko is also of national aesthetic significance, with evidence of vernacular architecture and design. The various bush skills, traditional crafts and construction methods, which are a response to the unique environment, are important for the continuation of traditional skills and for research into them.

### **Kosciusko Huts**

The Kosciusko Huts in their landscape setting, including the group of pastoral huts, probably comprise the largest group of different types of huts, designed for the widest range of purposes that exist in a comparative area anywhere in Australia. The complex of huts, ruins and huts sites have national historic and social significance.

### **Mining**

The mining theme of the park relates to the adaptations in Australian the living and working conditions of mining practise to cope with life in a remote and rugged Australian environment. These adaptations include the Kiandra landscape, a gold rush site of national historic importance; there are additional outstanding sites at Grey Mare and Tin Mine.

## **Water harvesting**

The water harvesting theme is illustrated at the Kiandra goldfield, and is also related to the Snowy Mountains Hydro-electric Scheme, a large part of which is within Kosciuszko National Park. The Snowy Scheme is the largest engineering scheme ever undertaken in Australia, with national significance as an engineering feat, a symbol of Australian achievement and a basis for Australia's multicultural society.

## **Conservation**

The conservation theme relates to the effort that created Kosciuszko National Park, which was of historic importance in the development of the conservation movement at a national level. Its subsequent development as a major national park has had an important national influence on the development of park management policies and procedures in Australia.

## **Recreation**

The recreation theme of cultural heritage has a number of aspects of significance, including the Yarrangobilly Caves complex and Caves House and associated developments, which have historic and aesthetic significance as a component of the complex of cave sites developed for tourism as part of an important national social movement. The Kiandra area has significance as the place where downhill skiing was first practised as a recreation in Australia. The ski fields and ski resorts have elements of significance for historic, aesthetic and social reasons, for the important social movement they reflect, and because of elements of the architecture and layout.

## **Tourism and recreation**

The tourism and recreational value of Kosciuszko National Park has been assessed as significant at a national level because of the natural scenic qualities of the park. These include its mountainous landscapes, its size and the presence of snow, and the exceptional variation in diversity of natural settings for recreational opportunities, including education opportunities. The park is especially valuable for its large areas of natural lands, which offer opportunities for solitude and self-reliant recreation.

Kosciuszko National Park and the Victorian Alps are the only two snowfields tourism destinations in mainland Australia. The domestic tourism significance of the park lies not in the total number of visitors who are attracted to it, but in the uniqueness of the tourism experience. It is one of the few areas of Australia where people are able to experience the unique climate, scenery, history and danger of an alpine destination.

## **Uses and service functions**

### **Significant use values of the park include water supply for irrigation and agriculture, and power generation.**

The soils and catchments of Kosciuszko National Park provide vital 'service functions' including water yield and protection of the park's catchments; they supply clean water for domestic use, industrial uses, irrigation, hydroelectric power and a wide range of recreational activities.

The contribution of the waters from the Snowy River to the value of irrigated agriculture in the Murray-Darling Basin is significant. Through Snowy Hydro Ltd, the Snowy River contributes at least 7% (\$245 million) to the annual value of irrigated production in the Murray-Darling Basin. It was estimated that in 1992, the Murray-Darling Basin contained about 70% of Australia's irrigated crops and pastures and accounted for approximately 40% of Australia's total gross value of agricultural production.

Power generation is a use of the park's resources. The Snowy Mountains Hydro-electric Scheme has a generation capacity of 3756 megawatts, and can provide up to 11% of the total power requirements of the mainland of eastern Australia. It is an important peak load and emergency supplier because of the speed with which it can respond to sudden power demands. From a national perspective it is important as a power generator using a renewable resource. The actual contribution through its participation in the National Electricity Market is nationally significant; its physical location within the electricity grid provides support to both northern and southern major centres of electricity demand.

The recreation use values are significant to the region's economy; it has been estimated that the value of recreation in the NSW part of the Australian Alps is in the order of \$5 billion per year.





# Chapter 19

## pressures

Lorraine Cairnes

### Introduction

Many pressures have the potential to threaten the significant values of the park; however, there is now better knowledge about the pressures and the state of the park's values than there was at the time of preparing previous management plans.

The purpose of reserving land as a national park in New South Wales (NSW) is..

*'to identify, protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena that provide opportunities for public appreciation and inspiration and sustainable visitor use and enjoyment ...'*<sup>1</sup>

The Independent Scientific Committee (ISC) recognised that management principles for national parks in NSW are becoming more flexible, in common with those for protected areas elsewhere. Also, protected areas are tending to become more inclusive than exclusive in the activities that may occur within them. However, some of the uses are now far removed from traditional conservation priorities and original purposes of reservation, and these new uses bring new pressures, create new demands on managers and may compromise some values.<sup>1</sup>

Pressures vary in scale and intensity — they range from global pressures such as climate change to local pressures such as use of a particular track. Pressures may arise from indirect or underlying societal and economic processes or from activities that act directly on ecosystems (e.g. land clearing or pollution). Underlying societal pressures that lead to more people wishing to visit the park can translate into more specific, direct pressures; for example, demand for the construction of more tourism and recreation facilities in turn increases pressure on the park's land, water and ecosystem resources. Where there is pressure on a value, that value may be degraded unless the pressure is removed, reduced, or appropriately managed to mitigate its effects. There may be several different pressures acting on a value at any given time, and these pressures may interact, multiplying the end effect. Where significant values are degraded by more than one pressure, managing individual pressures alone may not reverse the degradation.

It is important to differentiate between pressures and their impacts. For example, a pressure might be 'increasing visitor numbers in wilderness areas' and its outcome or impact might be 'loss of experience of remoteness'.

The pressures discussed in this section are those identified by ISC members that relate to the park's values. Some pressures, such as climate change or land use change outside the park's boundaries, are clearly beyond the realm of the plan of management to control; nevertheless, the potential consequences of such pressures need to be understood.

Some of the pressures identified by the ISC would not have been important issues a decade ago, and it is inevitable that more pressures and impacts will be identified as time goes by.

This chapter considers the pressures and potential impacts caused by climate change, regional land use, development, visitor use and park management. It also looks at the way in which certain pressures may affect ecological processes and landscapes, at the cumulative effects of pressures and at values as pressures.

*"Pressures vary in scale and intensity - they range from global pressures such as climate change to local pressures such as use of a particular track."*

<sup>1</sup> National Parks and Wildlife Act 1974 (NSW), S.32E(1)

## Pressures and potential impacts

### Climate change

Climate change is an important potential pressure that the ISC discussed, but was unable to address fully in the short timeframe under which it operated. The United Nations' Intergovernmental Panel on Climate Change (IPCC) has issued several reports over the past years, and refinements of its climate model have consistently increased the projected effects of global warming and the potential for changed climatic conditions within a few human generations. In addressing the World Summit on Sustainable Development in 2002, Rajendra Pachauri, IPCC Chairman, said:

*It is now well accepted that under the most optimistic Kyoto outcomes a significant level of climate change is inevitable.*

Models have suggested that there will be warming of the atmosphere under an enhanced greenhouse effect and that this results, at least in part, from human activities. Although the inevitability of climate change is now recognised, the degree and direction of regional change is uncertain. Global warming may have profound effects on regional and local climates, but these will not necessarily be limited to changes in the minimum, maximum or mean temperatures. Effects may include increases or decreases in precipitation amounts, intensity, distribution or phase (rain, snow, hail, etc). Changes might also be expected in the frequency and magnitude of floods, frosts and droughts.

### Climate change and Kosciuszko National Park

Current thinking is that the climate and weather regime of Kosciuszko National Park will change, although the magnitude and time frames of the changes remain speculative. Changes will not be confined to changes in snow cover and alpine habitat, but will include increased temperature, reduced rainfall and higher UV levels. It is clear that global warming threatens some of the park's alpine species and the ski industry; less obvious are the potential impacts on all areas and ecosystems of the park. Climate change is likely to affect fauna (particularly geographically confined species such as the mountain pigmy possum), vegetation and endemic plant species (particularly those restricted to alpine habitats or dependent on specific rock types or soils that occur with limited spatial or altitudinal distribution), geomorphic processes, tourism and recreational activities, fire regimes, and road maintenance.

Specific pressures related to climate change that will impact on the values of the park were identified by the ISC; they include pressure on snow, habitat and species composition.

#### **Pressure of climate change on snow**

- Snow depth and cover will change, with associated impacts on soil process, distribution of flora and fauna and hydrologic regimes.
- Decreasing snow depth and cover as a result of global warming may lead to pressure for even more snow-making infrastructure. Snow manipulation is known to have a range of negative effects on flora, fauna, soil process and hydrology. Reduced snow cover and duration may also change the style of winter tourism and/or reduce its level and associated revenue.
- Extreme winter weather may reduce quality of visitor experiences and safety of travel.

#### **Pressure of climate change on habitat**

- Habitat change as a result of global warming could lead to loss of already endangered alpine and subalpine species such as the Mountain Pygmy Possum. Species extinction is a real risk.
- Habitat and vegetation changes as a result of global warming may have a negative effect on visitor experiences and reduce their options for experiencing the natural environment.

#### **Pressure of climate change on species composition**

- Increase in UV radiation as a result of ozone layer depletion could be responsible for declines in range and population of alpine frog species.
- Global warming is expected to produce changes in alpine flora species composition and increase the likelihood that invasive species will impact on the integrity of native vegetation. Global warming may also change the position of the tree lines over a 100-year plus period, with inverted tree lines expanding into frost hollows and the alpine tree line ascending.

### Research into the implications of climate change

The Australian Greenhouse Office, Cooperative Research Centre for Sustainable Tourism, and NSW National Parks and Wildlife Service have recently commissioned new studies to review the implications of climate change for the upland environments of southeastern Australia. CSIRO Atmospheric Research is further refining climate models for southeastern Australia.

In most climate change scenarios, large protected areas such as Kosciuszko National Park will become increasingly important as biodiversity refugia. Thus, the park should be considered a laboratory for evaluating climate change.

Clearly, the National Parks and Wildlife Service (NPWS) is not in a position to markedly influence the international or national approaches to the potential or actual progress of climatic change. It should, however, be in a position to:

- establish and maintain long-term research projects and benchmarks, as well as an environment where other anthropogenic variables can be held constant;
- establish a management regime that allows the NPWS to be responsive to adaptations that will be required to ameliorate (where possible) adverse changes to values, particularly biodiversity assets; and
- use climate scenarios in planning such aspects as species and plant community recovery, or development or decommissioning of facilities (e.g. ski resorts).

### Regional land use

The regional setting of the park brings pressures, as intensified land use and new developments (often stimulated by the existence of the park) isolate the park as a natural area, and the ecological edge effects on the boundary areas of the park intensify. Table 19.1 summarises the pressures and potential impacts related to regional land use.

**Table 19.1 Pressures and potential impacts due to regional land use**

Pressure	Impact
Demands for managing fire in the regional context as a protection for neighbouring properties that are not consistent with fire as an ecological process essential to the park's natural values	Natural ecological processes within the park are disrupted
Regional land clearing	Severing of linkages to other parts of the Australian alps and loss of continuity of the alps wilderness areas; loss of habitat linkages
Increase in number of residents close to the park who use it as their primary recreation destination and commercial businesses that use the park as their primary business focus	Additional visitor impacts and potential visual and aural effects into the park

### Development

#### Key points

**Expansion of development within the park for increased access and tourism infrastructure, both for summer and winter facilities and services (motivated mainly by commercial reasons) will increase pressure on the park's values. There may also be commercial pressure to expand snowfields resort areas. Management of these pressures needs to give priority to conservation of the core values of the park, on which sustainable tourism and high quality visitor experience depends.**

As visitor numbers grow, it is predicted that there will be increased pressure for more access, further tourism infrastructure within the park (both for summer and winter visitor facilities and services) and commercial pressure to expand resort areas. In addition to infrastructure for tourism and recreation, there may be pressure from other organisations (e.g. Snowy Hydro, Transgrid, Roads and Traffic Authority) for further development in the park.

The ISC has identified pressures on natural and cultural heritage, social, tourist and recreational values from increased development. These are shown in Table 19.2. More detailed explanations are given in the chapters concerning individual values.

**Table 19.2 Pressures and potential impacts due to increased development**

<b>Pressure</b>	<b>Impact</b>
<b>Natural values</b>	
Building, road construction, tracks, tunnels, bridges smoothing of ski runs	Damage to periglacial and other geological features and flora and fauna habitats
Clearing and infrastructure for ski runs	Destruction of tree lines and other native vegetation and fauna habitat
Demand for increased resort capacity or expansion of area of resort leases to accommodate users, requiring additional land and water resources	Direct impact on natural values of the park (eg landscape, subalpine vegetation, old- aged mature snow gums and aquatic ecosystems); and impacts on some natural values of the park (eg subalpine vegetation, potential introduction of pathogens and weeds, nutrients in aquatic ecosystems, increased feral animal populations, etc)
Inappropriate development in karst areas	Degradation of the values associated with karst
Damage to soil and vegetation by development	Loss of scenic amenity of geological features, and flora and fauna habitats
Demand for more visitor facilities and services within the park, and additional infrastructure associated with public safety	New development using park areas that are currently in a natural state.
<b>Social values</b>	
Developments within or outside park	Impingement on visual and aural fields causes loss of feelings of remoteness in wilderness and other areas of park
Increased development (especially holiday homes) around margins of park	Loss of recreational opportunities; threat of fire
Demand for further (inappropriate) facility development to meet rising visitor levels, resulting in new development costs and high maintenance cost	Loss of low cost accommodation and associated recreation opportunities for park visitors who cannot afford expensive accommodation
<b>Tourism and recreation values</b>	
Developments within or outside the park that are directly visible, or cause noise or light pollution in semi-remote and remote areas	Loss of experience of remoteness and reduced quality of visitor experience of area as a natural environment
Demand for further or inappropriate development to meet rising visitor levels	Reduced quality of visitor experience of natural environments
Expanded development outside the park in adjacent shires, creating additional source of increased numbers of visitors using the park	Direct impacts on natural values and decreased opportunities to experience natural environment and isolation
Increased visitation attracted to the region around the park	Visitors may impact on local communities; the exact nature of pressures should be investigated as part of study proposed to better understand local community groups and values, and it may be positive or negative
Structural change or innovations in visitor and or infrastructure provided (eg, as experienced with snowboarding and mountain bike riding) with consequent new demands for expanded visitor facilities and services	New impacts on natural and recreational assets

## Visitor use

Increased numbers of visitors have direct impacts. The ISC has identified pressures from visitor use on natural and cultural heritage, social values, and tourist and recreational values. These are shown in Table 19.3. More detailed explanations are given in the chapters concerning individual values.

