

**Climate change research and monitoring needs for the
Australian Alps National Parks:
Survey of Parks staff and researchers**

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1. EXECUTIVE SUMMARY

Worldwide anthropogenic climate change threatens natural ecosystems including those in the Australian Alps. The Australian Alps National Parks currently conserve nearly all of mainland Australia's snow country and are important nationally and internationally due to their conservation values, ecosystem services and economic benefits. Climate change predictions for the Australian Alps include higher temperatures, reduced snow cover, increased risk of fires and increased abundance and diversity of weeds and feral animals. In addition to these impacts, there will be changes in winter and summer tourism. Research for the National Climate Change Adaption Research Facility surveyed protected area managers, researchers, local government and resorts to identify the strategies they plan to use to adapt to climate change, and the limits to those strategies. Research, or rather not enough research on climate change and its impacts was seen as a major limit for adaptation. Griffith University was commissioned by the Australian Alps Liaison Committee to extend that study by undertaking a more detailed survey of park managers and researchers to identify specific research and monitoring requirements for managing climate change and its impacts in the Australian Alps. This report presents the survey, results, implications and recommendations for research priorities for the Australian Alps National Parks.

1.1 The survey

Developing the survey involved an iterative process with input from Griffith University academics, members of the Australian Alps Liaison Committee and a Principal Research Scientist from NSW National Parks and Wildlife Service to formulate the aims of the survey, which stakeholders would be surveyed and the design of the survey including its format and the specific questions used. The aim of the project was to identify research needs and priorities for climate change adaptation and mitigation for the Australian Alps. The target audience for the survey was refined to focus on Parks staff and researchers involved in the Australian Alps. Three iterations of the survey were produced and pilot tested until it was ready for release.

The survey consisted of 20 questions including questions about impacts of climate change, priority areas for future research and background information about respondents expertise/positions. Parks staff and researchers were contacted using e-mail by the

Australian Alps Liaison Committee or its nominees in early December 2011. Researchers in the Australian Alps were also contacted using by an email sent to members of the Australian Institute of Alpine Studies by Dr Ken Green in early December 2011. The e-mails outlined the project, including its aims and importance and asked staff/researchers to undertake the questionnaire electronically using an e-mail link. The survey was completed on the 12 March 2012.

1.2 Survey results

A total of 31 of people responded to the survey consisting of 17 Parks staff, 6 Parks staff who are also researcher, 4 researcher and 4 others. All respondents agreed that climate change is already occurring in the Australian Alps. The most common impacts were decreased snow cover, increased fire frequency and changes in the timing of biological events decreased/altered rainfall and water availability, and increases in invasive species.

Research/monitoring was seen as a major limit to adaptation and management of climate change impacts in the Australian Alps. Although climate change research already exists in the Australian Alps, they wanted more information about the range of threats and better ways to deal with them. The most important issues where invasive species, threats to endemic species and plant communities and increased risk of fires.

Specifically they want more information on bogs/moss beds/fen communities, alpine plant communities, frogs, the Mountain Pygmy-possum and Broad-toothed Rat. They were very concerned to know more about how climate change will increase the abundance, diversity and impacts of invasive plants and animals. This includes many specific weed and animal threats and ways to manage them including feral horses, introduced deer and hawkweed among others. They also want long-term datasets established and/or supported including on the spread of invasive species and changes in hydrology and wetlands. In terms of how this information should be disseminated, Parks staff prefers science-management workshops and reports, with factsheets and websites also useful.

1.3 Implications and recommendations

The survey highlighted the range and scale of the problems faced by those managing the Australian Alps. They know that climate change is occurring and increasing the impact of

many existing threats, and that much more needs to be known to assist management. This reflects the complexity of dealing with climate change more generally for those responsible for conservation of natural ecosystems in Australia. As always the challenge is how do as much as possible with limited resources. Therefore we recommend the following approach and priorities to support climate change research for the Alps:

1. Maintain and support existing long term monitoring programs, particularly those already run and supported by the Parks. They already exist and are often part of day to day management. The Alps are lucky as they already have several programs, some with over 50 years of data. This is very unusual in Australia and puts the Alps at the forefront of monitoring the effects of climate change and other processes.
2. Provide support through co-funding and/or logistical support when approached by outside organisations (Universities or others) for research that match the topics listed by Park staff. Co-funding and/or logistical support provides greater benefit to the Alps from limited funding pools.
3. Widely disseminate existing research. There is a lot of good research in the Alps, but often Park staff are unaware of it. Science-management workshops and newsletters are great ways to promote recent research findings and ensure that research is easily available. This can also include practical implications of research for management.

2. PROJECT BACKGROUND

Anthropogenic climate change is already affecting ecosystems worldwide and much larger effects are predicted in the future (Intergovernmental Panel on Climate Change, 2007). Mountains are considered to be among the most vulnerable ecosystems to future climate change, and the Australian Alps is one of the three most at risk ecosystems in Australia. Predictions include warmer temperatures, less snow, reductions in glaciers and increases risk of glacial lake outburst floods (Intergovernmental Panel on Climate Change, 2007). These changes matter as mountains are important providing economic, cultural and ecological values such as major water catchments, biodiversity reserves and tourist destinations (United Nations Environment Program, World Conservation Monitoring Centre, 2002; Harmon and Worboys, 2004).

The Australian Alps National Parks conserve most of mainland Australia's snow country, contain a UNESCO Biosphere Reserve and RAMSAR wetlands, and are of such national significance that they are The area is a National Heritage List as a National Landscape and is considered to be of world heritage quality. The unique biota is of considerable biological importance individually and collectively, including many endemic and rare species of plants and animals (Pickering *et al.*, 2004; Green and Osborne, 2012). Globally it has one of the highest proportions of endemic species of any alpine flora (Pickering *et al.*, 2004). The total amount of precipitation falling as snow and the maximum altitudinal range within which snow occurs is already very limited in Australia (Green and Osborne, 2012).

Climate change predictions of temperature increase and changes in precipitation will result in a dramatic reduction of snow cover; amplifying existing threats such as biodiversity loss, intensive fires, increasing weeds and feral animals, human demands on ecosystem services and tourism uses (Pickering *et al.* 2004; Pickering, 2007; Green and Osborne, 2012; Morrison and Pickering 2012a).

Long term monitoring of changes in climatic factors is critical to expose the physical, biological and social effects of a warmer climate on natural systems. For the Australian Alps this includes monitoring changes in temperature, snow cover, ice cover, stream flow, phenology of plant and animal species and composition of plant and animal communities

among others (Pickering et al. 2004; Nicholls, 2005; Scherrer and Pickering, 2005; Gallagher et al., 2009; Green and Osborne, 2012). Long term physical or biological datasets are limited in the Australian Alps compared to European and North American mountains, but within Australia, they are exceptional (Pickering et al. 2004; Hennessy et al., 2008; Pickering, 2011; Green and Osborne, 2012; Morrison and Pickering 2012b). There are few climatic stations that have monitored temperatures for more than 50 years in the Australian Alps. Snow depth monitoring is limited to four snow courses and only one snow course, at Spencers Creek, has been monitored continuously since 1954 (Hennessy et al., 2008; Green, 2010). There has been some long term monitoring of vegetation including plots in Victoria and NSW to assess the impacts of grazing, which are now used to assess climate impacts (Scherrer and Pickering, 2005; Green and Osborne, 2012). There is also long term monitoring of animal populations including the Broad-toothed Rat (*Mastacomys fuscus*) (Green, 2002; Green and Osborne, 2003), Mountain Pygmy Possum (*Burramys parvus*) (Broome, 2001) and Corroboree Frogs (*Pseudophryne corroboree* and *P. pengilleyi*) (Osborne and Davis, 1997), now being used to monitor climate change impacts (Green and Osborne, 2012). Incidental monitoring by long term researchers has been used to look at the impacts of climate change on a range of plants and animals (Green, 2010). Monitoring programs specifically assessing changes in vegetation from climate change have been established including the Global Observation Research in Alpine Environments (GLORIA) (Pickering et al., 2008), the Global Mountain Biodiversity Assessment (GMBA) (Pickering et al., 2004) and the International Tundra Experiment (ITEX) (Williams et al., 2008).

Despite the increased use of monitoring in the Australian Alps, more research is required (Morrison and Pickering, 2011, 2012a,b). When different stakeholders in the region were asked to list factors that limit their capacity to adapt to climate change, a lack of research and knowledge of existing research was considered a major issue (Morrison and Pickering, 2011). They also identified future research needs involving long term monitoring (Table 1).

Table 1: Future research needs identified in Morrison and Pickering (2011).

Long-term ecological monitoring
More accurate climate change predictions
Identification of trends (ecological and climatic)
Understand limits for human disturbance (numbers, activities)
Social perceptions (skiers and general public)

Better data on climate variability and frequency of extreme events**Separate impacts of climate change and other factors**

Path models to demonstrate flow on impacts

Cost-benefit analysis research for adaptation strategies

Environmental impacts of cloud seeding and feasibility in natural settings

Better data on impacts of climate change on water- surface and groundwater**More information on major weeds and removal****Community response to climate change****Better data on fire risk**

Research needs in bold involve long term monitoring.

2.1 AIMS

The aims of the survey are to assess climate change research and monitoring requirements of Parks staff and researchers in the Australian Alps. This survey follows on from work for the National Climate Change Adaption Research Facility on limits to climate change adaptation in the Australian Alps (Morrison and Pickering, 2011). It expands on the interviews of the focus groups in that study in order to:

1. Assess the level of knowledge of climate change and its impacts among protected area staff and researchers in the Australian Alps.
2. Assess how/if a lack of research and monitoring and/or knowledge of existing monitoring is a limit to climate change adaptation in the region.
3. Assess the priorities for physical and biological monitoring relating to conservation issues for the Parks – as seen by both Parks staff and by researchers.
4. Asses the priorities for social/visitor research and monitoring by Parks staff and researchers.

3. METHODOLOGY

3.1 DEVELOPMENT OF THE SURVEY

A survey instrument was designed to obtain information about climate change research and monitoring requirements of Parks staff and researchers in the Australian Alps. The questions in the survey followed on from the interviews conducted by Morrison and Pickering (2011). Fink's (2003a, 2003b) 'Survey Kit' and Veal's (2011) 'Research Methods for Leisure and Tourism' were also used as survey design guides. Fourteen questions were included in the first draft survey including information on respondents' perceptions of ecological, biological and visitor impacts due to climate change, research availability on those topics and future

research needs for monitoring and management of climate change in the Australian Alps. The questions were derived from the responses of previous stakeholder interviews (Morrison and Pickering, 2011) and from a draft survey developed by Ken Green in a research proposal for the Australian Alps Liaison Committee (Green, 2011). The surveys are anonymous and no personal information about the participants was requested, except for their job title and responsibilities so that the opinions and needs of different stakeholders could be compared.

Question formats included six multiple choice, four Likert scale and four open-ended questions. The survey was then programmed into SurveyMonkey™ online (basic version is free to the public) and a web link created (<http://www.surveymonkey.com/s/ozalpscc>). This link was sent to Griffith University academics, a representative from the Australian Alps Liaison Committee (AALC) and a Principal Research Scientist from NSW National Parks and Wildlife Service to pilot test the survey. A total of three iterations of the survey were produced until it was accepted by the research team. An extra five open-ended questions and one multiple-choice question were added to the survey. Even though it can be more difficult to analyse data from open-ended questions, they allow survey respondents to be more specific when listing their research needs. The final survey instrument (Appendix 1) was submitted to the Griffith University Ethics Committee and ethics approval obtained prior to survey distribution (ENV/44/11/HREC).

3.2 SURVEY ADMINISTRATION

Parks staff and researchers working in the Australian Alps region were surveyed. Parks staff were contacted via an e-mail from members of the Australian Alps Liaison Committee or their nominees in early December 2011. Researchers in the Australian Alps were contacted via an email sent to members of the Australian Institute of Alpine Studies by Dr Ken Green, also in early December 2011. The e-mails outlined the project, including its aims and importance and asked staff/researchers to undertake the questionnaire electronically using a link in the e-mail to SurveyMonkey (see Appendix 3). A hard copy of the survey was also available upon request. The first page of the questionnaire provided information about the survey and required informed consent before proceeding with the survey (Appendix 4). The

survey was closed on 12 March 2012 after consultation with the Australian Alps Liaison Committee and Australian Institute of Alpine Studies regarding the number of responses.

4. RESULTS

4.1 WHO PARTICIPATED IN THE SURVEY?

A total of 31 of respondents answered one or more question in the survey, and all provided informed consent. All of those who answered the survey had completed 'tertiary/university level' education.

Nearly all the respondents were Parks staff, with 17 respondents selecting just Parks staff and a further 6 selecting both protected area management and researcher (Figure 3). Only 4 respondents only selected "researcher". Of the four respondents who selected 'other' their professions were: consultant, conservation partnership officer, adaptation policy officer and consultant researcher/advisor on management adaptation.

The most common answer given to the open-ended questions "What is your current position" was park staff/ranger (Table 2). The next most common positions were lecturing and researching, natural resource or environmental managers.

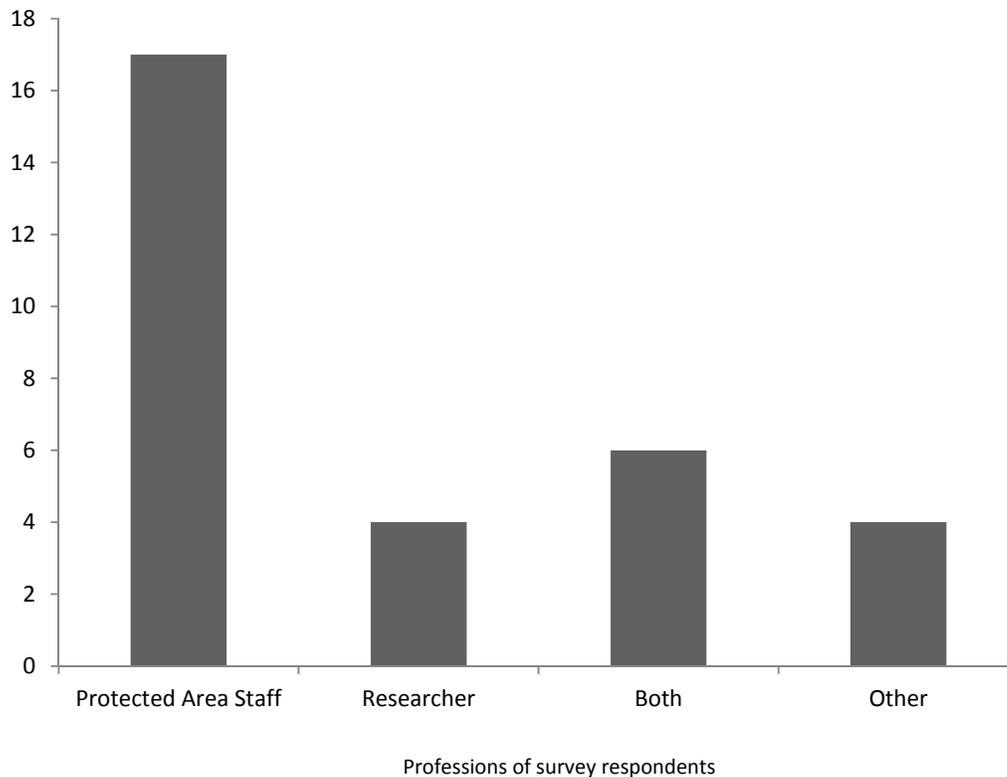


Figure 1: Number of respondents in different professions.

Table 2: Responses to the open-ended question “What is your current position” (29 respondents).

Position	Number of respondents
Park staff/ranger	8
Other	6
Lecturer/researcher	5
Natural resource/environmental managers	4
Project officer	3
Ecologist	3
Total responses	29

When asked to describe the primary responsibilities of their positions, 7 respondents listed acting project managers, 6 working in ecology, 5 conduct original research, and 4 each listed conservation work, pest management, consultation and advice-giving/staff management.

The majority of those who undertook the survey have considerable experience in their position (Figure 2). Nine respondents had over 10 years’ experience, 8 between 6 and 10 years and 6 between 3 and 5 years.