### Key points

**Increasing visitor use has widespread implications for loss or degradation of the park's values. In particular, the increase in visitors in the alpine and subalpine areas in summer is seen by the ISC as the highest priority pressure that needs to be addressed by management of the park.**

**Table 19.3 Pressures and potential impacts due to visitor use**

Pressure	Impact
<b>Natural values</b>	
Increasing annual visitor numbers	Reduced capacity of the natural environment to assimilate changes or to recover
Increasing visitor use in wilderness areas	Loss of diversity in visitor opportunities that depend on relatively low levels of visitation; formation of pads, tracks and degraded campsites, increased spread of feral animals, plants and pathogens, increased human waste etc. Soil compaction, soil erosion etc
Increased summer tourism in the alpine and subalpine areas	Increased number of tracks, soil compaction and soil erosion, faecal contamination, demand for water, loss of aesthetic amenity and disturbance, meaning an increase in weeds and pest animals
Increased visitation in karst areas	Degrading cave and surrounding environments at Yarrangobilly and Cooleman Plains, and the Indi area (which will require liaison with Victorian agencies)
Increased use of ski resort areas in winter and summer	Damage caused by new infrastructure/facilities including increase in tracks, soil compaction, faecal contamination, demand for water, loss of aesthetic amenity, disturbance- influenced increase in weeds & feral animals, soil compaction and erosion
Visitors causing increase in tracks, soil compaction, faecal contamination and demand for water	Damage to all natural areas particularly subalpine ecosystems and frost hollows; loss of aesthetic amenity, disturbance-influenced increase in weeds and feral animals
<b>Tourism and recreation values</b>	
Increasing visitor use in wilderness areas	Loss of diversity in visitor opportunities that depend on relatively low levels of visitation; formation of pads, tracks and degraded campsites
Direct visitor impacts on water quality in high use areas	Health risks for visitors with increase in the occurrence and distribution of human pathogens such as <i>Giardia</i> and <i>Escherichia coli</i>
Visitor damage to recreation sites, the cycle of site hardening, and overuse of existing facilities and lack of maintenance	Decreased quality of visitors' experience of the natural environment; declining quality of visitor experiences; reduction in recreation use value for particular groups of visitors
Overcrowding or visitor facilities and services, especially near wilderness areas	Reduction in recreation values for particular visitor groups; loss of diversity of visitor opportunities that depend on relatively low densities of visitors; conflicts between visitor activities and competing demands for access to the same area for incompatible recreation impact on visitor experience
<b>Cultural heritage</b>	
Damage to cultural heritage items by visitors	Gradual attrition of Aboriginal and other cultural landscape features and structures.

## Management

### Key points

The park will need to institute a program of continuous development and retention of appropriate and adequate skills, knowledge, competencies and resources to manage the park's values; otherwise the process of management will itself be a pressure on the park's identified values.

Staff numbers, resources and skills need to be adequate to manage the identified values; however, the high demands of public expectations and administrative requirements are making inroads into the resources available for field management of the park. The loss of Kosciuszko National Park 'corporate knowledge' cannot be ignored as a factor that will affect the conservation of the park's values. Knowledge and expertise are being lost due to both reducing numbers of personnel and changes in employment patterns (e.g. the introduction of short-term employment opportunities).

Pressures identified by the ISC related to aspects of management of the park are shown in Table 19.4.

**Table 19.4 Pressures and potential impacts due to management**

Pressure	Impact
<b>Management activities</b>	
Activities such as weed spraying in karst areas, uncoordinated feral animal control, inappropriate fire regimes and road de-icing	Direct impacts on natural values
<b>Management knowledge and skills</b>	
Insufficient park management competencies across the agency in social and recreational aspects of management, and economic and concessions management; limited recognition of the full significance of natural, scientific and cultural values of the park in management	Degradation of values related to natural and cultural heritage; diminished recreational and social experience
Insufficient monitoring and research conducted by or for NPWS in relation to the natural and cultural values of the park	Degradation of values through inappropriate conservation practice
<b>Management roles and resources</b>	
Inadequate park management budget for the tasks of managing the values	Service's restricted ability to manage values and pressures
Expectation that NPWS should raise fees through tourism development to help meet costs of management	Diverts effort and causes conflict between the organisation's roles in values conservation

### Pressures on ecological processes

#### Key points

Pressures caused by disturbance of catchments, the managed fire regime, and by introduced plant and animal species are causing substantial impacts on the park's biodiversity and the natural ecological communities by disturbance of the ecological processes on which their conservation depends.

Pressures identified by the ISC on the natural ecological processes of the park include those related to catchment and hydrological processes, introduced plants and animals, and the fire regime. Each of these is a vast issue, for which the assessment carried out here has only been able to provide indicative comment.

**Table 19.5 Pressures and potential impacts on ecological processes and landscapes**

Pressure	Impact
<b>Catchment and hydrological processes</b>	
Damming/diversion of rivers and streams	Vegetation invading riverbeds, major changes to aquatic ecosystems in many rivers, and macroinvertebrate communities have changed from lotic to lentic in many areas where flow, habitat and water quality have changed those typical of a mountain stream to those typical of a lake or lowland stream. Ecological integrity has been greatly affected by the Scheme, both directly (through the changes to the natural flow regime) and indirectly (through the impacts of changes to hydrology, geomorphology and water quality).
Disturbance to catchments	Increased nutrient levels and sedimentation leading to change in species composition in the park's lakes and streams.
<b>Introduced species</b>	
Weed invasion	Loss of natural character leading to decrease in visitor experience of natural environment; increase in disease, fungi and pathogens that affect native species; displacement of native riparian vegetation by blackberries and willows; decline and potential loss of native species; changes in vegetation form and composition; alteration to animal behaviour including feeding, breeding, etc
Trampling and grazing by feral horses, pigs, deer, hares and rabbits	Changes in vegetation species composition and abundance for karst areas, riparian tracts, in lower subalpine areas and along roadsides in higher areas as a result of feral horses and rabbits; in frost hollows as a result of feral horse and pig disturbance. A general decline in habitats (at variance from the 'natural' condition) and may destroy some components, such as bogs, if left unchecked.
Introduced predators and their management	Various impacts (eg in alpine and subalpine areas, pigs and fox predation on broad-toothed rat; fox and cat predation on mountain pygmy possum), complicated by interrelationships between introduced species (dingoes, dogs, foxes, cats) and their impact on control programs aimed at one of the species
Introduced fish	Change in invertebrate species composition and elimination of native galaxiids in streams and lakes due to trout.
<b>Fire</b>	
Inappropriate fire management regime and fire suppression activities(eg use of heavy earth moving plant, back burning, prescribed burning, cumulative effects of imposed fire regimes)	Numerous and widespread impacts including fire suppression with heavy earth-moving plant damaging Pleistocene and Holocene landscapes, subalpine vegetation; inappropriate prescribed burning can kill snow gum stands, maintain understorey species composition and structure in a primary successional stage, enhance the spread of weed species; autumn prescribed burning may leave catchments bare, increasing turbidity and sediment loads in streams and rivers; wildfire suppression operations, particularly backburning, can destroy cultural sites.
Social and political misperception of appropriate solutions to fire hazard problems.	Reluctance to engage in ecological burns which are necessary to maintain or improve naturalness.
High fire intensities in karst areas	The presence of forest and understorey and steep slopes may result in high fire intensities and some destruction of surface karst features and some sediment transfer into caves and dolines
Fire regimes that cause the death of older eucalypts	Threat to the transition to old growth, disrupt large continuous eucalyptus sequences and prevent genetic interchange between separated communities.

There are major pressures on the ecological integrity of the park caused by catchment and hydrological pressures, invasive introduced species and inappropriate fire regimes that interrupt the natural ecological processes. Some of these pressures need the understanding of the community and there is need for a program that builds the community's capacity through involvement and understanding of the issues.

### **Cumulative effects of pressures**

The ISC found that many of the park's identified values are subject to a number of pressures, and the cumulative, and possibly synergistic, effect of these needs to be considered in management. For example, the mountain pygmy-possum faces habitat loss from climate change and the demands of visitor use (ski resort development), and direct predation by foxes.



## Values as pressures

Some pressures have been identified that might also be related to or part of some values of the park. Examples include the natural fire regime which is a value of the park as a natural ecological process, but the fire regime that is imposed in the park to achieve other management objectives can be a pressure on the natural values of the ecological communities.

## Findings — pressures

The ISC makes the following findings in respect of pressures on the park's identified values.

### **General**

- The park's natural heritage values underpin the majority of its other values, thus the pressures on its ecosystems and fundamental ecological processes such as increased development, fire management and introduced species have the greatest potential to affect the values of the park. The impacts increase in severity when these pressures are overlaid with increase in visitor use and intensification of regional development.
- While all parts of the park are affected by individual or cumulative pressures, the alpine and subalpine areas are the most vulnerable, and increased pressures from tourism and recreation activities and facilities are of particular concern.
- The pressures on the park's values demand adequate capacity within the NPWS and the understanding and support of the community to effectively manage the full range of the park's values.

### **Climate change**

- The Kosciuszko National Park Plan of Management needs to recognise the implications of the climate change as a pressure on the park and incorporate a planned management response based on conservation of the park's values.

### **Development**

- Expansion of development within the park for increased access and tourism infrastructure, both for summer and winter facilities and services (motivated mainly by commercial reasons) will increase pressure on the park's values. Management of these pressures needs to give priority to conservation of the core values of the park, on which sustainable tourism and high quality visitor experience depends.

### **Visitor use**

- Increasing visitor use has widespread implications as the direct or indirect cause of loss or degradation of the park's values. In particular, the increase in visitors in the alpine and subalpine areas in summer is seen by the ISC as the highest priority pressure that needs to be addressed and mitigated by park management.

### **Park management**

- The park will need to institute a program of continuous development and retention of appropriate and adequate skills, knowledge, competencies and resources to manage the park's values; otherwise the process of management will itself become a pressure on the park's identified values.

### **Pressures on ecological processes**

- Pressures caused by disturbance of catchments, the managed fire regime, and by introduced plant and animal species are causing substantial impacts on the park's biodiversity and the natural ecological communities by disturbance of the ecological processes on which their conservation depends.
- There are major pressures on the ecological integrity of the park caused by catchment and hydrological pressures, invasive introduced species and inappropriate fire regimes that interrupt the natural ecological processes. Some of these pressures need the understanding of the community and there is need for a program that builds the community's capacity through involvement and understanding of the issues.

### **Regional land use**

- The regional setting of the park brings pressures as intensified land use and new developments (stimulated by the existence of the park itself) potentially isolate the park as a natural area, and create edge impacts on the boundary areas of the park. These pressures require an inclusive regional management approach by the park's management rather than an introspective one.

### **Cumulative effects of pressures**

- The cumulative effect of pressures on the park's values needs to be considered in management; most values are experiencing more than one pressure.

## Values as pressures

- Some pressures have been identified that might also be related to or part of other values of the park; these will need careful consideration and management.

# Chapter 20

# condition

Lorraine Cairnes

## Introduction

The terms of reference required the Independent Scientific Committee (ISC) to identify, describe and report on the condition and trend in condition of the natural, cultural, recreational, economic and social values of Kosciuszko National Park. This chapter brings together the condition evaluations for all of the park's values.

The concept of 'condition' requires assessment of the state of the value, with reference to an appropriate baseline, such as its state at some previous time, or a defined desirable state. For some values, condition can be expressed with reference to a desired state; for example, for a threatened species of plant or animal, the desired state might be *restoration to a sustainable population*, and the trend in condition might be *declining in numbers*. It might also be appropriate to describe condition by reference to the state of that value at some previous time, used as a baseline. This might be 1788 (the year of first permanent white settlement in Australia), which was used as a reference point by some authors.

Comments on condition are included in the individual reports on earth sciences, soils, aquatic ecosystems, flora, fauna, fire regime, landscape (wilderness, aesthetics), cultural heritage, social values, recreation and economic use values. The remainder of this chapter summarises the information on the condition and trend in condition of the values of Kosciuszko National Park.

## Earth science

### Ordovician

#### *Condition and trend in condition*

Ordovician rocks are robust and in their natural condition. These rocks are a permanent feature of the landscape and, assuming quarrying and mining continue to be banned, no change in condition is expected. There may be some reduction in their scenic value if additional buildings and roads are created. To maintain their condition, no special management is required other than retention of the existing ban on prospecting, mining or unlicensed collection of samples.

### Tertiary

#### *Condition and trend in condition*

The major landforms resulting from the geomorphic history of the Tertiary are generally robust, as is the Tertiary basalt. The surviving remnants of the Tertiary stream deposits are liable to loss by erosion. Evidence of deep weathering was clear in fresh road cuts made when the Snowy Scheme was under construction, but in many places rainwash, slumping and vegetation now obscure it.

While the scenery and the solid rocks will survive unchanged in terms of human lifetimes, there will probably be a gradual deterioration in the accessibility and visibility of rock exposures and mining evidence, as vegetation continues to encroach and explanatory notices become illegible. However, reasonable maintenance should maintain the surviving features indefinitely. Ironically, further loss of visible evidence of deep weathering in road cuts seems inevitable in view of soil conservation measures.

*“The concept of ‘condition’ requires assessment of the state of the value, with reference to an appropriate baseline, such as its state at some previous time, or a defined desirable state.”*

Natural Values

Cultural Values

Economic Values

Social Values

Recreational Values

## Pleistocene

### *Condition and trend in condition*

The glacial features are generally clearly visible, although the older ones have naturally lost much of their pristine form through natural erosion. Glacial erratics have become more difficult to find since the termination of grazing has encouraged vegetation to recolonise bare areas. The periglacial deposits are best exposed in road cuttings and quarries where they gradually become less identifiable because of rain wash, growth of vegetation and soil conservation measures. A road has cut through the block stream at Ravine.

Continued obscuring of relevant exposures through vegetation growth and soil conservation measures is to be expected. The quarry showing permafrost evidence near Mount Kosciuszko mentioned above will be concealed for reasons of conservation.