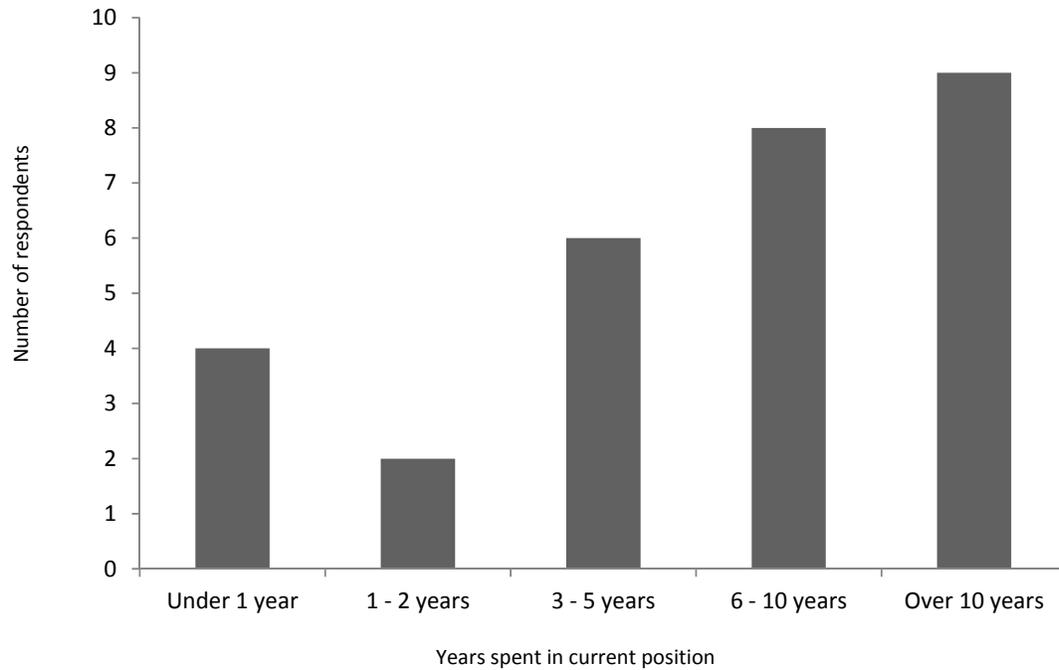


Figure 2: Duration respondents have spent working in current position.

4.2 CLIMATE CHANGE IN THE AUSTRALIAN ALPS

Those surveyed obtain information on climate change in the Australian Alps from a range of sources including their own organisations, scientific sources and the media. Where respondents selected the ‘other’ option, sources listed included: agency staff, the internet, participation and involvement in climate change work, colleagues, Alps newsletters and personal research.

When asked how they would prefer to access new information about climate change, the most common response was through reports and also science and management workshops (Figure 4). Websites and factsheets were also seen as useful by some. Other responses included the use of: internet, international collaboration and community initiatives.

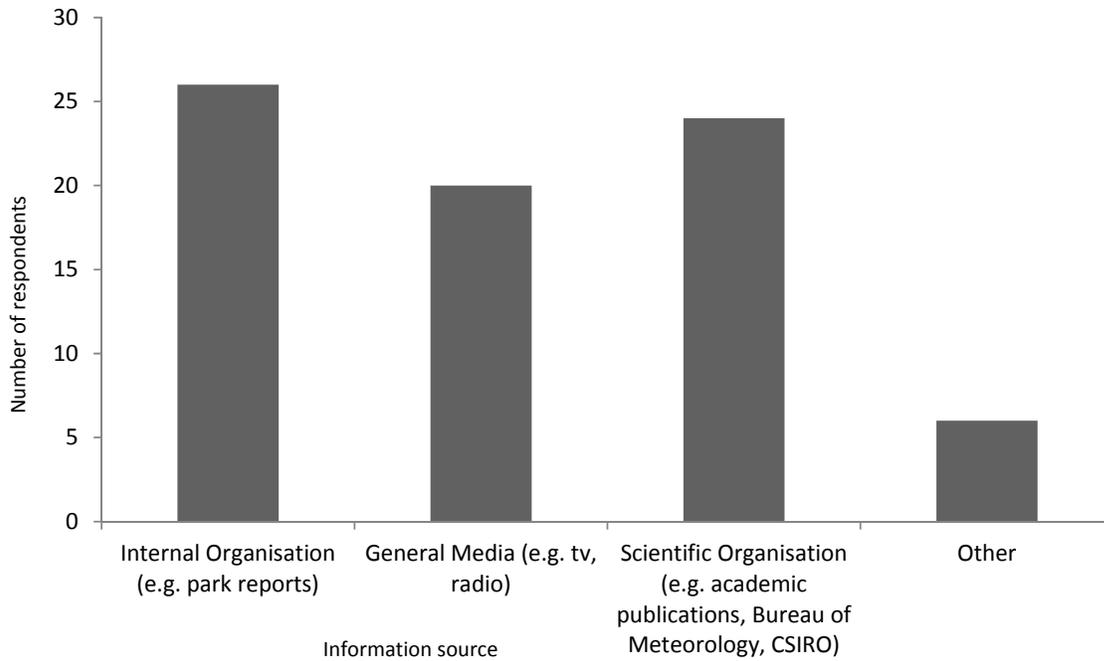


Figure 3: Information sources from which knowledge of climate change in the Australian Alps has been gained by the respondents.

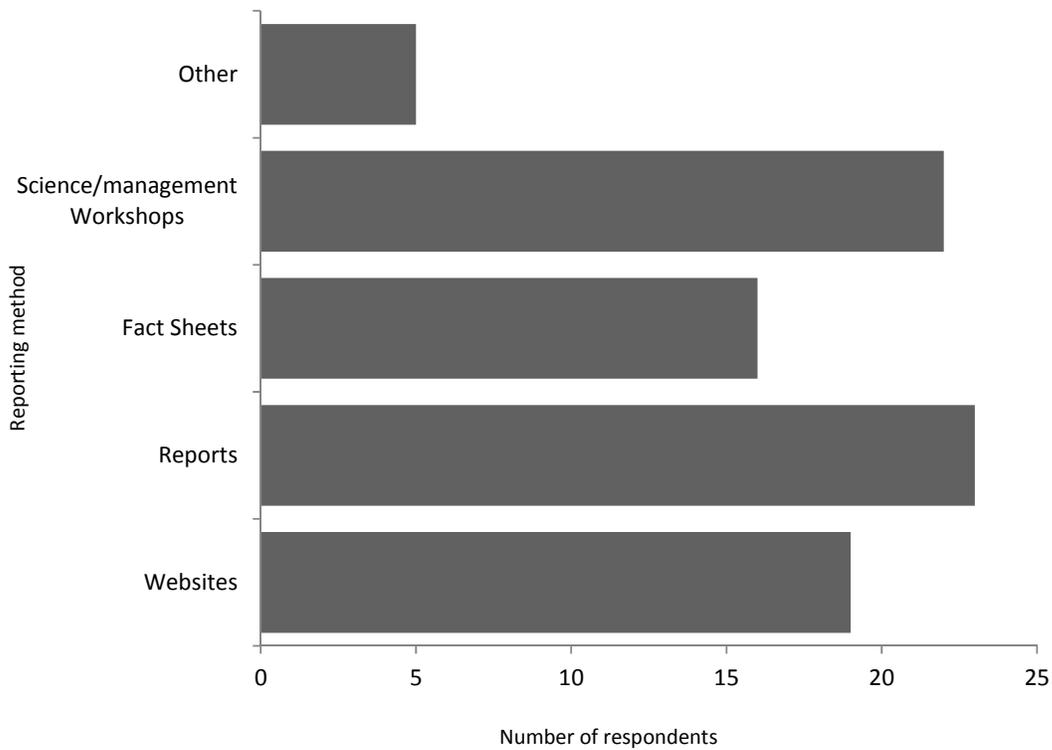


Figure 4: Sources used to obtain new information on climate change.

Respondents were asked if they thought that there were climate change impacts currently occurring in the Australia Alps. Fourteen potential impacts were listed and respondents given the option of saying yes, no or don't know (Figure 5). All staff agreed that at least one impact was already occurring, with impacts listed by respondents ranging from changes in the timing of biological events to decreased water availability and the loss of endemic species.

The impacts most commonly listed as already occurring was decreased snow cover with 30 saying yes and one person not knowing. Other common impacts were increased fire frequency and changes in the timing of biological events. Other impacts were decreased/altered rainfall and water availability, and increases in invasive species. Impacts listed by at least half of those surveyed were decreasing soil moisture, increased storms and loss of endemic species. Impacts most commonly listed as not occurring were changes in summer tourism, decrease in snow-based tourism industry and drier summers. The impacts respondents felt least able to express an opinion about were increased cost of skiing, changes in summer tourism and the loss of endemic communities.