## Holocene

### *Condition*

Over most of the park, Holocene processes and deposits are generally in reasonably good condition, but there are limited areas of concern such as the heavily impacted summit of Mount Kosciuszko and much of the ski concessions. It has been feared that 'snow farming' in ski concessions could lead to changes to the natural surface and processes. While this may be true for vegetation and soil compaction, the depths of snow involved are substantially less than would be required for full nivation to occur. Active stream bank erosion below Blue Lake is cutting away sediments with potential value in dating.

In the last century and a half stock grazing, road construction, mining and engineering works have had major impacts on the area of the park. The completion of the Snowy Mountains Hydro-electric Scheme, soil conservation efforts and walkway construction have now helped to re-establish more natural, gradual Holocene processes. On the other hand, the increasing tourism in the park and the growth of skiing have inevitably added new pressures. The effects of the 2003 fires and the associated fire-fighting measures such as bulldozing access tracks will also adversely affect the condition for years to come. In future, nivation may be reduced if snowfall decreases as a result of climatic warming. However, no significant change in snow fall is yet apparent even though there has been some warming.

## Soils

### *Condition and trend in condition*

Surveys in the 1940s and 1950s<sup>1</sup> documented widespread soil erosion, attributed to the destruction of soil cover by fires and grazing. Improved fire management and progressive removal of grazing from 1944 to 1958 has been followed by natural stabilisation of most soils in the park, associated with an increase in the soil surface cover on a catchment scale to between 70–100% in amounts of at least 10 tonnes per hectare.

Associated soil measurements in some subalpine areas over a 20-year period show reduction in bulk density (ie increased porosity and infiltration of moisture) and increase in soil organic matter. In general, the recovery trend of the last 40–50 years has reached a plateau of relative stability, but has not always reached the former original condition. Where sufficient organomineral topsoil remained, near original conditions have been achieved, but not where topsoil loss advanced to residual stony erosion pavement stage. This stage will persist for a long time, probably centuries; fortunately, shrub regeneration on these stony sites is stabilising most of them. In the alpine zone, these stone pavements have reached stability as 'erosion' fieldmarks.

On the Kosciuszko Main Range, and Gungartan and Bulls Peaks area to the north, some of these erosion 'hot spots' involved losses of up to half a metre of organomineral topsoil over a total area of about 1500 hectares. Soil losses from the Main Range between Mount Kosciuszko and Mount Twynam were recorded by the Soil Conservation Service of New South Wales (NSW) to be in the order of 1.2 million tonnes. Soil reclamation work by the Soil Conservation Service between 1954 and 1980 eventually stabilised most sites, but erosion problems requiring attention still remain there.

Incising and eroding peats and other groundwater soils require attention. Stream bank and stream bed profiles in subalpine valleys show continuing erosion, even though the initial disturbing agents are no longer present. Where there has been only minor incision, a slow upward trend is apparent.

Localised soil damage has occurred in many other areas, such as that arising from former engineering operations of Snowy Mountains Hydro-electric Authority; along transmission lines, roads and management tracks, four-wheel drive tracks, horse riding and walking tracks; and in development sites such as resort areas. Much of the former damage has been repaired, but continuous maintenance work will be required.<sup>1</sup>

On the areas where the ground is now exposed after the 2003 fire, pre-existing erosion scars are now clearly visible, without indication of significant soil restoration; in other words, the post-1950s stabilisation of these soils has arrested the continuing trend towards further erosion but has not improved the damaged condition. On an extensive catchment scale, the only practicable means of controlling soil erosion is through management of the type and amount of ground cover.

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<sup>1</sup> *Surveys of the snow leases and permissive occupancies in Kosciusko State Park, carried out by the Soil Conservation Service of NSW of the snow leases and permissive occupancies in Kosciusko State Park*

## **Aquatic ecosystems**

### **Lakes**

Physicochemical measurements indicate that water in all the alpine lakes is very fresh, with extremely low salinities, slightly acid pH and very low levels of nutrients. No other lakes in mainland Australia have lower salinities and few glacial lakes anywhere are as dilute. Salinity records taken in the late 1960s and early 1980s in Lake Cootapatamba are virtually identical. The nutrient levels in these lakes are low.

The only section of the aquatic biota to have been examined in detail in these lakes is the invertebrate community. Approximately 8–11 species of benthic invertebrates have been identified from deep (0.5–26 m) regions of these lakes and 15–26 species from samples taken in the shallow littoral region. Eight zooplankton species were recorded over two ice-free seasons in Lake Cootapatamba.

The invertebrates in these lakes are typically found in other upland regions in southeastern Australia, and species richness is comparable to that of highland lakes in Tasmania. Species richness is higher in lowland lakes and in many northern hemisphere lakes with similar rocky shorelines. It is thought that this relative impoverishment is a result of the small size of these lakes.

No indication of seasonal variation in the benthic fauna can be given because sampling has only occurred in summer. Therefore it is not possible to come to any specific conclusions about temporal trends in the invertebrate fauna of these lakes.

Given the nature of the habitat and the current very low concentrations of nutrients and ions, it seems unlikely that marked changes in physicochemical conditions have occurred since European settlement. As both the benthic and planktonic communities would be sensitive to changes in these conditions, it is reasonable to suggest that neither of these assemblages has changed greatly in the last 200 years as a result of changes in water quality. Random changes, however, in species composition cannot be excluded.

### **Streams and rivers**

An expert panel commissioned in 1998 to assess the environmental flows of rivers affected by the Snowy Mountains Scheme concluded that the Snowy Mountains Scheme has affected the hydrological, geomorphological and ecological condition of many streams in the Snowy Mountains. These impacts are particularly severe in the Tumut, Eucumbene, Snowy and Gungahlin Rivers and some of the reaches of the Tooma and Geehi Rivers.

The impacts of the Scheme on stream flow in most of these rivers are:

- reduced flood frequency and magnitude;
- reduced volumes of flows at all times;
- reduced seasonal flow variability; and
- in some cases, unnaturally rapid and aseasonal changes in water levels from power station releases.

The geomorphological outcomes of these changes to stream hydrology have been:

- channel contraction due to reduced discharge;
- lack of channel adjustment to reduced flows in some reaches, resulting in isolation of the channel from riparian vegetation;
- loss of rapids, chutes and riffles in many reaches; and
- lateral isolation of pools and sedimentation.

Ecological integrity has been greatly affected by the Scheme, both directly (through changes to the natural flow regime) and indirectly (through the impacts of changes to hydrology, geomorphology and water quality).

Macroinvertebrate communities have changed from lotic to lentic in many areas where flow, habitat and water quality have changed those typical of a mountain stream to those typical of a lake or lowland stream. This indicates that important ecological processes have been disrupted, and ecological integrity is low.

## **Flora**

### **Alpine — condition and trend in condition**

Much of the area was damaged by grazing in the days of snow leases, but in the time since the leases were withdrawn and soil conservation work was completed there has been some recovery, especially of the tall herbfields. Loss of topsoil on parts of the Main Range has caused a change in vegetation that is virtually permanent, with fieldmark species colonising bare erosion pavements. On the edges of these areas the remaining alpine humus profile is still subject to erosion and needs further conservation work. However most of the vegetation on the Kosciuszko plateau has achieved a relatively stable state, with changes being cyclic in response to short-term changes in climate. An exception is the continuing increase in some species such as ribbony grass *Chionochoa frigida* and the anemone buttercup *Ranunculus anemoneus* that were greatly reduced under stocking.

Grazing was withdrawn from the Kosciuszko plateau from as early as 1944, but north of this, legal grazing continued for another 14 years. Subsequent monitoring of changes to the vegetation in a limited number of sites suggests that recovery of *Sphagnum* bogs, and change from a grazing-induced disclimax short herbfield to tall herbfield is continuing.

## Tree lines

### **Condition and trend in condition**

Most of the tree lines of the park are intact as structural features. However, during the grazing era, a substantial length of natural inverted tree line was eliminated by ringbarking of trees and burning of forest. There has been relatively little reinvasion of trees into these areas. On the treeless side of the tree line, the vegetation is still in the process of recovery from grazing. In general the tree lines are in the process of recovery, the main exception being where cleared for ski runs. Little (2000) has suggested that soil calcium and manganese concentrations can be used to discriminate areas that have supported trees before the grazing era and those that did not. Soil microtopography and extrapolation along contours from surviving tree lines are other ways that could be used to locate the original tree lines. If such a reconstruction were achieved, improvement in the condition of tree lines could be measured as the proportion that is structurally intact.

## Subalpine

### **Condition and trend in condition**

As with many alpine areas at Kosciuszko, the subalpine tract suffered extensive damage from burning and grazing for the first 100-odd years of European occupation. This damage included large areas of deforestation, where livestock prevented the regeneration of snow gums after hot wildfires. The trend since 1958, when leases were withdrawn above 1400 m, has been one of slow but steady recovery. Areas still occupied by tussock grasses in 1958 are now still covered in grasses and a greatly increased number of other herbs. Areas that had been denuded of vegetation are now largely occupied by shrub species. Where some topsoil remained, there appears to be a slow decrease in shrubs and an increase in herbs, but where the soil profile had eroded down to pavement, the shrubs seem likely to persist.

Subalpine groundwater areas have, in some instances, seen an increase in bog mosses and shrubs as streamlines became blocked and the water table was locally raised. However, many streamlines had been deeply eroded and have reached a new entrenchment that is unlikely to be reversed without active conservation work.

## Eucalypts

### **Condition and trend in condition**

Most of the eucalypt forest and woodland in the Kosciuszko National Park has a minor component of introduced animal or plant species, and a large proportion has been structurally changed by a high fire incidence and grazing by stock. There is relatively little old growth forest compared to the likely situation in the mid-18th century. With stock grazing excluded and fire less frequent, it is on a trajectory back to its mid-eighteenth century condition. Trend in condition might be best measured by the proportion of old growth eucalypt forest and woodland, with the management goal being to have this increase to pre-European levels — a necessarily protracted process.

### **Condition of vegetation communities following 2003 fires**

The subalpine bogs are in a sorry state. A few areas escaped the fires, but most of the bogs observed between Valentines and Snakey Plain were badly burnt, the odd hummocks of *Sphagnum* brown and undercut and the bog shrubs blackened sticks. The wetland sedges were sprouting from the base but it is hard to see how the bogs will recover in the short term.

The widespread fires in forest and woodland areas will put back plant successions there towards earlier stages characterised by shrubby understoreys and regrowth trees (seedling and epicormic/lignotuber regeneration). Many of the relatively few stands of near-old growth communities have also been affected in this way. Future management should give particular attention to the protection of surviving old growth communities and to the encouragement of successions elsewhere towards middle and old growth conditions.

## Fauna

### **Condition of populations and habitat**

It is difficult to assess condition and trends for the park's fauna at the general level. Amongst other elements, a systematic evaluation is required of the condition of the park's vegetation and fauna habitats.

Despite the majority of the land area having a positive to benign biodiversity management regime, populations of some species (and the taxa themselves) are declining or remain highly threatened. This is most notable in amphibians and some mammals in the alpine area and drier forests.

A species with threatened status at the national or state level suggests that there is evidence of the species' decline, as opposed to being naturally rare. Populations of some threatened species in the park may be declining, but there is insufficient knowledge to define their condition and the extent of impacts of the threatening processes.

For many threatened species, the condition of the park population remains unknown, and some may be partly dependent on the condition of regional ecosystem processes and habitats. For example, the large owls may be threatened across their broad range (by logging and land clearing), but populations in the park may not yet have changed in condition.

Recently, it has been discovered that bogong moths transport arsenic to the alpine regions, presumably from their 3–4 years as larvae in the self-mulching soils of western NSW. The effect of this on the condition of the moth population and the effects up the food chain have yet to be determined, but are possibly significant.

The extent of mature seral vegetation types and consequent critical resources (e.g. tree hollows) affects the distribution and abundance of many threatened fauna species and needs to be maximised by management. Fire regimes are a critical process for this and the distribution and abundance of other functional elements such as nutrient cycling fungi.

The concept of 'condition' of a fauna population includes the extent of depletion of a population, and the state of the remainder compared with the natural state. There is no standard measure of condition for the vegetation and/or habitats that support fauna populations, such as net change in extent and state, or the time that habitat recovery would take, but such measures are needed to develop an ecological policy. The broad condition is affected by the scale and effect of the threatening processes. Condition assessments are confounded because baseline data is generally not collected prior to the threatening processes operating.

Although the drier woodlands and forests of the park have received less attention than the alpine and subalpine areas, they should not be neglected, because large segments of the fauna of these environments are threatened in southeastern Australia. Historically, the park has suffered the most extreme extinction of vertebrate species where these species have declined at a continental scale. For example, a suite of woodland bird species is regarded as being threatened at the continental scale as a result of factors such as land-use changes and land clearing. Similar patterns may also be affecting reptiles. The decline or extinction of native medium-sized predators is significant in these environments, as is the replacement by feral predators (dogs and foxes).

To conserve the condition of fauna populations in drier woodlands and forests of the park, it is critical that management should achieve a closer surrogate of the pre-European habitats. Outside reserved areas, habitat loss such as depletion of fallen wood debris (estimated to now be 16% of the pre-European amount for woodlands because of threatening processes such as logging, firewood collection and fire management) depletes and changes the functional condition of a wide range of fauna habitats.

#### ***Future trends in condition***

Critical ecological elements and processes that will affect the condition of the fauna populations in the park environments include:

- protection, reinstatement and enhancement of habitat and habitat continuity in the park and the regional management of populations as metapopulations;
- protection of wetlands and hydrology;
- control of introduced predators and restoration of a natural predator regime and predator–prey relationships;
- restoration of the natural grazing regime;
- increased research into invertebrates and their role in ecosystem function;
- restoration and protection of mature seral vegetation stages and tree hollows;
- reinstatement of appropriate fire regimes for habitats of dependent fauna (e.g. smoky mouse); and
- regional habitat changes that affect species with habitat requirements extending beyond the park's boundaries.

#### **Fire**

Fire has and will continue to influence the occurrence and distribution and condition of vegetation communities and some species. The fire regime is arguably the most significant element of the park's program of natural area land management, but there is still little or no knowledge of this component of the environment and the way in which management of fire will manipulate, modify or reduce the park's ecosystems.

Fire can have deleterious impacts on the condition of the soils of Kosciuszko National Park, particularly the organic soils of the alpine and subalpine zones (alpine humus and transitional alpine humus soils).

Fire regimes in Kosciuszko National Park over the last 40 years probably approximate the natural in alpine vegetation and closed-forest, in that fire has been largely absent from these ecosystems. Elsewhere in the park there are some areas that are frequently burned for hazard reduction, and these areas are probably burned more often than in the natural condition. There are also large areas that have probably been burned less often than in the natural condition. These regimes are taking place in vegetation modified from that which covered the country when occupied by gatherers and hunters.

Fire management in the park has developed from a very simplistic approach in the past of attempting to suppress all wildfire ignitions together with an annual program of fuel reduction. To maintain the condition of the park's natural ecosystems, the fire management regime should now be based on ecological principles that provide for sound nature conservation, catchment stability and the maintenance of an acceptable level of risk from wildfire impacts on infrastructure, neighbours and park users.

## **Landscape**

### ***Condition and trend in condition***

Several tendencies, largely related to human activities at a global scale, have been recognised in the climate of Kosciuszko National Park and adjacent areas since 1900. These tendencies are: a decrease in winter rainfall; a decrease in snow incidence; an increase in temperatures; an increase in UV radiation. The balance of the evidence suggests that the proportion of years with low snow cover and duration are likely to increase during this century as a result of global warming.

Inputs of UV radiation depend on lower atmospheric conditions as well as the condition of the ozone layer. The present condition is poor, with UV-B circumstantially, and experimentally, implicated in the decline of frog species in Kosciuszko National Park. The medium and longer term prognosis is for improvement, as a result of international success in reducing the release of ozone-depleting substances.

At a landscape scale, the combination of burning and stock grazing that took place over most of the area occupied by dry and subalpine eucalypt forest and woodland for more than one hundred years has dramatically changed vegetation structure over much of the present park. In some cases this unnatural management resulted in the elimination of trees. In others it resulted in dense stands of regrowth trees where previously woodland with old growth trees predominated. The wet eucalypt forest seems likely to have been burned more frequently than in the natural condition, with some extensive landscape fires that have replaced older trees with younger ones happening even in recent decades. Most of the park is remote enough from settlement and mechanised human activity to allow the sounds, smells and feelings of the bush to dominate. However, unnatural sounds can penetrate large distances in particular weather conditions, even where there is no visual disturbance. No noise mapping or monitoring has been undertaken.

The desired outcome for the condition of physical ecosystem processes is an increase in the degree of their naturalness.

## **Wilderness**

### ***Condition and trend in condition***

The National Wilderness Inventory provides a technique for measuring the components of the wilderness resource. The results of initial mapping using this technique indicate variable quality in the wildernesses of Kosciuszko National Park.

The wilderness areas of Kosciuszko National Park are traversed by vehicle tracks, contain a wide variety of human artefacts, have substantial populations of introduced organisms, and have large areas of soil and vegetation modified by human use since the European invasion of Australia. On the positive side, the tracks are not available to recreational vehicles; the artefacts, with a few exceptions, including huts, are no longer functional; the introduced organisms form a small component of the biomass; and the modifications have largely ceased.

The removal of post-Aboriginal cultural disturbances, such as stock grazing, that changed the soils and vegetation of much of the wilderness areas has placed these areas on a trajectory of recovery to naturalness. Limited data from snow gum woodlands in the nearby Australian Capital Territory (ACT) suggest that the post-1970 incidence of fire was similar to that in the 18th century, after an intervening period of massively increased incidence. This, if maintained, would also tend to result in a return towards naturalness.

## **Aesthetic**

### ***Condition and trend in condition***

View fields are the critical variable in gauging the natural scenic condition. A technique developed to calculate disturbance to the view field provides a visibility disturbance score based on the percentage of the arc of visibility from the highest point in a grid square that contained roads, quarries, artificial impoundments, cleared land, buildings or forestry activity. In deriving an ultimate score, the types of disturbance are weighted, with roads, quarries and human artefacts weighted more heavily than less visually disruptive disturbances.

The present natural aesthetic condition of Kosciuszko National Park varies from extremely poor in the vicinity of ski resorts, hydroelectric infrastructure and roads in open country, to poor where impoundments, cleared land and forestry activities are visible, to excellent in the heart of much of the wilderness country.

Unfortunately, the areas that have the least natural views (ie the poorest natural scenic condition) are among the most visited areas of the park.

The trend in condition is negative as a result of the ongoing development of skiing facilities and development outside the park that is visible within it.

## **Cultural — Aboriginal heritage items**

### ***Condition and trend in condition***

There is insufficient evidence to assess the condition of Aboriginal heritage items within the park. There have been no systematic surveys of these items and no overall assessment of their condition has been undertaken. What follows is therefore necessarily generalised.

The condition of both physical remains and the cultural traditions and uses associated with them has declined dramatically since European settlement because of the loss of continuity and control by Aboriginal people. Aboriginal connections and traditions — the non-tangible values connected with Aboriginal history and heritage — have been violently and significantly damaged in the past by the processes of the European settlement and dispossession.

Presently, lack of formal Aboriginal involvement can be considered to be seriously affecting the condition of this value and the present management plan does not acknowledge these issues nor provide adequate management. Over the last two decades, gradual recognition of Aboriginal traditions, the employment of Aboriginal staff and research and documentation in this area have improved the chances of preventing the loss or further damage to these values, but this trend requires active augmentation and management support.

Physical remains of Aboriginal history and heritage have been destroyed since the park was created, because of lack of proper consultation and of systematic surveys.

Because of the widespread nature of the items and lack of comprehensive information about them, management practices and any new development have the capacity to damage them.

While the condition of the majority of the known physical remains is relatively stable and the management regime which is now in place goes some way to ensuring less inadvertent destruction than previously, many of the physical remains are also subject to natural weathering and erosion.

Overall, it would appear that the condition of Aboriginal heritage items within the park is at best average and in many cases degraded or in danger of being so.

## **Cultural — historic heritage places**

### ***Condition and trend in condition***

#### ***Data and methodology***

At present, it is not possible to adequately or accurately assess the general condition of the heritage items within the park. In Australia, the only relevant condition assessment methods for cultural heritage are those which have been designed for Australia's State of the Environment Report 2001, which used defined criteria to assess physical condition. No overall survey of condition has been carried out for the cultural heritage of the Australian Alps, or Kosciusko National Park, and the regional strategies do not assess condition overall.

An overall assessment of condition requires comparative data and a consistent methodology. A regional framework is needed, into which to fit this suite of items, systematic identification of many types of sites, especially archaeological sites, and recognition and documentation of the many intangible items especially relating to the traditions and social history of the park.

Many assessments have been carried out, mainly on a needs basis, of certain major items such as the huts, past and present resorts, homestead complexes and the Kiandra cultural landscape.

A sample survey would provide a basic condition assessment of the tangible heritage items of Kosciusko National Park. The closest we can get to a condition survey is to look at the data on the Kosciusko Huts. It is not clear from the literature whether the total figure (239) is the result of systematic survey and represents all huts previously built in the park, but it is assumed that most of them, or their sites, have been located. The spread between huts that are intact, in ruins or no longer in existence is an indication of condition. Because cultural heritage is of its nature subject to decay and change it is not appropriate simply to characterise this figure as poor condition. More than half the huts have been ruined or destroyed. Less than half are intact. About 30 huts have been lost in the past 30 years, some deliberately destroyed, but most lost to fire. Since 1993, both loss of huts and their active management has been in evidence.

This study points out the fragility and vulnerability of the cultural items in the park.

#### ***Current condition***

Only a sketchy and somewhat subjective assessment can be given of the condition of some of the historic heritage places.

Places of high public visibility and current use (including active interpretation) that have been subject of specific conservation work tend to be in relatively good condition. They include:

- historic homesteads;
- huts in current use;



- resort buildings in current use;
- the infrastructure of the Snowy Mountains Scheme currently in use; and
- historic walking tracks and recreation facilities currently in use.

Some other major items such as Yarrangobilly Caves House, while not in current use, are stabilised and currently have priority for restoration.

The past history of park management has affected the condition of some of its cultural values and has led to their diminution. Previous lack of understanding or sympathy among park managers for cultural heritage items, augmented by a lack of resources, and in some cases their misguided destruction or neglect has led to the diminution of some values.

In some cases, management practices aimed at conservation of natural values have been in conflict with the conservation of cultural values. As a result, the condition of a number of cultural heritage items is poor, or they no longer exist. These include buildings, ruins and landscape features.

There has also been the loss of legitimacy and acknowledgment suffered by those whose way of life relates to the heritage values of Kosciuszko's pastoral era. People feel unduly blamed for damage that has occurred to the park as a result of pastoralism, and the hostility of some members of the community to the establishment and management of the park has compounded these problems, causing the loss or diminution of some of the social aspects of the park's cultural heritage.

Heritage places do not renew themselves, and especially if they constitute evidence of the past rather than being in current use, their natural tendency is towards change or decay. Although their condition is not naturally stable, an aim of good management is to make them as stable as possible. Some cultural landscapes are being lost or diminished as revegetation, control of introduced species, and the general diminution of signs of human activity occur. Many minor elements of these landscapes, such as mine workings, small structures, ruins and archaeological sites, are in an average to poor condition and the trend is towards a significant decline in condition. Most of the buildings of 19th century Kiandra have disappeared but the New Chum and other mine sites, storage dams and leads are still clearly visible.

### ***Trends in condition***

The condition of cultural heritage values in the park is improving in some respects:

- The level of knowledge and of management of the park's cultural heritage has improved during the period of the present plan, with contributions by management staff within the organisation at all levels.
- The newly drafted regional strategies indicate recognition of cultural heritage as a legitimate value, and of priority being given to its management. They have identified needs for specific sites and identified priorities for site management. The strategies identify a number of encouraging trends, including a growth in interest in cultural tourism, development of an integrated (natural and cultural) landscape approach to management, increasing prevalence of surveys of sites ahead of proposed development, the development of centres which will emphasise historic and Aboriginal heritage and the consideration of huts in their landscape setting.
- The Australian Alps Liaison Committee's research work focuses on values common to all the Australian Alps national parks, but has provided a great deal of basic information about the cultural values of Kosciuszko National Park and consequent management recommendations, especially within the themes of mining, science and cultural landscape management. This information now needs to be incorporated into the Kosciuszko management regime.
- Overall, the trend in condition of historic heritage places is improving, but it starts from a very low threshold. There is a need for proactive consolidation and augmentation because lack of active management for restoration and stabilisation, or of regular monitoring and corrective action at many sites, and a similar level of attention to non-tangible items, will lead to their inevitable decline.

### **Social**

The social dimensions of park management are given limited recognition in legislation, yet they are a key component of management practice. There are a number of significant social barriers to effective and holistic management of the park. From the beginning, there has been a series of major problems in local relationships, and sometimes deep and long-enduring resentment of the park. The problems primarily centred on the change in land tenure to a protected area that required cessation of grazing, and resulted in loss by the cattlemen of part of their commercial operation. In particular, although leaseholders received compensation, many of their workers lost both their job and their highly valued lifestyle. For many, the mountains and the mountain lifestyle had been their family tradition and their heritage, which is valued and is continued, where possible, to this day.

The park as a place of natural and cultural heritage can sit in an uneasy relationship to the park as a place of industrialised snow sports.

A great deal has been done by the National Parks and Wildlife Service (NPWS) in recent years to build bridges with the mountain community, although a dogged minority still maintain their hatred of the park. At local, state (and national) level, it appears that the park and its staff have gained increasing community respect. This is due very largely to the commitment of the on-ground staff who have direct responsibility for shaping visitor experience.

This respect is not only from visitors, but also from local communities, including some of the earlier antagonists, who see that staff are making enormous efforts to work, and develop relationships, with neighbours. Complaints about the perceived heavy-handedness of the park bureaucracy may well be due in part simply to lack of effective communication or to generalised characterisations from deeply seated community attitudes to parks and bureaucracies.

As the park gets older it becomes more significantly entrenched in people's minds as a park rather than for its former uses and status. In general, new groups moving to the region for lifestyle reasons tend to be more sympathetic to nature conservation as a land use.

However, for the people who use the park, there is steadily increasing ambiguity about the basic nature of the park as both a site of great natural and cultural heritage values and a major tourism destination.

## **Recreation**

### **Condition and trend in condition**

#### ***Natural attraction***

The extraordinary aesthetic scenic and natural heritage of Kosciuszko National Park is one of the primary tourism and recreation attributes of the park.

The park is scenically very diverse. There are many large natural areas where the natural scenery is in very good condition. Some other areas are impacted on by power lines, urban areas and car parks within the ski resorts and the many human made features of the Snowy Scheme. Some areas are degraded, including the nation's highest peak, Mount Kosciuszko, where further rehabilitation works are required. Natural scenery is very important for tourism and recreation.

Tourism and recreation has impacted on native wildlife. Habitats of endangered species have been modified in the ski resorts. There are road kills, and many species are influenced by visitors throughout the park; for example, bats may be disturbed in caves, and breeding populations of snakes and other species may be disturbed by walkers. Special management is needed for the ski resorts, including managing their impact on aquatic organisms.

Slashing of native vegetation in the ski resorts and trampling of alpine area plants are two impacts that need managing. There are water quality issues for streams downstream from urbanised facilities in the park, and other streams may contain waterborne parasites. Management of water quality needs action to help maintain minimum standards of water quality, especially in remote areas.

Access to the caves in the park is by a permit system or by ranger-guided tour, and this system appears to be working satisfactorily.

Non-natural noise is usually very low, but this is an issue that may affect visitors within the ski-resort areas, near the major dams and transmission lines of the Snowy Scheme and along the highway routes. The helicopters used by NPWS may be an issue in remote areas. Non-natural light pollution is usually very good, with the exception of the ski resort areas.

#### **Cultural attraction**

Many Aboriginal heritage sites are in the same locations as visitor-use sites and need careful management. Some sites need repair; others are in a satisfactory condition.

Many historic sites within the park need constant work. The Kosciusko Huts are maintained through voluntary work with the Kosciusko Huts Association. Yarrangobilly Caves House has been renovated and repainted. Locations such as Kiandra need work to conserve heritage features.

#### **Educational activities**

Whilst there is a range of educational programs linked to the park, there could be far more. The park has unique infrastructure that could be used far more in facilitating education programs. The resorts could play a new role in the future. The range of potential educational opportunities available is considered to be poorly adopted.

#### **Diversity of tourism and recreation opportunities**

There is a wide range of recreation opportunity settings within the park. Recent (2002) expansion of wilderness areas has consolidated this diversity with the additional protection of the most vulnerable recreation opportunity setting type — the facility-free, disturbance-free areas.