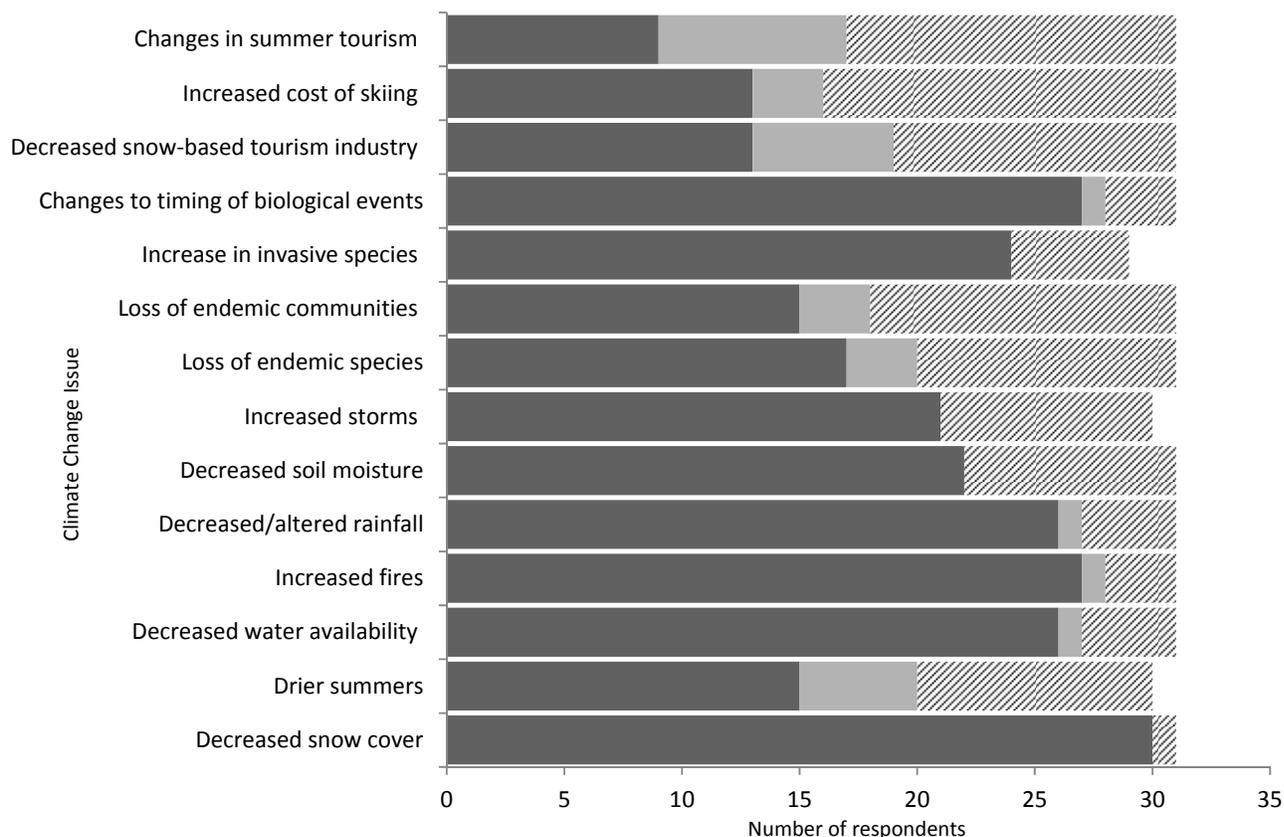


Figure 5: Different impacts of climate change identified by park staff and researchers within the Australian Alps protected area. Responses were 'Yes' (dark grey), 'No' (light grey) and 'Not relevant to my area of expertise' (hatched).

4.3 RESEARCH AND MONITORING IMPACTS OF CLIMATE CHANGE

It was important to determine if Parks staff and researchers felt that information about research limited adaption to climate change in the Australian Alps (Figure 6). All but 1 respondent listed that research was a limit for at least one topic, 3 listed all topics, and 7 listed at least 80% of these topics. The topics most commonly listed were increases in invasive species (25), loss of endemic species (24) and communities (23), changes to timing of biological events (22) and decreased soil moisture (18). The topic thought to have the most adequate monitoring was snow cover, but even for this many respondents felt monitoring was still insufficient. Topics which most respondents felt unable to comment or were not relevant to their area of expertise were changes in summer tourism, increased cost of skiing and decreases in the snow based tourism industry.

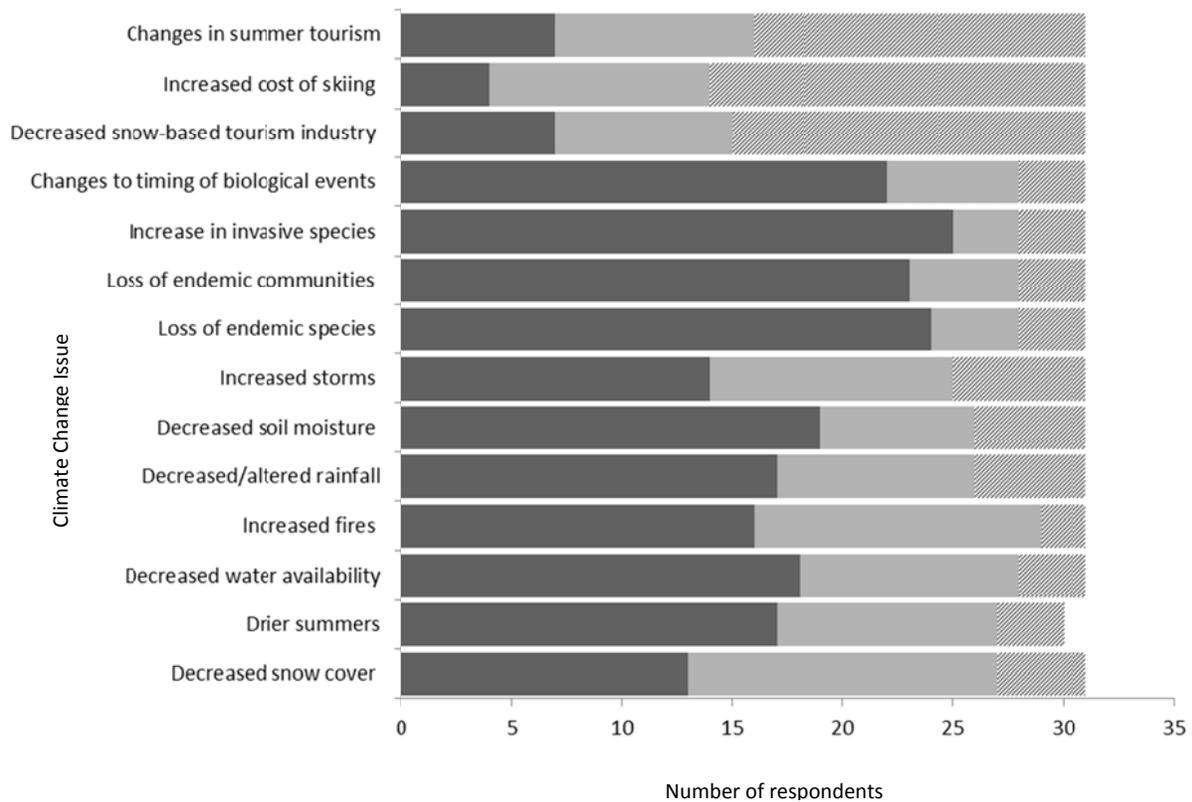


Figure 6: Research areas concerning climate change in which park staff and researchers believe there should be more work. Responses were 'Yes' (dark grey), 'No' (light grey) and 'Not relevant to my area of expertise' (hatched).

Respondents were asked about the importance of information regarding different impacts for their area of expertise/responsibility (Figure 7). All respondents answered this question with several people listing all or nearly all topics. There were six topics everyone listed: increases in invasive species, loss of endemic communities and species, decreased/altered rainfall, decreased water availability and drier summers. For a further three topics, all but one person felt they were important: decreased snow cover, decreased soil moisture and changes in the timing of biological events.

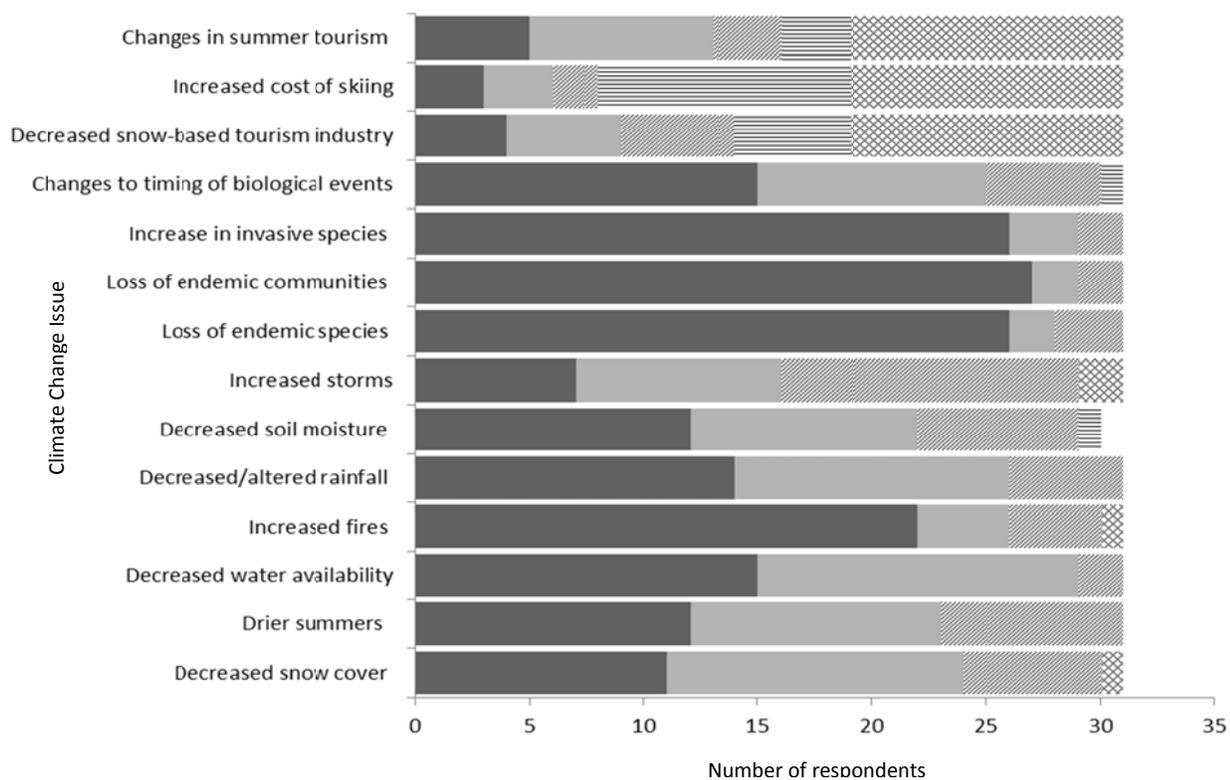


Figure 7: Important areas for future research and monitoring. Responses were 'Very Important' (dark grey), 'Important' (light grey), 'Moderate' (diagonal hatching), 'Not Important' (horizontal hatching) and 'Not relevant to my area of expertise' (crossed hatching).

Physical process were insufficient data could limit management included erosion and stream flows (Figure 8). Other processes listed by a few respondents including catchment, bog and wetland hydrology, soil moisture and evaporation, changing weather patterns and fire regimes.

Open-ended questions were used to determine priorities for physical and biological monitoring for the Australian Alps. When asked which plant or animal species need attention, a wide range of responses were provided (Table 4). The most commonly mentioned species/types of animals were frogs, in particular the Corroboree Frogs (*Pseudophryne corroboree* and *P. pengilleyi*). Other species specifically mentioned were the Mountain Pygmy-possum (*Burramys parvus*), Broad-toothed Rat (*Mastacomys fuscus*), rare skink species, Spotted-tail Quoll (*Dasyurus maculatus*), Snow Gum (*Eucalyptus pauciflora*), Leadbeater's Possum (*Gymnobelideus leadbeateri*) and Bogong Moths (*Agrotis infusa*). More general answers included species in alpine communities, threatened species, species in

threatened communities and endemic species. One respondent highlighted the need for a focus on soil invertebrates, invertebrate herbivores and pollinators.

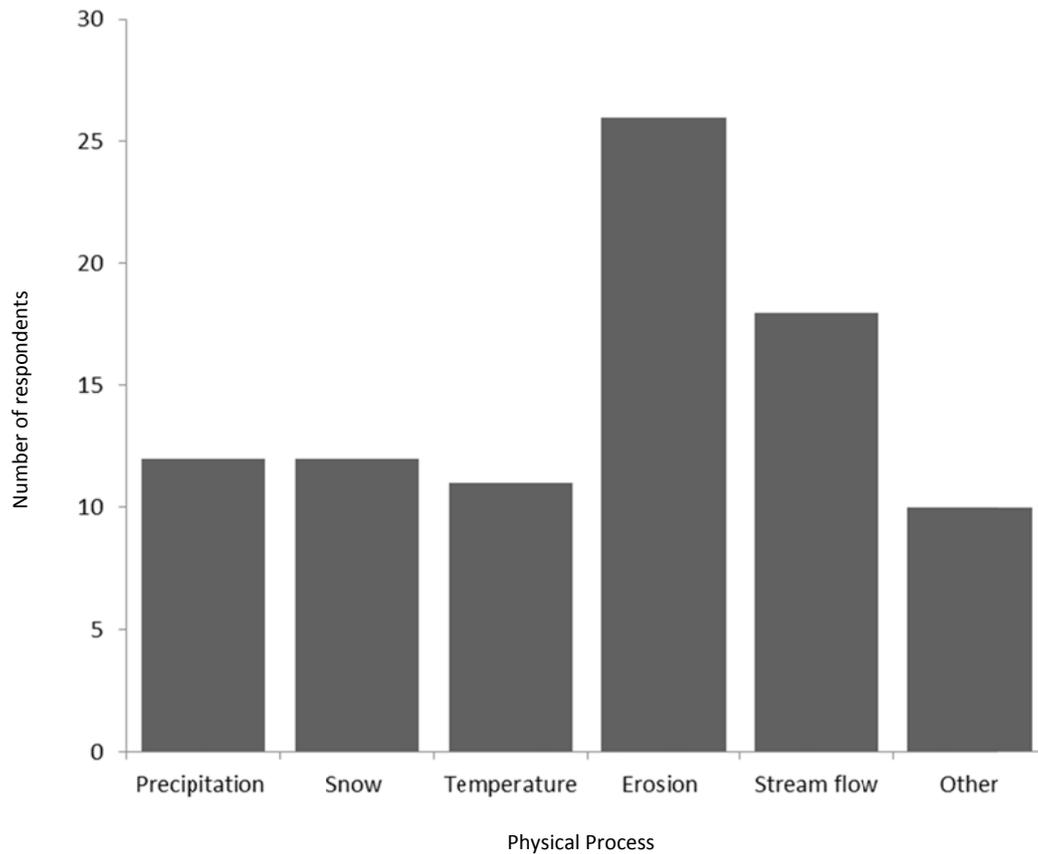


Figure 8: The variety of physical processes for which there is insufficient data to guide appropriate management.

Table 4: Summary of response to the open-ended question “What plant or animal species need attention to preserve them in Australian Alps National Parks?” (30 respondents)

Response included mention of...	Number of respondents
Frogs (incl. Corroboree spp.)	12
Species in alpine communities	8
Mountain Pygmy-possum	8
Other	7
Endemic species	6
Broad-toothed Rat	5
Species in threatened communities	4
Threatened species	3
Reptiles (primarily rare skink spp.)	3
Snow Gum	2
Spotted-tail Quoll	2
Total responses	60

Specific responses included:

“All listed threatened species and communities” “All threatened or rare species and communities”, “All rare and threatened sp or sp. with limited distribution” “Frogs” “Alpine ash (sensitive to fire), corroboree frogs and broad-toothed rat (dependent on bogs)” “rare skinks/herps.” “Plants and animals of the high alpine and bog and Fen EVC’s, including: Mountain Pygmy Possum, Broad toothed Rat, Corroboree Frog and others” “Mt Pygmy Possum, B-Tail Rock Wallaby. Euc. Fastigata stands.”...“All endemic species, particularly species restricted to high altitudes.” “Horses and Orange Hawkweed need serious control” “Bogong Moths, Frogs, Mountain Pygmy Possum” “Threatened species in alpine areas particularly in resorts eg. MPP, BTR, Bog, Alpine and Guthega Skinks” “We need to know what impact there will be on the Alpine environment with reduced snow cover - what species are most at risk and what can be done to minimise this risk” “highly specialised or localised species, such as the corroboree frog” “in general alpine communities” “All of the many threatened species especially amphibian species such as corroboree and alpine tree frogs and the spotted tailed quoll.” “Corroboree Frogs Broad toothed rats Mature Snow Gums Mountain Pygmy Possums lack of data to determine invertebrates” “Southern Corroboree Frog Baw Baw Frog Spotted Tree Frog Mountain Pygmy Possum Broad-toothed Rat” “mountain pygmy & leadbeater possum, tiger quoll, corroboree frogs” “Snowpatch communities.” “As a priority all obligate alpiners and endemics but all communities and species need some attention to ensure maintenance and survival” “Burrhamys. Sphagnum and other bog species” “all endemic species” “soil invertebrates invertebrate herbivores pollinators” “endemic species should have priority; it won’t be possible to preserve all species” “Small mammal species - including threatened species Burrhamys & Mastacomys Skink species Bat species Montane Bogs All alpine vegetation communities” “probably all but particularly the endemics’ “C Frog Mtn PP” “Alpine endemic invertebrates and alpine/subalpine frogs”

When asked what geographical areas, ecosystems or communities need attention, and why, the most commonly mentioned were bogs, moss-beds and fens (Table 5). Second to this, were alpine communities, snow-patch communities, all communities listed as threatened, fire-sensitive communities, grasslands/treeless plains, sub-alpine communities and Snow Gum woods. A number of single responses were tourism-affected areas and boulder-field vegetation, as well as particular locations and species such as the Victorian Alps and Surveyors Creek basin.