NPWS has no active management planning guidance or policy to control the nature of facilities provided at particular settings. In the absence of such guidance, there is a strong probability of incremental damage to sites over time.

## **Access to Kosciuszko National Park**

Improvements of highways between Sydney and Kosciuszko National Park, and the recent improvements to the Kosciuszko Alpine Way have helped to reduce travel times and make travel safer. Access by air is somewhat diminished due to the infrequency and uncertainty of regional air service to Cooma, and the distance between Cooma airport and Kosciuszko National Park. The competitive advantage achieved at Mount Hotham ski resort in Victoria as a result of the Dinner Plain airfield adjacent to the snowfields has placed some competitive pressures on NSW ski resort operators. The absence of regular bus services to many areas in the region and in the park, particularly in summer, detracts from low cost access to the park and the region.

The highway system servicing the park has been improving with time. Travel times to the snow fields are consistently being reduced through better road systems. Public transport systems to the snowfields and the park are generally less than satisfactory. The exception is the outstanding service provided by Skitube from Bullocks Flat to Perisher Valley and Blue Cow.

## **Access within Kosciuszko National Park**

Recent improvements to the Alpine Way and the general consistent maintenance of the gravel public access roads within the park have contributed to the quality and reliability of access for tourism and recreation. The absence of regular bus services within the park, particularly in summer, detracts from low cost access to the park and region. The construction by the Snowy Mountains Hydro-Electric Authority has provided visitors to Kosciuszko National Park with an outstanding public road access system. More recent access facilities such as Skitube have considerably assisted skier access to snow. Access to the ski fields is generally acceptable, to better than satisfactory. However, poor weather conditions and icy roads easily disrupt traffic flows. Access to recreation opportunity settings is excellent for the park.

## **Services and facilities**

There is a high diversity of recreation facilities and services within the park. The 1988 Kosciuszko National Park Plan of Management provides a detailed inventory of those facilities.

The settings in Kosciuszko National Park are diverse, ranging from ski resort areas with urban style facilities to wilderness areas with no facilities. The literature describing recreation opportunity settings describes certain services and facilities that are appropriate to different recreation opportunity setting classes; however, NPWS currently lacks a formal system for dealing with this.

Incremental damage to visitor sites is a potential management problem. Good planning can overcome this issue. Limits of visitor use reflect that there is a limit to the number of people that a site or area can accommodate at any given time. A planning framework is available that should be adopted to provide a rationale and process for such decision making. The nature of the visitor services and facilities provided is generally satisfactory.

## **Impacts of use**

The condition and trend in condition of 'impacts of use' for Kosciuszko National Park can be expressed relative to the global environmental criteria identified by Agenda 21 for the travel and tourism industry, and subsequent work by the Co-operative Research Centre for Sustainable Tourism.

The condition status analysis indicates how well particular environmental management performance criteria are managed, to minimise either primary or secondary impacts of visitor use to the park. It is clear that 'impacts of use' in the park can be managed better.

Energy consumption is relatively high for snow-based tourism that is underpinned by snow making. Transport to and from the ski fields consumes energy, as does the heating for accommodation and the energy consumed in treating sewage. Electricity consumption based on coal fired power stations contributes to greenhouse gases and global warming. Reduction targets for the park in tonnes of carbon per year may be possible. Currently, there are no known tourism programs in place for energy conservation or greenhouse gas reduction from tourism in the park. Greenhouse gas reductions can be achieved by lowering energy consumption in all aspects of travel and tourism operations, and energy reduction means cost savings for companies and authorities.

A reduction in the amount of solid waste could be achieved through systems that minimise waste generation, recycling and reuse. This would mean less waste going to landfill (and thus less pollution), less energy used to manage the waste and cost savings for the managing authority. There is no known program in place for the strategic reduction of solid waste generated for the park.

Liquid waste reduction could be achieved through reduced water use, which would mean less wastewater to be treated. All ski resorts discharge into subalpine streams within the park. Licensed disposal standards being met reflects on the quality of treatment achieved, but some discharges have not met licensing performance standards. Some pollution incidents have been associated with ski resort management. There is no known program in place for the strategic improvement of liquid waste generated within the park.

Reduction in potable water use will benefit the natural flow regimes of the mountain streams that provide water supplies to service visitor use facilities. There is no known program in place for the strategic reduction in potable water use within the park.

Social criteria currently focus on local employment created through travel and tourism. This criterion is considered satisfactory, and there are active programs of employment generation locally through tourism.

There is no known program for noise reduction in place for the strategic reduction of non-natural noise within the park.

There are a number of biodiversity conservation programs and specific species conservation initiatives within the park. There is no known program in place within the park for the strategic improvement of biodiversity conservation developed as a joint initiative with the travel and tourism industry.

There are no known supplementary indicators specific to Kosciuszko National Park in place within the park for the strategic improvement of 'impacts of use' developed with the travel and tourism industry.

### **Affordability**

Demand and supply needs to be carefully managed, consistent with the sustainable limits of visitor use established for recreation settings for Kosciuszko National Park.

Competition for the provision of services and facilities for visitors appears to be generally effective.

There is a need for the tourism industry and Government to work together over pricing and charging for services.

### ***Regional recreational opportunity settings***

The tourism and recreation values of the Snowy Mountains Region surrounding the park could be managed in a more integrated way. Evaluation of more sophisticated, urban-style tourism and recreation facilities and services outside the park suggests that there is a greater opportunity for such facilities for the greater region outside of the park.

### **Economic**

#### ***Use values***

The park's catchments provide water for western agricultural areas through the Snowy Mountains Scheme.

The annual value of irrigated agricultural production varies with seasonal conditions and world prices. Despite these variations, it could be expected that, in real terms, the value of production over the last few decades would have increased because of improvements in production efficiency.

#### ***Power generation***

Snowy Hydro Limited now operates in the national electricity market in the eastern states of Australia. A key feature of this market is the variability of electricity spot prices that are based on half-hour intervals and respond to market conditions, which change rapidly. As such, it is difficult to determine how Snowy Hydro Limited's income from power generation is likely to change in the future.

### **Findings - condition**

Unless the condition of the park is known, it cannot be adequately managed. The condition of the park is the combined expression of the condition and trend in condition for each of its identified values.

It is not possible to make a meaningful single statement on the condition and trend in condition of the Kosciuszko National Park because there are different ways of expressing the condition of different values, and some values have become degraded, or are threatened with degradation, while other values are in good or improving condition.

Understanding the condition of the park's values is important; but more critical is understanding trends in condition. Monitoring of condition is essential to understand whether a value is improving or degrading, and to allow management actions to focus on restoration, repair and reinstatement of the values that are at risk.

The overall management aim for the condition of the park should be to ensure that it is progressively made more healthy, robust and resilient to changes that are caused by disturbance.

As the largest national park in NSW, Kosciuszko has the opportunity to create a framework for monitoring of condition that can be an example for other parks in NSW and for the other Australian Alps national parks.



# Chapter 21

## knowledge gaps

Lorraine Cairnes

### The role of knowledge in management of the values of Kosciuszko National Park

This report identifies the values of Kosciuszko National Park, based on existing knowledge that has been interpreted by experts in areas related to those values.

Adequate knowledge is needed to understand the values of the park, and to conserve them by appropriate management, even though there will always be gaps in that knowledge. The Australian Natural Heritage Charter (2nd Edition 2002) acknowledges the principle of uncertainty:

*that our knowledge of natural heritage and the processes affecting it is incomplete, and that the full potential significance or value of natural heritage remains unknown because of this uncertain state of knowledge.*

This principle can be extended to other values.

Perfect understanding and knowledge of the park's values is not possible, and in fact is not needed for management, provided that the park is managed conservatively and changes are made only when there is sufficient knowledge to give confidence that the values will not be degraded or lost.

In Kosciuszko National Park, research, studies and monitoring will remain a priority because the changing landscapes and shifting pressures placed on the park require continuous management responses and new decisions. Also, improved knowledge will provide increased opportunities for education and interpretation across a wide range of topics.

The Independent Scientific Committee (ISC) has identified areas where additional understanding is needed to manage and protect the park's significant values.

### Key knowledge needed to manage and protect significant park values

#### General

There is a need for knowledge and understanding of the way in which changes in management direction, actions and approaches may impact on the values of the park.

#### Natural values

The report identifies certain actions that need to be taken to provide the knowledge required to manage and conserve the park's natural values. These are summarised in Table 21.1.

*"The ISC is aware that the park holds much more information than is yet known."*

Natural Values

Cultural Values

Economic Values

Social Values

Recreational Values

**Table 21.1 Natural values — knowledge needed and actions required**

Knowledge gap	Actions needed to fill the knowledge gap
Impacts of climate change on the park's biodiversity assets, particularly the alpine environments	Establish monitoring of key indicators to determine feasible management options, including the role of the park as refugia for species outside the park
Detailed information on geological features such as periglacial features, especially in ski resort areas and high visitor use areas	Carry out detailed geological mapping to identify and date key features; radiometric dating of periglacial features
Information is needed on impacts on Holocene values: <ul style="list-style-type: none"> <li>• What effect will the use of artificial snow have on stream processes?</li> <li>• How much erosion and other effects might occur in a 100 year flood?</li> <li>• Will significant climatic change occur and, if so, what will be its effects on earth processes?</li> </ul>	
The Cooleman and Yarrangobilly karst areas are lacking information on terrestrial flora, subterranean fauna, hydrological relationships, long-term fire history and landscape evolution.	The manifold values of karst provide many opportunities for research and interpretation of natural environments
The tufa deposits at Ravine / Lobbs Hole have not been investigated for any evidence of vegetation or climate change.	More study of these Quaternary landscape features is warranted
Status of aquatic ecosystems (needed to establish pressures, thresholds and impacts caused by recreation management)	Monitor water quality in key streams across the park
There is little seasonal and no long-term data on species composition and the stability of the assemblages for benthic fauna. This might give some idea whether climate change is affecting lakes in Kosciuszko National Park.	Sampling of at least the littoral zone of the four lakes once every few years in summer would be feasible
Streams and rivers have been examined only in small sections of Kosciuszko National Park. Park-wide surveys of freshwater invertebrates should be made, emphasising taxonomic aspects, as there may well be undescribed species in these groups endemic to the park	Studies should target groups such as mayflies, stoneflies and caddis flies, which are thought to be most sensitive to human disturbance
The broad-scale sampling of reference sites for the alpine AUSRIVAS model should continue. The current model is based on collections from a single summer period.	Additional sampling will increase the reference site database, which should improve the reliability of model predictions; and continued sampling may indicate the extent of any secular changes in benthic fauna due, for instance, to climate change
Changes in biodiversity and ecological integrity	<ul style="list-style-type: none"> <li>• Establish quantifiable reference points for monitoring such changes</li> <li>• Establish framework (habitat hectares) for measuring vegetation condition.</li> <li>• Examination of meso predator release and exotic grazing pressure on ecological function.</li> </ul>
Understanding of ecological processes at a landscape scale	Continue or initiate studies
Understanding of the mesopredator system in the park, with the aim of restoring the dingo–quoll predator system and establishing landscape-scale control of both foxes and cats.	Extend existing research
Extent of erosion over the whole park(including post-grazing recreational tracking, service roads and tracks, development sites, and other disturbance sites)	Survey and map current erosion
Ecology of, and threats from, pest animals and weeds	Map weed distribution; assess potential for spread of pest animals (including release of mesopredators) and weeds; monitor introduced plants (particularly in ski resorts and areas with high visitor use)
Strategic knowledge to thwart the expansion into alpine areas in the park of the suite of feral grazers (eg horse, deer, pig and rabbit), which are profoundly altering the natural ecological grazing regime	Research initiated, with the aim of efficient and effective control or elimination
Potential for introduction of diseases (eg phytophthora fungus) and possible impacts on the native biota	Assess risks

Knowledge gap	Actions needed to fill the knowledge gap
Ecological role of invertebrates, including soil invertebrates (the major grazers in the alpine zone), including subterranean biodiversity and nutrient availability	Initiate study
Ecology of key fauna species and groups (eg relationship between arsenic, Bogong Moths and <i>Burramys</i> )	Extend or initiate studies to assist their management and meet statutory recovery requirements for threatened species
Ecology and taxonomy of alpine animals and plants and their relationships to flora and fauna in other countries	Initiate co-operative studies
Tree lines, frost hollows and karst terrains	Study to improve knowledge and understanding of the environment before grazing stock were first introduced
Techniques for unbounded patch burning within the dry eucalypt and lowland grassland ecosystems of the park	Research directed towards developing required techniques
Ecology of montane and lowland eucalypt communities in terms of past and present fire regimes throughout the park	Study with reference to tree rings, pollen, karst, tufa deposits and soils
The condition of the vegetation (and habitat) of the park, linked to surrounds to assist resolution of questions concerning seral stages and area of mature vegetation, and fire regimes	Geographic information system (GIS)-based systematic evaluation
It is important that KNP takes the opportunity following the 2003 fires to correlate the fire intensity with vegetation condition and fauna habitat, and track this through time and to quantify vegetation and habitat condition with catchment condition, both within KNP and the down stream ecological services	Post-fire study to quantify vegetation and habitat condition with catchment condition, both within KNP and the down stream ecological services

### Landscape values

The report identifies certain actions that need to be taken to provide the knowledge required to manage and protect the park's landscape values, these are summarised in Table 21.2.

**Table 21.2 Landscape values - knowledge needed and actions required**

Knowledge gap	Actions needed to fill the knowledge gap
Natural aesthetic usage and the nature of people's perceptions of naturalness	Landscape analysis using viewfield analysis and social research
Understanding of means of integrated protection of landscape and catchment quality	Develop effective method of measuring.
Understanding of the economic, social and environmental benefits and costs of fire trails and other management access roads in wilderness	Critical review of issue
There are no data on the penetration of unnatural noise into the undeveloped parts of the park	Sampling study

### Cultural values

The report identifies certain actions that need to be taken to provide the knowledge required to manage and conserve the park's cultural values, these are summarised in Table 21.3.

**Table 21.3 Cultural values - knowledge needed and actions required**

Knowledge gap	Actions needed to fill the knowledge gap
Aboriginal use and values of the park area	Systematic study to compile a database and knowledge of Aboriginal use and values of the park area controlled by Aboriginal community (an Aboriginal heritage study is currently being conducted that may yield information useful to managers)
Non-Aboriginal cultural heritage	Research identified by Australian Alps Liaison Committee



## Recreational values

The report identifies certain actions that need to be taken to provide the knowledge required to manage and protect the park's recreational values, these are summarised in Table 21.4.