Table 5: Summary of response to the open-ended question “What geographical areas, ecosystems or communities need attention, why?” (29 respondents)

Response included mention of...	Number of respondents
Bogs/mossbed/fen communities	15
Alpine communities	11
Other	5
All threatened communities	4
Snowpatch communities	4
Subalpine communities	3
Fire-sensitive communities	3
Grassland/treeless plains	3
Snow Gum woods	3
Short alpine herbfield	1
Tourism-affected areas	1
Total responses	53

Specific responses included:

“Treeless plains and alpine areas, all threatened ecosystems” “Bogong High Plains, Mossbed communities” “Victorian Alps, with the possible exception of the Bogong High Plains” “All alpine and subalpine. Areas subject to 2003 fires Don't forget outliers e.g. Coolah Tops, Barrington Tops etc where there are remnant alpine species.” “sub alpine bogs and fens - changes in hydrology could change this community to another community” “areas impacted by natural events, such as fire, coupled with areas impacted by increased tourism.” “The high alpine and bog and fen ecosystems to ensure they are resilient to withstand changes brought about by Climate change, particularly to be resilient to movement upwards of invasive species, both plant and animal, increased fire and decreased soil moisture” “Would like to see section of Surveyors Creek basin between Mt Barlow & Mt Tempest (30km south of Corryong) included in the ANP. Little studied high rainfall EVC including Euc. fastigata & giant tree ferns. Other isolated PV managed areas should be linked via protected corridors eg scenic reserves, Wabba Wilderness, island parks, internal State Forests i.e. surrounded by ANP. These currently are too difficult to manage & protect because of different Regulations or impractical boundaries.” “Some areas, such as Bogong High Plains in Victoria are relatively well studied; most other areas very poorly studied. Snow patch and most alpine/subalpine wetland and riparian communities need much greater attention.” “All of them but eroding landscapes and sensitive ecosystems such as bogs need most attention.” “Snow Gums & Alpine Ash as they have a very altitude cool climate dependency. Sphagnum Moss beds as they are dependent as above and with rainfall levels” “Alpine areas in resorts” “fire sensitive communities” “Karst areas and grassland plains as these are being most heavily impacted by large introduced herbivores such as

horses and deer.” “Needs to be more assessment of fire impacts on communities to answer that question. Mature Snow Gum Woodlands may be impacted by fire, drier climate. Bogs and Fens likely to be impacted by drier climate.” “Bogs and fens. Decreased snow cover and water availability through summer means that they are becoming more ephemeral in the landscape. This has implications for threatened species such as the Southern Corroboree Frog” “alpine peatlands (bog and fen), poa species” “All areas as they are all a part of the Alps catchments, hence runoff and water yields in terms of impacts upon Alps and downstream ecosystems.” “Boulder field vegetation communities (for Burramys). Alpine bogs and fens” “All areas, ecosystems and communities require attention to maintain whole-catchment values, for the alps, and those areas downstream” “highest elevations freshwater communities detritivore communities” “alpine peaks & slopes (restricted communities) and peatlands (fire management & water mgt implications)” “All alpine areas - identification of communities most vulnerable to increased threats, ie fire, pests, recreation, etc” “Alpine Bogs and Associated Fens. Most of what we think we know about them has yet to be satisfactorily tested.” “snowpatch and peatland communities as these are particularly sensitive and contain many endemics” “Snow patch feldmark because of lack of long duration snow patches” “Snowpatch communities, short alpine herbfields, bogs and fens”

When asked to list invasive plants or animals the most commonly listed were introduced deer and horses (Table 6). For these two species, suggested methods of control included coordinated research and long-term innovative plans for removal, direct elimination by shooting or poisoning, declaration of these animals as national pests and the intensification of current control programs.

Invasive hawkweeds (*Hieracium* sp.) were identified as a threat to the region’s ecosystems with increased monitoring and control and physical removal of plants suggested as management techniques. Common Broom (*Cytisus scoparius*) and feral pigs were mentioned. Management of Common Broom was only discussed by 2 respondents who also suggested long-term monitoring and targeted removal.

In order to control pig populations, respondents suggested coordinated long-term monitoring and shooting. Other species of concern included hares and rabbits, Red Foxes (*Vulpes vulpes*), exotic willows (*Salix* sp.) and cats and dogs. For exotic willows, pulling was mentioned as a possible management strategy, and long-term monitoring was also discussed. For hares, rabbits, foxes, cats and dogs, coordinated control programs were

suggested including phasing out of pet ownership within the resorts and experimental baiting, shooting, trapping and poisoning.

Other problem species included Common Blackberry (*Rubus fruticosus*), exotic Asteraceae and exotic Hypericaceae, exotic grasses, European Carp (*Cyprinus carpio*), Laughing Kookaburras (*Dacelo novaeguineae*), European Starlings (*Sturnus vulgaris*), the Rutherglen Bug (*Nysius vinitor*) and insect herbivores in general. Others discussed very general points about climate change and introduced taxa without detailing any particular species or control methods.

Table 6: Summary of response to the open-ended question “What invasive plants or animals are likely to cause problems, how can we best deal with them?” (27 respondents).

Response included mention of...	Number of respondents
<i>Invasive species</i>	
Feral horses	12
Introduced deer species	12
Exotic hawkweeds (<i>Hieracium</i> spp.)	8
Feral pigs	7
English Broom	7
European Red Fox	6
European hares and rabbits	6
Exotic willows (<i>Salix</i> spp.)	6
Feral cats and dogs	5
Exotic Asteraceae (not incl. hawkweeds)	3
Common Blackberry	3
Exotic Hypericaceae	3
Introduced European Carp	1
Exotic Poaceae	1
Other	8
<i>Proposed management of invasive species</i>	
Coordinate research + LTM with targeted control	4
Shooting	4
Poison-baiting and trapping	4
Pulling (weeds)	2
Long-term monitoring (LTM)	1
Focus on new and emerging species	1
Declaration of species as a national pest	1
Intensification of current control regimes	1
Phasing out of pet ownership in resort areas	1
Total responses	107

Specific responses included:

"Horses, Pigs, Deer, Cats, Foxes, Rabbits, Hares -- all require control programs and co-ordinated research" "Hawkweed, English Broom, St Johns, Shasta and Ox Eye Daisy, Lotus, Yarrow, introduced grasses etc" "Many sp. but should have a focus on NEWT's (new and emerging) that impact vulnerable communities." "Feral horses Deer spp ELIMINATION - NOT JUST "CONTROL" - must be the objective" "hawkweed, horses, deer. learn more, monitor and control" "This is the key area that needs research, but expect that increased pressure will come from the upwards movement of Broom, Balckberry, Willow, Feral Horses, Deer et al" "E.Carp expansion into new waters. E. Fox & feral cats/dogs - increased experimental baiting & eventual fazing out pet ownership in Resort Commission Areas eg. Falls Creek." "feral horses, feral pigs, rabbits & hares exotic daisies, brooms, seeding willows, weeds of alpine bogs and streams" "Horses and Orange Hawkweed - horse programs need to be stepped up." "Blackberry, Hawkweed, St Johns. continued follow up, More effort in natural predators treatments. Sambar deer , Brumbys- - declare them to be a pest animal" "Orange hawkweed, cats and foxes - ongoing and intensive survey and removal programs" "we need to know what invasive species are the highest risk / priority for future management. These may be native to Australia" "unclear which plant species will become weeds with increasing temperature and declining snow cover" "A very wide variety -- too many to mention but as a starter english broom" "To many to mention but top priorities are: Horses - Significantly reduce numbers through a range of methods including ground and aerial shooting. Ox-eye daisy - suitably resource control programs including aerial spraying. Pigs, deer, rabbits, st johns wort, etc" "Orange Hawkweed needs to have major attention to contain and hopefully eradicate." "Feral deer are spreading throughout the Alps and will inevitably spread above tree-line with increased temperature and decreased snow cover. These need to be controlled. Similarly, foxes and feral cat populations may be increasing above tree-line and/or have a greater impact with reduced snow cover and warmer weather. These need to be controlled also." "horses, deer, cattle, pigs, broom, willow, blackberry, hawkweed" "I think insect attack on plants may increase with climate change. Especially as flowering regimes, fire incidents and bird migrations change." "Wild horses, deer, goats, foxes, rabbits Increasing innovative control and management effort and financial resources" "Feral horses, deer, pigs, rabbits. Willow, Broom. All require a long-term strategy to eradicate them as much as possible." "This is a whole PhD thesis and can't be answered here. Anything with high fecundity, broad ecological niches, and good dispersal mechanisms." "species that structurally alter the ecosystem - such as woody weeds and species invading degraded peatlands/wetlands" "We need to better understand and or separated invasive from non-invasive species. Altitudinal changes in exotic plant species Riparian/ aquatic species - Salix, Juncus Large herbivores major issue for all of

the alps areas - increasing numbers - impacts on riparian vegetation. Montane Bogs” “willows, hawkweed, broome, cats, foxes, bait, shoot, trap, poison and pull out” “Deer-poison Horses- shoot pigs-shoot, trap and poison” “Horses, deer, pigs, foxes, rabbits, kookaburras, starlings, rutherghlen bug”

When asked to list what long-term datasets are most urgently required and where, eight people discussed the importance of creating and maintaining long-term datasets on invasive species spread within the Parks (Table 7). Seven proposed that hydrological change requires urgent attention in terms of responses to and interactions with climatic change. The cover of native vegetation and its changes within the Parks, the altitudinal distribution and abundance of native species and soil moisture/flow received was also mentioned. Other factors included the importance of monitoring and recording changes in fire regimes and the compilation of a consistent and widely-disseminated dataset across the region.

Table 7: Summary of response to the open-ended question “What long-term datasets do we need most urgently to monitor changes in natural resources and where?” (25 respondents).

Response included mention of...	Number of respondents
Invasive species spread	8
Hydrology and wetland change	7
Soil moisture and flow	3
Species altitudinal distribution and abundance	3
Native vegetation changes and cover change	3
Fire regimes	2
Focus on consistent datasets across the region	2
Weather and climatic trends	1
Impacts of control programs	1
Forest debris monitoring	1
Increased understanding of recreation impacts	1
Monitoring alpine communities	1
Phenological change	1
Other	4
Total responses	38

Specific responses included:

“weed spread and weed behaviour related to temperature and moisture” “Any that are relevant to the above.” “fire regimes, wetland hydrology and changes to extent or character of wetlands” “distribution and abundance of above species, and impacts of control programs.” “Catchment

condition and related movement of invasive species into higher altitudes” “Areas such as expansion of lower alt species increasing up mountain. DNA changes to Alpine species. Water quality over stream lengths in & out of ANP. Effect of increased burning regimes.” “In addition to all the things mentioned in previous questions, we need data on catchment, ecosystem condition and vegetation community condition.” “Change in vegetation cover and structure, monitoring of forest debris and invasion of weeds” “Vegetation changes including both native and non-native plant species transition into higher altitudes and habitats not previously seen” “Increased understanding of recreational impacts should be better understood, so while some activities may be reduced others may be expanded as impacts may be minimal (or can be mitigated)” “start with alpine communities” “Better understanding of what flora and fauna we currently have where.” “most pressing issue - would need to investigate more to give a good answer.” “Information about stream flow and soil moisture levels. Information about changing status of pest vertebrate animals.” “consistent field recording across districts” “common baseline vegetation data across all areas.” “Catchment soil moisture regimes and water yields, and ecosystem thresholds to changes / reductions of these.” “Spatial data to monitor the extent of different types of alpine treeless vegetation. This should be able to act as a surrogate for overall alpine vegetation and the treeline in general.” “rainfall, snow data, soil moisture, solar radiation from the alpine areas. Vegetation change data-sets in alpine/sub-alpine areas too -specifically changes to woody vegetation (trees/shrubs)” “flowering dates and key insect emergence dates” “using historical data (plots, photos) gives us the best data to assess how climate change is already affecting the Alps” “Changes in exotic species distribution - altitudinal changes.” “you can't create long term data sets urgently, so it is best to build on/revisit those that we already have, like Maisey's plots and Costin's work” “widespread monitoring of deer and horse impacts across all areas” “Freshwater quality and quantity”

When asked about any other topics for research or monitoring the most commonly listed topic was the increased spread of invasive species due to climatic change (Table 8). Four respondents added their opinions that monitoring hydrological change should take precedence in the Australian Alps and two discussed the importance of fire regime and species distribution/abundance data.

Table 8: Summary of response to the open-ended question ““Is there any other field of research or monitoring that you think should be undertaken in the Australian Alps National Parks as a climate change priority?” (19 respondents).

Response included mention of...	Number of respondents
Invasive species spread	6
Hydrology and wetland change	4
Fire regimes	2
Species altitudinal distribution and abundance	2
Soil moisture and flow	1
Direct impacts of climate change on vegetation	1
Geomorphological change	1
Phenological change	1
Research into community perceptions of climate change	1
Restoration and adaptive management	1
Increased understanding of recreation impacts	1
Other	2
Total responses	23

Specific responses included:

“Increase/change in weeds and pests movement in the alps” “invasive weed spread over time”
“Landscape sciences’ - eg Geomorphology, Soils” “water and the alps - relationship between more/less water and environment” “Likely tourism and visitor trends” “Water/ carbon extraction of various species of plants in high & low alt sections of the ANP.” “distributions, abundances and impacts of introduced animal species (and natives with likelihood of changed distributions), including horses, deer, pigs, lagomorphs, rodents, insects.” “Stream water temperature and flow volumes.”
“Fire, both in terms of impact on species / communities from increased fire as well as improved methods in reducing fire threats to assets (both natural and man-made assets)” “better understanding of how species (native and invasive) will move along altitudinal gradients. Do we need to (as a priority) create functional connectivity from lowland to highland areas, or is it more important to create longer north-south corridors?” “Change in treelines.” “more peatland”
“Research into community perceptions on climate change and management response.” “Research to underpin innovative adaptive management programs that will ameliorate the impacts of any climate changes. Ecosystem restoration ecology” “The main priority is determining how best to control introduced plants and animals. We can't make the alps colder or wetter, so all we can do is buffer the native plant and animal communities to give them the best chance to cope with the inevitable changes.” “Impacts of predicted reduced snowfalls on vegetation community assembly and continued phenology studies. A better understanding of interactions between taxa (eg. pollinator

arrival and changes in species phenology), and the follow-on effects on community / ecosystem function.” “establishment of invasive species” “Fire, the response of hydrology-soils and ecologies.” “Freshwater quality and quantity”

When asked what non-research based activities should the Alps or individual organisations undertake to mitigate or deal with climate change the most common response was the control of weeds, introduced animal and diseases (Table 9). Other recommendation were better communication and education, evaluating and mitigating climate change effects on resort operators, snow-based industries, climate-change sensitive species/areas and high value species/areas.

Table 9: Summary of response to the open-ended question “What non-research based activity should the Alps program or individual agencies undertake to mitigate or deal with the effects of climate change?” (23 respondents).

Response included mention of...	Number of respondents
Control programs (weeds, pests, diseases)	9
Appropriate dissemination of knowledge/education	8
Protect climate change-sensitive species/areas	2
Evaluate resort operators response to climate change	1
Protect high value species/areas	1
Monitor water quality	1
Increased adaptability of snow-based industries	1
Reduce impacts of tourism/recreation	1
Fire management	1
Total responses	25

Specific responses included:

“Control programs for Feral animals and weed species” “target resources to protect high value areas/species/communities.” “Manage and treat threats to areas most likely to be impacted by Climate Change to build up resilience” “Spend money in areas such water quality i.e. natural erosion control with increased storm events, large scale, coordinated control of feral animals especially cats, foxes, carp etc.” “Dissemination & sharing of knowledge, convening of workshops & presentations.” “Culling feral species and controlling weeds” “Increased education with schools - not just with the Out door ed groups.” “better public education on the changes that will occur - this is a critical adaptation strategy that will help build public acceptance of new management approaches under CC” “Control horses.” “Measures to ensure local snow reliant industries are adaptable and have

options to develop beyond snow reliance.” “Pest and weed control.” “priority education in local alpine area schools - long term investment for future - awareness raising issues so they remain not so specific” “Education “Enhance all current management programs that can contribute to ecosystem resilience eg feral animal control, ecosystem restoration, etc. All programs should be underpinned by research!!” “Control introduced plants and animals.” “Reduce tourist impacts; upgrade informal routes through threatened ecosystems with board-walks (eg through bogs, especially between Charlottes Pass and the Thredbo Valley). Vehicle and foot station wash-downs (simple foot wash baths for reducing weed fungi spores etc). Boot brushes for tourists. Improved signage about the threatened/protected ecosystems in the alpine areas.” “lobbying and education of policy makers and the public” “Managing other threats to the ecosystem, such as fire, inappropriate development, weeds, pests & diseases” “Increased education amongst staff” “continue to educate the public about effects of climate change in the alps, particularly the skiing public” “maintain current weed and pest control programs” “Feral animal and weed control”

5. IMPLICATIONS

This project (i) determined current knowledge of climate change in the Australia Alps, (ii) how/if a lack of research is limiting adaptation and (iii) assessed priorities for physical, biological and social/visitor research and monitoring. All those surveyed recognised that climate change is occurring and were aware of, or had firsthand experience, of its impacts in the Australian Alps. The majority agreed reduced snow cover, changes in species phenology, water availability, fire regimes and the spread of invasive species will be/are important, which is similar to what was found by Morrison and Pickering (2011) and is supported by the literature (Pickering et al., 2004, Pickering and Morrison, 2012a; Green and Osborne, 2012).