**Table 21.4 Recreational values — knowledge needed and actions required**

Knowledge gap	Actions needed to fill the knowledge gap
<p>Specific, detailed information about tourism and park visitation, such as:</p> <ul style="list-style-type: none"> <li>social and environmental impacts of visitor use and visitor infrastructure</li> <li>tourism supply and demand issues</li> <li>trends in visitor's expectations of services and facilities</li> <li>regional recreational opportunities and the packaging of opportunities extending beyond Kosciuszko National Park</li> <li>opportunities for educational use and interpretation, modelled on the success of current programs.</li> </ul>	<p>Develop a management model of opportunity settings for tourism and recreation within the park; gather information about recreational activities, uses and trends; develop a model of thresholds to show unacceptable levels of impact.</p> <p>Review of activities appropriate inside and outside the park</p>
Baseline environmental and social performance levels for sustainable tourism for Kosciuszko National Park	
Visitor use limits related to physical impacts and visitor experience for areas of high use and high environmental sensitivity (eg Kosciuszko Summit in peak periods, individual caves at Yarrangobilly, Blue Waterholes area and horse riding trails and sites)	
Access information, particularly the limits needed for access arrangements in their current form; visitor-use profiles for the different forms of access to the park; alternative access opportunities for the park; cost-benefits of investments in the provision and maintenance of access for tourism and recreation; environmental and social effects of the provision of access; and the carrying capacity of access roads to the ski resorts.	

## Social values

The report identifies certain actions that need to be taken to provide the knowledge required to manage and protect the park's social values, these are summarised in Table 21.5.

**Table 21.5 Social values - knowledge needed and actions required**

Knowledge gap	Actions needed to fill the knowledge gap
Information on the social aspects of visitation within Kosciuszko National Park, which is critical for management	Additional research
Information about the views and values of park communities and visitors, including information on the regional perspective of park neighbours	Additional research
Information aimed at understanding the diverse values and views of the range of people who regard themselves as having a relationship with Kosciuszko National Park	Additional research

## Economic values

The report identifies certain actions that need to be taken to provide the knowledge required to manage and protect the park's economic values, these are summarised in Table 21.6.

**Table 21.6 Economic values — knowledge needed and actions required**

Knowledge gap	Actions needed to fill the knowledge gap
Economic benefits of the park and its values	Implement economic valuing or a choice modelling survey to identify these benefits and values (would need to be within a wider state or national context)
Costs of NPWS providing specific services and facilities to implement key aspects of the plan of management	
Value of catchment services in the water supply equation (would provide basis for determining cost of repair and maintenance of the catchments, including bushfire management)	Economic modelling
Value of other ecosystem services provided by the park	Economic modelling
Pricing, demand management, elasticity of demand and regional economic contributions through tourism	Economic modelling of tourism supply and demand as a basis for understanding (this is a variation of choice modelling)
A more detailed economic evaluation will need to be completed should significant changes to the management of the Park be considered. Such an evaluation would require the extra level of detail that can best be pursued once details of various options for changes to park management are known. Such an evaluation would also need to consider how the different values could be expected to change over time.	The evaluation would need to consider the impact of the various management options on the value of the future stream of goods and services provided by the Park. Such an evaluation would need to be conducted against an estimate of how the value of that stream could be expected to change in the absence of such management changes. It would also need to consider the distributional effects of those changes ie how the management changes could be expected to affect

## Findings — knowledge gaps

The Kosciuszko National Park Plan of Management would benefit by inclusion of, or reference to, a protocol for knowledge management for the park that would:

- make existing knowledge available;
- incorporate and disseminate new knowledge as it becomes available; and
- record advice on existing and new knowledge needs of the park.

The values of the park should be reviewed from time to time to incorporate new knowledge and understanding. This process should not be dependent on a review of the plan of management, but should be a periodic and systematic procedure.

The actions needed to provide the knowledge for effective management of the park's significant values have been identified in the topic chapters and summarised here. In addition, there are gaps in our understanding of generic ecological processes in the Kosciuszko National Park and its region. These knowledge gaps include vegetational succession, predator-prey interaction, fire processes, ecosystem recovery from fire, and erosion.

A program to acquire the knowledge should be part of the monitoring framework, and an adaptive management approach should be used to determine further knowledge needs.

The cooperative management and liaison arrangements established for the Australian Alps national parks should be encouraged and strengthened, as they offer opportunities to share knowledge about the alps.

Unfortunately, the in-house resources devoted to research by the NPWS continue to decline; therefore, opportunities for collaborative research between the NPWS and other organisations should be pursued. The NPWS must maintain a high level of expertise in all of the park's value areas, otherwise there will be loss of understanding of essential knowledge areas and diminished ability to translate this knowledge into appropriate management responses (e.g. fire ecology and research over the past 15 years).

The knowledge gaps about the Kosciuszko National Park identified by the ISC should be addressed systematically in conjunction with the implementation of the plan of management.



# Chapter 22

# indicators

Marc Hockings

It is not practical to directly measure the condition of all the attributes of a protected area (either the condition of the environment itself or other attributes, such as social and economic values). Environmental indicators provide a mechanism for tracking changes in these attributes by allowing the selection of a limited number of representative measures that are indicative of the condition of the system as a whole (ANZECC 1998). The selection of priority issues, and hence indicators, for monitoring should be guided by an understanding of the natural, cultural, recreational, social and economic values of the area and the key processes that sustain these values.

The selection of indicators is a complex process, often involving trade-offs between partially incompatible attributes. As Bernstein (1992) points out:

*[D]eveloping indicators that successfully reflect ecological effects and are managerially useful requires reconciling two sets of often conflicting constraints [that] emerge from the separate ecological and management contexts that indicators must be responsive to.*

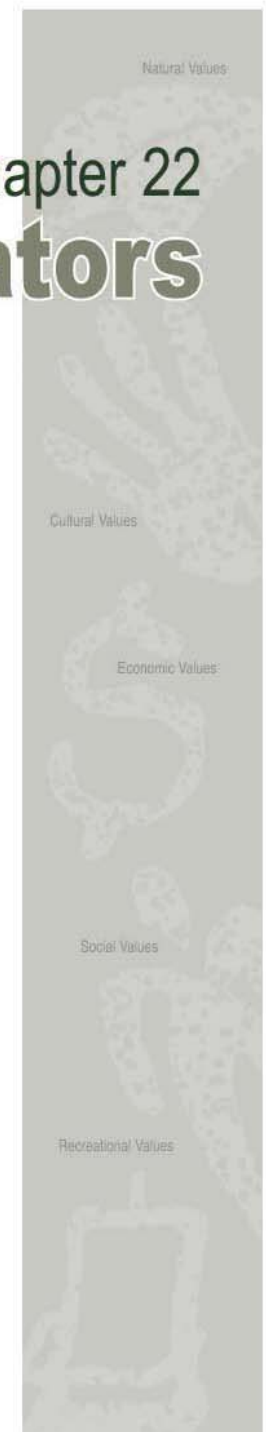
Key attributes of useful environmental indicators have been identified by various authors (e.g. Centre for Coastal Management 1993, Briggs et al. 1996, Abbot and Guijt 1998, ANZECC 1998). They suggest that, to the greatest extent possible, indicators to measure management effectiveness should:

- reflect a valued element of the system or an important management issue;
- have an unambiguous, predictable and verifiable relationship to the attribute being assessed;
- be scientifically credible;
- be sensitive to change in the attribute being assessed;
- integrate effects over time and space (that is, reflect enduring change rather than short-term or localised fluctuations in conditions);
- reflect changes and processes of significance to management (including biophysical, social, cultural, economic, political and managerial attributes);
- reflect changes at spatial and temporal scales of relevance to management;
- be cost-effective in terms of data collection, analysis and interpretation;
- be simple to measure and interpret; and
- be able to be collected, analysed and reported on within a time frame that allows effective responsive action to be taken.

It is important that data collection programs for the selected indicators be sustainable in terms of budgets and staff skills. Simple indicators are generally preferable to complex ones. If assessments are to be reported widely, the extent to which indicators are understandable by the nonspecialist is also a consideration.

## A framework for organising and presenting information on indicators

The World Conservation Union (IUCN) World Commission on Protected Areas (WCPA) has developed a framework for evaluating the effectiveness of protected area management (Hockings et al. 2000). The WCPA framework provides a basis for the design of evaluation systems and the identification of relevant indicators that can be measured through monitoring programs.



*“The selection of indicators is a complex process, often involving trade-offs between partially incompatible attributes.”*

The framework is based on the premise that the process of management starts with establishing a vision for the area (within the context of the status of existing values and pressures), progresses through planning and allocation of resources and, as a result of management process and actions, eventually produces a set of products and outcomes.

Assessment should ideally look at all aspects of the management cycle, including the context (current status of values and pressures) within which management takes place. It requires both monitoring and evaluation at various stages, each with a different type and focus of assessment.

Figure 22.1 presents the management cycle that underlies the WCPA framework.

**Figure 22.1 The protected area management cycle and evaluation**

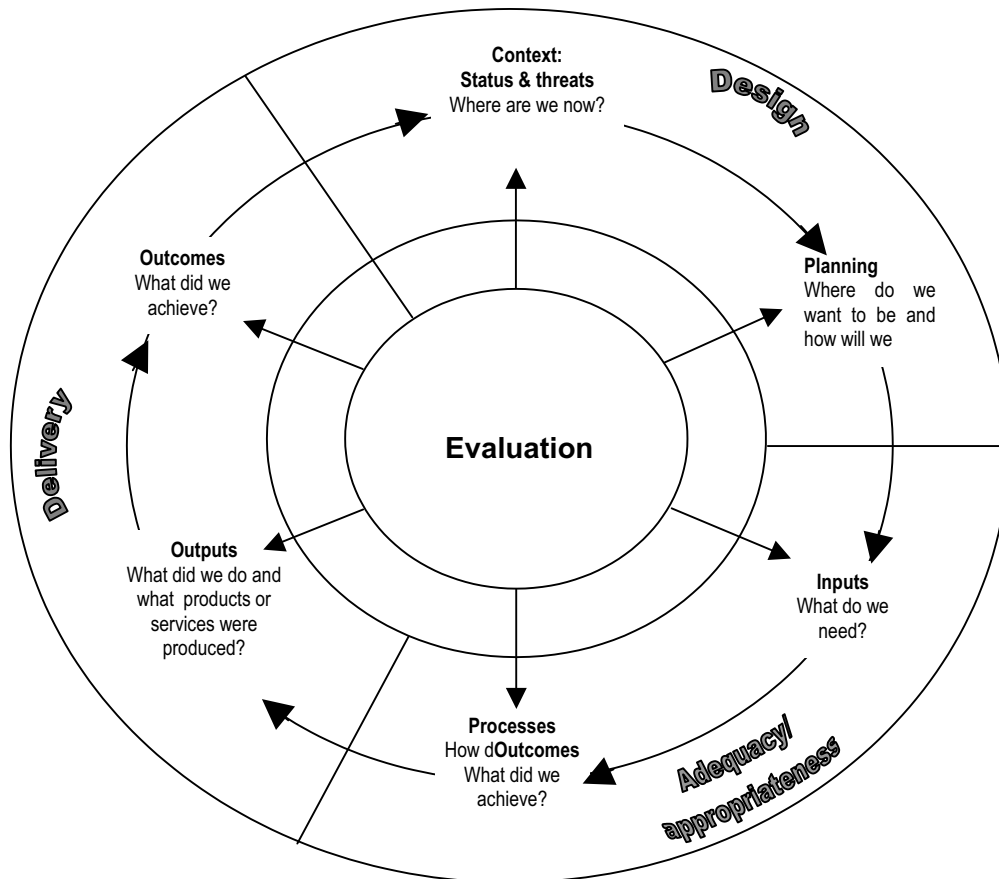


Table 22.1 sets out each of the framework elements (context, planning, inputs, processes, outputs and outcomes), explains the issues covered within each element, and lists some of the criteria that can be used to evaluate each element. Indicators are selected to enable assessment of each of the criteria specified in the framework.

The 1988 ANZECC (Australian and New Zealand Environment and Conservation Council) report on core environmental indicators points out that while frameworks are important for organising and presenting information and defining the range of issues to be considered, they are less critical for selecting indicators. The WCPA framework was not used directly in the initial designation of indicators; it has been used here to organise and present the indicators in relation to each of the values. The indicators have been selected by each of the members of the Independent Scientific Committee according to their area of expertise and the values and pressures that they assessed. Most indicators therefore relate to the outcomes element of the WCPA framework (that is, they can be used to assess the extent to which values have been maintained or pressures abated).

**Table 22.1 WCPA framework for assessing management effectiveness of protected areas and protected area systems**

Element of evaluation	Design issues		Appropriateness of management systems and processes		Delivery of protected area objectives	
	Context	Planning	Inputs	Processes	Outputs	Outcomes
Explanation	Where are we now? Assessment of importance, threats and policy environment	Where do we want to be? Assessment of protected area design and planning	What do we need? Assessment of resources needed to carry out management	How do we go about it? Assessment of the way in which management is conducted	What were the results? Assessment of the implementation of management programs and actions; delivery of products and services	What did we achieve? Assessment of the outcomes and the extent to which they achieved objectives
Criteria that are used to assess management effectiveness	Significance Threats Vulnerability National context	Protected area legislation and policy Protected area system design Reserve design Management planning	Resourcing of agency Resourcing of site Contributions from partners	Suitability of management processes	Results of management actions Services and products	Impacts: effects of management in relation to objectives

**Table 22.2 Suggested values and indicators**

Value	Indicator	Notes	Priority	WCPA framework element
<b>Earth science</b>				
	Specific objectives for management of geological features need to be set in the management plan before any monitoring needs can be identified. The geological features themselves are robust and do not require specific monitoring.			
<b>Karst</b>				
Coolleman Plain	Extent of weed infestation and feral animal disturbance	Mapping of weed infestation (biannual); patrol reports of feral animal sightings/damage	Medium	Outcome
	Visitor impacts around Blue Waterholes environs	Rapid mapping of visitor-use area campsites, fireplaces and tracks (resurvey biannually)	Medium	Outcome/output
	Visitor impacts in Murrays, Cooleman and Barbers Caves	Photomonitoring points in caves	Medium	Outcome
Yarrangobilly	Extent of weed infestation and feral animal disturbance	Mapping of weed infestation (biannual); patrol reports of feral animal sightings/damage	High	Outcome
	Visitor impacts around Yarrangobilly Village	Rapid mapping of visitor-use area campsites, fireplaces and tracks (resurvey biannually)	Medium	Outcome
	Visitor impacts in wild caves	Cave inspection report to be completed by cavers visiting sites; photomonitoring of sites	Medium	Outcome
	Visitor impacts in show caves	Cave inspection report to be completed by staff	Medium	Outcome
Indi	Visitor impacts in caves	Photomonitoring points in caves	Medium	Outcome
<b>Natural flora</b>				
Alpine vegetation	Condition and species composition of tall herbfield, sod tussock grassland and heath	Maintain existing transects and resurvey every 5 years (survey midsummer)	High	Outcome
		Establish new transects in sensitive vegetation communities (eg snow patch) to assess long-term change in species composition and abundance (5 years)	Medium	Outcome
Subalpine vegetation and frost hollows	Condition and species composition in a range of subalpine habitats	Relocate existing transects in Guthega catchment and establish new sites (plots) as necessary (especially in frost hollows)	High	Outcome
	Change in vegetation structure	Fixed photopoints (perhaps established at sites of existing historical photos); rephotograph biannually	Medium	Outcome

Value	Indicator	Notes	Priority	WCPA framework element
Lower Snowy Valley habitats	Condition (density and structure) and species composition in cypress pine – white box communities	Remeasure existing plots and transects every 10 years	High-medium	Outcome
Upper slope and inverted tree lines	Proportion of original tree line that is structurally intact	Monitoring is dependent on establishing a baseline of the presumed extent of the original tree line; resurvey tree line (using satellite imagery) every decade	Medium	Outcome
Eucalypts from tree line to sea	Proportion of old growth eucalypt forest and woodland to total forest and woodland	Dependent on data for areas outside National Park estate	Low-medium	Outcome
	Weed and feral animal invasion of forest and woodland	Cover/abundance for weed species and signs of feral animal disturbance in fixed plots; could be undertaken as part of monitoring program proposed for subalpine vegetation)	High	Outcome
<b>Aquatic values</b>				
Lakes	Benthic invertebrate fauna	Community composition assessed at 5–6 sites/lake once every 5 years	High	Outcome
	Water quality	Conductivity, pH and chlorophyll a or nutrient levels	Medium-low	Outcome
Streams and rivers	Ratio of observed taxa to expected taxa	Use AUSRIVAS model, establish permanent survey sites, monitor spring and autumn each year	High	Outcome
	Water quality	Conductivity, pH and nutrient levels	Medium-low	Outcome
<b>Fauna</b>				
Alpine and subalpine fauna	Condition of populations of selected threatened or significant species/communities	Mountain pygmy-possum, southern corroboree frog, alpine tree frog, bogong moth (including arsenic); invertebrate grazing community in alpine grassland	High	Outcome
Tall wet forest fauna	Condition of populations of selected threatened or significant species/communities	Tree-hollow dependent birds (owls) and mammals	High	Outcome
		Woodland/dry forest bird communities (surveillance/baseline); link to broader studies	Medium (strategic)	
		Specialists - smoky mouse, spotted tree frog, brush-tailed rock wallaby, cave communal breeders (bats)	High	
General terrestrial habitat	Condition of vegetation type (area and condition of habitat) and percentage of mature seral stage	Need to establish measure of vegetation condition, benchmark at pre-European condition and correlate faunal communities; permanent plots established in major habitat types and resurveyed approximately every 3–5 years	Medium	Outcome
Restoration of pre-European meso-predator system	Density (condition) of dingo and fox populations	Need to establish integrity of dingo population - will require landholder liaison; <i>Mastacomys</i> populations may be a good response indicator for density of fox above the snow line	High	Outcome
	Density and extent of quoll population			
	Fox and cat density (above snow line)			



Value	Indicator	Notes	Priority	WCPA framework element
<b>Natural landscape</b>				
Physical ecosystem processes	Proportion of area of park with fire regimes within appropriate range	Best-guess ranges of appropriate fire frequencies should be established for the ecosystems of the park; on-ground monitoring of biotic responses to fire will also be necessary to allow adaptive management (ie shifting of the ranges of appropriate fire frequencies in response to increasing knowledge)	High	Outcome
Wilderness	Wilderness quality index for areas within designated wilderness areas	Reassess wilderness quality every 5 years	Medium	Outcome
Natural aesthetics	Disturbance to view fields	Using method of Kirkpatrick (1979); resurvey approximately every 5 years Need to define standard sites for regular sampling; target sampling sites to development areas and add new sites in association with any developments in previously undisturbed areas of the park	Medium	Outcome
<b>Cultural heritage</b>				
Aboriginal history and heritage	Extent to which cultural heritage management prescriptions are being implemented	Management programs and monitoring of implementation need to be conducted in association with the Aboriginal community	High	Process and output
Pastoralism	Condition of Aboriginal cultural heritage sites	Need to select a sample of most significant sites for monitoring	High	Outcome
	Condition of homesteads, huts and associated structures	Need to select a sample of most significant sites for monitoring (eg Currango)	High-medium	Outcome
Mining	Condition of mining heritage items	Need to select a sample of most significant sites for monitoring	Medium	Outcome
Logging, timber extraction and silviculture	None recommended			
Water harvesting	Condition of huts associated with the Snowy Mountains Scheme	Need to select a sample of most significant sites for monitoring	High-medium	Outcome
Science, research and conservation	None recommended, although established monitoring sites may form the basis for ongoing monitoring programs looking at other values			
Recreation	Dealt with as a value under Tourism and recreation, below			
<b>Social values</b>				
	Development of indicators for monitoring of communities and their perspectives/attitudes is dependent on more clearly characterising park communities and their attributes. Monitoring related to park visitors is addressed under Tourism and recreation, below.			

Value	Indicator	Notes	Priority	WCPA framework element
<b>Economic value</b>	Quantity of power provided to the national grid by Snowy Hydro Limited	Available from Snowy Hydro Limited	High	Outcome
	Volume of water contributed to the Murray and Murrumbidgee systems			
	Annual traded price of that water			
<b>Economic value of tourism</b>				
International tourism	International visitor nights by season	Data available from Bureau of Tourism Research	Medium	Output
National tourism	National visitor nights by season	Data available from Bureau of Tourism Research	Medium	Output
Economic input to region	Economic value of tourism to the state assessed through periodic economic impact studies	Research methodology should be kept consistent with previous studies; resurvey approximately every 5 years	High	Outcome
<b>Tourism and recreation</b>				
Biological and physical setting	Monitoring of condition of biological and physical setting undertaken through the indicators specified, in relation to values such as fauna, flora, aquatic habitats, wilderness and cultural values	Notes on monitoring techniques and frequencies given under relevant headings above	Various	Outcome

## **Recommendation**

As part of the process of completing the management plan, it is strongly recommended that the National Parks and Wildlife Service add additional indicators relating to the other elements of the WCPA framework. Specification of some of these indicators will have to await the completion of a draft of the management plan, as they will relate to the specifics of objectives and strategies in the plan. The general nature of these indicators can be outlined now.

## **Context**

The Independent Scientific Committee report identifies the significant values of the area and the pressures (threats) acting on these values. The status and trend, both of values and pressures, should be monitored as part of the outcomes component of the monitoring program.

## **Planning**

As part of the preparation of the management plan, the adequacy of existing general protected area legislation and policy should be assessed. Similarly, the plan should contain an assessment of the strengths and weaknesses in the design of Kosciuszko National Park. Any deficiencies in design can then be addressed through acquisition or adoption of relevant management strategies. This design assessment should be conducted in relation to the major park values identified in the Independent Scientific Committee report. The new management plan should also assess current issue-oriented planning documents and identify requirements for development or review of subordinate plans.

## **Inputs**

As a minimum, a structure should be developed for monitoring the allocation of resources (staff and funds) to major aspects of park management. Additionally, there should also be a parallel process for identifying needs in relation to each aspect of management, so that an assessment of adequacy of resourcing can be undertaken.

## **Processes**

Evaluation of the appropriateness of management processes requires that a set of relevant management standards be prepared as a basis against which the assessment can be made. The preparation of the management plan provides an ideal opportunity for establishing such a set of standards. Existing consultative mechanisms set up for the plan's preparation could be used to get stakeholder input to the standards. Evaluation can be undertaken by scoring current management practices against the ideal standards, with assessments repeated every 1–2 years to track progress in management practices.

## **Outputs**

The preparation of the management plan also provides an opportunity to develop a system for monitoring later implementation of the plan. This should be done using a database that lists the policies and actions proposed in the plan and provides for annual recording of the status of implementation of each. Descriptive information on progress and any impediments to implementation of the plan can also be recorded in the database. The extent of implementation of major strategies of the plan can be analysed and reported on a regular basis. Additional fields characterising the nature of the policies and actions would allow more sophisticated analysis of trends in plan implementation.

Indicators of key work program outputs should also be monitored. The selection of attributes to be monitored should be made as part of the planning process, but preference should be given to those management activities that relate to the maintenance of park values or the abatement of threats (e.g. completion of annual burning programs). Other output indicators that should be monitored are key demand indicators that reflect external demands placed on the staff managing the park (e.g. visitor numbers).

## **Outcomes**

Indicators for monitoring the status of identified values and the abatement of threats are specified in Table 22.2. Additional monitoring of key management plan objectives should also be undertaken, indicators for which will need to be specified as part of or following the development of the management plan.

# Chapter 23

## findings and recommendations

This chapter brings together the findings and recommendations of the Independent Scientific Committee (ISC) arising from the chapters on the individual values and overview aspects.

### 1 Major recommendations and findings of the ISC

#### 1.1 Conservation of significant values

##### *Finding*

The values of the Kosciuszko National Park identified in this report are fundamental to the purpose of its reservation as a protected area.

##### *Recommendation*

The park's values identified in the ISC report should be recognised in the park's plan of management, which should incorporate strategies for their conservation.

#### 1.2 Knowledge base for the park's values

##### *Finding*

The knowledge base for the park's values is core knowledge for management, and cannot be left to research institutions to address in an unstructured or opportunistic way.

##### *Recommendation*

A structured program of research and knowledge management, which will require leadership and commitment by New South Wales (NSW) National Parks and Wildlife Service (NPWS), must continually update the knowledge base for the park's values.

#### 1.3 Conservative sustainable management

##### *Finding*

The values of the park will degrade unless the pressures that contribute to degradation are recognised and addressed before degradation occurs.

##### *Recommendation*

The park should be managed conservatively and sustainably to ensure that its values are not degraded and that pressures that might contribute to the degradation of values are recognised and managed before serious degradation occurs. Adaptive management is needed to ensure that management strategies can be changed if they are contributing to degradation of the values.

#### 1.4 Monitoring of the park's condition

##### *Finding*

Monitoring of the park's condition is essential for effective management. It is noted that some values have existing data sets on which to build, but for others, there is no existing reliable information.

*“The values of the Kosciuszko National Park should be recognised in the park's plan of management, which would incorporate strategies for their conservation.”*

### ***Recommendation***

Monitoring of the condition of the park's values should be a programmed activity with a reliable budget. Monitoring should address agreed indicators, and the results should be reported publicly.

## **2 Findings and recommendations on the condition of values**

### **2.1 Conservation of significant values**

#### ***Finding***

The terms of reference required the ISC to identify, describe and report on the condition and trend in condition of the natural, cultural, recreational, economic and social values of Kosciuszko National Park. The values of the park are very diverse and there are different ways of expressing their condition. While some values have become degraded, or are threatened with degradation, others are in good condition or improving. Therefore it is not possible to make a meaningful overall comment on condition, and trend in condition, of the park's values. However, all of the parks values need to be conserved to retain their significance.

#### ***Recommendation***

Monitoring of the condition of the values is essential to allow early detection of degradation trends.

## **3 Findings and recommendations on pressures on the park's values**

### **3.1 Capacity to manage pressures**

#### ***Finding***

The park's natural heritage values underpin the majority of its other values; thus, the pressures on its ecosystems and fundamental ecological processes such as increased development, fire management and introduced species have the greatest potential to affect the values of the park.

The impacts increase in severity when these pressures are overlaid with increase in visitor use and intensification of regional development.

While all parts of the park are affected by individual or cumulative pressures, the alpine and subalpine areas are the most vulnerable, and increased pressures from tourism and recreation activities and facilities are of particular concern.

#### ***Recommendation***

The pressures on the park's values demand adequate capacity within the NPWS and the understanding and support of the community to effectively manage the full range of the park's values.

### **3.2 Climate change**

#### ***Finding***

Climate change is a pressure beyond the ability of the park to manage directly, but it will have profound impacts on some values. Alpine environments are a key area for research and monitoring of climate change. The park is important as a biodiversity refugium, and better understanding of its ecological functions at the system level is needed; present habitats must be as robust and healthy as possible to maximise resilience in the face of climate change.

#### ***Recommendation***

The Kosciuszko National Park Plan of Management needs to recognise the implications of climate change as a pressure on the park and to incorporate a planned management response based on conservation of the park's values. Preparation for climate change requires:

- more detailed study of the implications for the park of enhanced climate change effects;
- planning of regional-scale corridors of natural vegetation communities across landscapes outside the park;
- integration of land uses adjacent to the park to maximise biodiversity and ecosystem conservation; and
- more detailed examination of the appropriateness and likely impacts of "solutions" such as cloud seeding.

### **3.3 Development**

#### ***Finding***

There will be increased pressure on the park's values if there is expansion of development within the park for increased access and tourism infrastructure, both for summer and winter facilities and services. Most demands will be motivated by commercial reasons, and there may also be commercial pressure to expand snowfields resort areas. Development for infrastructure also affects the park's values.

#### ***Recommendation***

Management of all development needs to give priority to conservation of the core values of the park, on which sustainable tourism and high quality visitor experience depends

### **3.4 Visitor use in alpine and subalpine areas**

#### ***Finding***

Increasing visitor use has widespread implications for loss or degradation of the park's values; in particular, the increase in visitors in the alpine and subalpine areas in summer is of concern.

#### ***Recommendation***

The pressure of increase in visitors in the alpine and subalpine areas in summer needs to be addressed by management as a high priority

### **3.5 Park management**

#### ***Finding***

The process of park management can itself be a pressure on the park's identified values.

#### ***Recommendation***

The park will need to institute a program of continuous development and retention of appropriate and adequate skills, knowledge, competencies and resources to manage the park's values.

### **3.6 Pressures on ecological processes**

#### ***Findings***

Pressures caused by disturbance of catchments, the managed fire regime, and by introduced plant and animal species are causing substantial impacts on the park's biodiversity and the natural ecological communities by disturbance of the ecological processes on which their conservation depends.

There are major pressures on the ecological integrity of the park caused by catchment and hydrological pressures, invasive introduced species and inappropriate fire regimes that interrupt the natural ecological processes.

#### ***Recommendation***

Some pressures on ecological processes need the understanding of the community and there is need for a program that builds the community's involvement and knowledge of the issues.

### **3.7 Introduced grazing herbivores**

#### ***Finding***

The individual and combined grazing pressure of introduced species (rabbits, hares, horses, pigs, deer and goats) is substantial. Populations of these introduced herbivores are affecting vegetation and sensitive areas such as bogs. The alpine area is highly vulnerable, particularly under changing population sizes and climate change; unchecked invasion by some of these herbivores is likely to change the structure of the alpine vegetation and move it away from the present insect-dominated system. In the absence of natural enemies (predators, parasites) or control, these species represent a major threat to the natural integrity of the park. According to the ecological concept of "trophic cascades", the suite of exotic herbivores current present in the park may represent a major problem that is not visible or at least perceived at present.

### ***Recommendation***

Re-establishment of the pre-European predator system should be incorporated into control measures for introduced grazing herbivores. Control of these herbivores within an adaptive experimental management framework should be a major management program of the park.

## **3.8 Introduced species**

### ***Finding***

It is critical to prevent the establishment of further new introduced species, and to make every effort to eliminate any new introductions identified.

### ***Recommendation***

Strategies are needed to ensure early identification of non-native species into the park.

## **3.9 Exotic diseases and pathogens**

### ***Finding***

The flora and fauna populations of the park may be vulnerable to exotic diseases and pathogens. Exotic diseases have the potential to have long-term detriment to the parks native species. In the national sense, the Australian Quarantine Inspection Service is the first line of defence, and park managers have powers to stop deliberate release.

### ***Recommendation***

Park staff must take active responsibility and remain vigilant in their surveillance and reporting and management of unusual events, with the objective of preventing the establishment of new diseases and pathogens.

## **3.10 Regional land use**

### ***Finding***

The regional setting of the park brings pressures as intensified land use and new developments, some stimulated by the existence of the park itself, potentially isolate the park as a natural area, and create edge impacts on the boundary areas of the park.

### ***Recommendation***

Pressures caused by changes in regional land use require an inclusive regional management approach by the park.

## **3.11 Cumulative effects of pressures**

### ***Finding***

Most values are experiencing more than one pressure.

### ***Recommendation***

The cumulative effect of pressures on the park's values needs to be considered in management.

## **3.12 Values as pressures**

### ***Finding***

Some pressures have been identified that might also be related to, or part of, other values of the park.

### ***Recommendation***

Pressures that are also values will need careful consideration and management.

## **4 Findings and recommendations on knowledge gaps**

The ISC makes the following findings and recommendations in respect of knowledge gaps concerning the park's identified values.

### **4.1 Knowledge management**

#### ***Finding***

The park needs a system that would make existing knowledge available, incorporate and disseminate new knowledge as it becomes available, and record advice on existing and new knowledge needs of the park.

#### ***Recommendation***

The Kosciuszko National Park Plan of Management should establish a protocol for knowledge management for the park.

### **4.2 New knowledge of values**

#### ***Finding***

The park's values are not fully known or understood.

#### ***Recommendation***

The values of the park should be reviewed from time to time to incorporate new knowledge and understanding. This process should not be dependent on a review of the plan of management, but should be a periodic and systematic procedure.

### **4.3 Systematics (taxonomics and molecular genetics) advances**

#### ***Finding***

Since the original Plan of Management for Kosciuszko National Park (1982) there have been many dramatic advances in systematics and the scientific tools derived from the study of molecular genetics and systematic analysis have profound implications for understanding of the park's values and their management. Many new taxa have been recognised, several of which are alpine endemics.

#### ***Recommendation***

Systematics (taxonomics and molecular genetics) offers a most valuable new tool for Park management and should be incorporated into future research plans.

### **4.4 Sharing knowledge with other Australian Alps national parks**

#### ***Finding***

The cooperative management and liaison arrangements established for the Australian Alps national parks offer opportunities to share knowledge about the Alps.

#### ***Recommendation***

The cooperative management and liaison arrangements established for the Australian Alps national parks should be encouraged and strengthened.

### **4.5 Collaborative research**

#### ***Finding***

The ISC recognises (and regrets) the continuing reduction in in-house resources devoted to research by the NPWS.

#### ***Recommendation***

Opportunities for collaborative research between the NPWS and other organisations should be pursued.



## 4.6 Maintenance of in-house expertise

### *Finding*

With continued reductions in specialist personnel, there will be loss of understanding of essential knowledge areas and diminished and inadequate ability to translate this knowledge into appropriate management responses to conserve the park's values (eg fire ecology and research).

### *Recommendation*

The NPWS must maintain a high level of expertise in all of the park's value areas.

## 4.7 Filling knowledge gaps through plan of management

### *Finding*

The plan of management is an appropriate vehicle for ensuring that the knowledge needed for management is acquired and used effectively.

### *Recommendation*

The knowledge gaps about the Kosciuszko National Park identified by the ISC should be addressed systematically in conjunction with the implementation of the plan of management.

## 5 Findings and recommendations on indicators and monitoring of values

### 5.1 Additional indicators

#### *Finding*

The World Commission on Protected Areas framework provides indicators that would benefit the plan of management.

#### *Recommendation*

As part of the process of completing the management plan, the ISC recommends that the NSW NPWS add additional indicators relating to the other elements of the World Commission on Protected Areas framework. Specification of some of these indicators will have to await the completion of a draft of the management plan, as they will relate to the specifics of objectives and strategies in the plan. However, the general nature of these indicators can be outlined now.

### 5.2 Indicators for condition and pressures

#### *Finding*

This report identifies the significant values of the area and the pressures (threats) acting on these values.

#### *Recommendations*

The status and trend, both of the condition of values and the pressures on them, should be monitored as part of the outcomes component of the monitoring program.

### 5.3 Planning context indicators

#### *Finding*

The planning process provides an opportunity to review the park's design and its planning context

#### *Recommendations*

As part of the preparation of the management plan, the adequacy of existing general protected area legislation and policy should be assessed. Similarly, the plan should contain an assessment of the strengths and weaknesses in the design of Kosciuszko National Park. Any deficiencies in design can then be addressed through acquisition, or adoption of relevant management strategies. This design assessment should be conducted in relation to the major park values identified in this report. The new management plan should also assess current issue-oriented planning documents and identify requirements for development or review of subordinate plans.

## **5.4 Monitoring resource inputs to management**

### ***Finding***

Resourcing the implementation of the new plan of management needs to be systematically addressed.

### ***Recommendations***

As a minimum, a structure should be developed for monitoring the allocation of resources (staff and funds) to major aspects of park management. Ideally, there would also be a parallel process for identifying needs in relation to each aspect of management, so that some assessment of adequacy of resourcing can be undertaken.

## **5.5 Evaluation of management processes**

### ***Finding***

Evaluating the appropriateness of management processes requires that relevant management standards be prepared as a basis against which assessment can be made. The preparation of the management plan provides an ideal opportunity for establishing such a set of standards.

### ***Recommendations***

Existing consultative mechanisms set up for the plan's preparation could be considered to obtain stakeholder input to the standards. Evaluation could be undertaken by scoring current management practices against the ideal standards, with assessments repeated every 1–2 years to track progress in management practices.

## **5.6 Monitoring outputs**

### ***Finding***

The preparation of the management plan provides an opportunity to develop a system for monitoring implementation of the plan.

### ***Recommendations***

Monitoring implementation of the new plan should be done using a simple database that lists the policies and actions proposed in the plan, and provides for annual recording of the status of implementation of each. Indicators of key program outputs should also be monitored. Preference in selection of attributes to be monitored should be given to those management activities that relate to the maintenance of park values or the abatement of threats. Other output indicators that should be monitored include those which reflect external demands placed on the staff managing the park (eg visitor numbers).

## **5.7 Monitoring outcomes**

### ***Finding***

The new plan provides the opportunity to monitor its outcomes with respect to the status of values and the abatement of threats.

### ***Recommendations***

Indicators for monitoring the status of identified values and the abatement of threats are specified in Table 22.2. Additional monitoring of key management plan objectives should also be undertaken, indicators for which will need to be specified as part of, or following the development of, the management plan.

## **6 Findings and recommendations on fire**

### **6.1 The natural fire regime**

#### ***Finding***

The natural fire regime has been a feature of the development of the region's vegetation structure for millennia; it is a major determinant of vegetation and its seral stages across the Australian landscapes and affects the spatial and temporal availability of habitat for fauna. Present vegetation distribution is an expression of past fire regimes.

#### ***Recommendation***

Fire management of the park should be based on an assessment of vegetation systems and fuel structures, applying the principles of combustion physics to ensure that desired outcomes are valid and achievable.

## 6.2 Focus of fire management

### *Finding*

Fire management influences the capacity to implement other management strategies and achieve planned management outcomes, and the occurrence and distribution of vegetation communities and certain species. Fire can have deleterious impacts on Kosciuszko National Park soils, particularly the organic soils of the alpine and subalpine zones (alpine humus and transitional alpine humus soils).

### *Recommendation*

A focus of fire management should be to minimise the impact of high-intensity fire on natural and human assets. The dominant objectives regarding should be to achieve a more representative range of succession, including areas of old growth vegetation (representing the end result of environmental stability) and to address the needs of fire dependent threatened species through ecologically-based fire regimes. Fire management practices should not be undertaken if, on balance, they detract from an objective of catchment protection.

## 7 Findings and recommendations on ecological research

### 7.1 Strategic ecological research

#### *Finding*

An overall framework for strategic research in Kosciuszko National Park will provide the information needed for effective management. Incorporating many of the research projects into a program of adaptive experimental management is arguably the most rewarding. In the recent past, threatened species have attracted a substantial research effort. This has been worthwhile, but a more wholistic landscape approach may prove more productive.

#### *Recommendation*

There is a need to establish an overall framework for strategic research in Kosciuszko National Park based on a wholistic landscape approach. Establishment of an external advisory group on research should be considered to assist in this task.

### 7.2 Ecological research beyond the park boundaries

#### *Finding*

For some ecological aspects (eg nutrient cycling, large owls, predation, health of system, and subterranean biodiversity) the major drivers could well be outside the park system.

#### *Recommendation*

Ecological research within Kosciuszko National Park should be linked to other areas outside the park.

### 7.3 Long-term vegetation and soil transects

#### *Finding*

The location and history of long-term vegetation transects in the alpine and subalpine zones have been documented. There are also various photographic records of soil conditions and other features made many years ago and some of these should be located and repeated at regular intervals to yield information on trend in condition.

#### *Recommendation*

The long term transects must be continued not only for the information they provide on vegetation trends but also for information on the soils. There is a good case for a professional 'ecological archivist' on the park's staff to coordinate re-photography of sites for which there is a useful photographic record.

## **8 Findings and recommendations on the park's future status**

### **8.1 Biosphere Reserve status**

#### ***Finding***

Kosciuszko National Park is a Biosphere Reserve, a status conferred in 1977 by UNESCO. Biosphere Reserves are areas of protected ecosystems where solutions to reconcile the conservation of biodiversity with its sustainable use are promoted. Collectively, Biosphere Reserves form a world network within which exchanges of information, experience and personnel are encouraged. To date, the Biosphere Reserve concept has not been utilised to the advantage of Kosciuszko National Park. This listing also brings the park into the ambit of the *Environment Protection and Biodiversity Conservation Act*.

#### ***Recommendation***

The Biosphere Reserve status of Kosciuszko National Park should be reviewed and utilised as a means of incorporating regional landscape perspectives, management and planning in conjunction with neighbouring authorities and the regional community.

### **8.2 Ramsar Wetland of International Importance - Blue Lake**

#### ***Finding***

The listing of Blue Lake and its surrounding area as a Wetland of International Significance is an important recognition. This listing also brings the site into the ambit of the *Environment Protection and Biodiversity Conservation Act*.

#### ***Recommendation***

Blue Lake, as a Ramsar Wetland of International Significance, should be specifically addressed and protected in the Plan of Management.

### **8.3 National Heritage Listing of Australian Alps**

#### ***Finding***

Kosciuszko National Park is significant in its context as part of the Australian Alps A National Heritage Listing of the whole of the Australian Alps would be appropriate, to be initiated under the new Commonwealth heritage legislation.

#### ***Recommendation***

A National Heritage Listing of the whole of the Australian Alps should be pursued through pooling and coordination of the knowledge held by each of the Alps protected area management authorities.



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# acronyms and abbreviations

AALC	Australian Alps Liaison Committee
ACT	Australian Capital Territory
ANU	Australian National University
ANZECC	Australian and New Zealand Environment and Conservation Council
BD	Bulk Density
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DNRE	Department of Natural Resources and Environment
EBPC Act	Commonwealth Environment Protection and Biodiversity Conservation Act
FFG Act	Flora and Fauna Guarantee Act (Victoria)
GIS	Geographic Information Systems
HSBC	Hume–Snowy Bushfire Council
ICOMOS	International Council on Monuments and Sites
ISC	Independent Scientific Committee
IUCN	World Conservation Union
NC Act	Nature Conservation Act (ACT)
ppm	parts per million
PR	Packing ratio
RLPB	Rural Lands Protection Board
RFA	Regional Forest Agreement
SMHEA	Snowy Mountains Hydro-Electric Authority
SMHES	Snowy Mountains Hydro Electric Scheme
NPWS	National Parks and Wildlife Service
NSW	New South Wales
RFA	Regional Forest Agreement
RFASC	Regional Forest Agreement Steering Committee
RLPB	Rural Lands Protection Board
STP	Sewage treatment plant
TSC Act	Threatened Species Protection Act (NSW)
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTS	University of Technology Sydney
VAMP	Visitor Activity Management Process (Canada)
VROTS	Victorian Rare or Threatened Species list
WCPA	World Commission on Protected Areas
WCMC	World Conservation Monitoring Centre