Research, or rather a lack of research, on key topics is limiting adaptation to climate change in the Australian Alps. This includes information about the spread of invasive species, the loss of endemic species and communities, species phenology, and the physical processes of erosion and stream-flow. These factors, in combination with changing fire regimes, are regarded as the priority areas for future research by those surveyed.

More specifically, conservation priorities for respondents were endemic frog species (*Pseudophryne corroboree* and *P. pengilleyi*), alpine mammals (Mountain Pygmy-possum and Broad-toothed Rat) and other alpine restricted species. Alpine habitats including fens,

bogs and moss beds, alpine restricted communities and snow-patch communities were identified as those needing most research effort into the impacts of climate change.

Research into a number of invasive species and the impacts of climate change on their distribution and spread was also identified as a priority area. Feral horses and deer, pigs, hawkweeds, foxes, hares and rabbits are seen as the main threatening species introduced to the area and research into their control and management is urgently required. In addition to research, the co-ordination of active, targeted removal programs with long-term monitoring was identified as paramount to reduce their threat and mitigate the negative impacts of climate change in the region.

6. RECOMENDATIONS

These results highlight a challenge for Parks in determining where to allocate scarce resources when so much is required. In some ways the major result of the survey has been to highlight the scale of what is needed, rather than provided a short list of priorities. However, this reflects the actual challenges involved in dealing with climate change in the Australian Alps. Therefore, we recommend the following approach when allocating limited funding to try and enhance what can be achieved:

1. Maintain and support existing long term monitoring programs, particularly those already run and supported by the Parks. They already exist and are often part of day to day management. The Alps are lucky as they already have several programs, some with over 50 years of data. This is very unusual in Australia and puts the Alps at the forefront of monitoring the effects of climate change and other processes.
2. Provide support through co-funding and/or logistical support when approached by outside organisations (Universities or others) for research that match the topics listed by Park staff. Co-funding and/or logistical support provides greater benefit to the Alps from limited funding pools.
3. Widely disseminate existing research. There is a lot of good research in the Alps, but often Park staff are unaware of it. Science-management workshops and newsletters are great ways to promote recent research findings and ensure that research is easily available. This can also include practical implications of research for management.

We also want to highlight that the importance of considering social issues. Little weight was given to changes in the tourism industry and social sectors in responses. This is likely reflect the survey audience with the majority of respondents experienced active park managers and staff involved in the biophysical management of the parks rather than those involved in social or tourism sectors. As such, there is a distinct lack of knowledge on the current and future impacts of climate change on the tourism/social sectors which may become an issue when dealing with impacts from increased summer tourism, use of snow-making, management of invasive species and fire.

The importance of social values in conservation management in the Australian Alps was highlighted by Morrison and Pickering (2011). For example, local community objections to fire management practices and decreased visitor satisfaction were social limits associated with fire management in the region. The reluctance of the public to condone brumby culls is another example of social influences on conservation management activities. In many cases, participants in Morrison and Pickering's study believed that social limits to climate change adaptation strategies could become more important than economic or biophysical limits due to the ability of the public to influence government agendas and strategies.

Acknowledgments

We appreciate the contributions of Dr Ken Green and Mr Anthony Evans in the design and execution of this project and their feedback on the outcomes. We thank all the Parks staff and researchers who took the time to complete the survey and provide us with their insights and perspectives. We hope that, and others involved in the Australian Alps find the resulting report useful.

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APPENDICES

Appendix 1: Survey instrument

Australian Alps and Climate Change Survey

1. Where do you obtain information about climate change in the Australian Alps from? (Please select all that apply)

- a. Internal organization (e.g. parks reports, etc.).....?
- b. General media (e.g. tv, radio, etc.).....?
- c. Scientific organization (e.g. academic publications, Bureau of Meteorology, CSIRO, etc.).....?
- d. Other.....?

Please Specify: _____

2. Which of these impacts of climate change do you think are occurring in the Australian Alps? (Please select only one answer for each option)

	Yes	No	Don't know
a. Decreased snow cover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Drier summers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Decreased water availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Increased fires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Decreased/altered rainfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Decreased soil moisture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Increased storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Loss of endemic species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Loss of endemic communities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Increase in invasive species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Changes to timing of biological events (e.g. flowering)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Decreased snow-based tourism industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Increased cost of skiing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Changes in summer tourism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. As far as you are aware, is there sufficient research/monitoring of the following impacts of climate change in the Australian Alps National Parks? (Please select only one answer for each option)

	Yes	No	Not relevant to my area of expertise
a. Decreased snow cover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Drier summers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Decreased water availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Increased fires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Decreased/altered rainfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Decreased soil moisture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Increased storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Loss of endemic species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Loss of endemic communities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Increase in invasive species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Changes to timing of biological events (e.g. flowering)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Decreased snow-based tourism industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Increased cost of skiing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Changes in summer tourism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Do you think that a lack of data/research is limiting the management of these impacts in Australian Alps National Parks? (Please select only one answer for each option)

	Yes	No	Not relevant to my area of expertise
a. Decreased snow cover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Drier summers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Decreased water availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Increased fires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Decreased/altered rainfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Decreased soil moisture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Increased storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Loss of endemic species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Loss of endemic communities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Increase in invasive species	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Changes to timing of biological events (e.g. flowering)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Decreased snow-based tourism industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. Increased cost of skiing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Changes in summer tourism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. According to your area of expertise/responsibility, how important is it to obtain information about the following impacts for park management?

	Very important	Important	Moderate	Not important	Not relevant to my area of expertise
a. Decreased snow cover	<input type="checkbox"/>				
b. Drier summers	<input type="checkbox"/>				
c. Decreased water availability	<input type="checkbox"/>				
d. Increased fires	<input type="checkbox"/>				
e. Decreased/altered rainfall	<input type="checkbox"/>				
f. Decreased soil moisture	<input type="checkbox"/>				
g. Increased storms	<input type="checkbox"/>				
h. Loss of endemic species	<input type="checkbox"/>				
i. Loss of endemic communities	<input type="checkbox"/>				
j. Increase in invasive species	<input type="checkbox"/>				
k. Changes to timing of biological events (e.g. flowering)	<input type="checkbox"/>				
l. Decreased snow-based tourism industry	<input type="checkbox"/>				
m. Increased cost of skiing	<input type="checkbox"/>				
n. Changes in summer tourism	<input type="checkbox"/>				

6. For what physical processes do we lack sufficient data for long term planning in Australian Alps National Parks? (Please select all that apply)

- a. Precipitation.....
- b. Snow.....
- c. Temperature.....
- d. Erosion.....
- e. Stream flow.....
- f. Other.....

Please specify _____

7. What plant or animal species need attention to preserve them in Australian Alps National Parks?

8. What geographical areas, ecosystems or communities need attention, why?

9. What invasive plants or animals are likely to cause problems, how can we best deal with them?

10. What long-term datasets do we need most urgently to monitor changes in natural resources and where?

11. Is there any other field of research or monitoring that you think should be undertaken in the Australian Alps National Parks as a climate change priority?

12. How would you prefer to access new information about climate change impacts in the Australian Alps? (Please select all that apply)

- a. Websites.....
- b. Reports.....
- c. Fact sheets.....
- d. Science/management workshops.....
- e. Other.....

Please specify _____

13. What non-research based activity should the Alps program or individual agencies undertake to mitigate or deal with the effects of climate change?

14. Are you a:

- a. Park staff.....
- b. Researcher.....
- c. Both.....
- d. Other.....

Please specify _____

15. What is your current position?

16. What are the primary responsibilities in this position?

17. How long have you been in this position? (Approximate Month/Year)

18. Have you been employed in a similar position before your current employment?

Yes.....No.....

If yes, where? _____

19. Do you work in the Australian Alps Region?

Yes.....No.....

If no, where? _____

20. What is the highest level of education you have completed?

- a. Primary/some secondary.....
- b. Completed secondary.....
- c. Vocational/technical.....
- d. Tertiary/university.....
- e. Other.....

Please specify _____

-----End of survey-----

Thank you very much for your time!!

Appendix 2: Ethics conditional approval letter

GRIFFITH UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE

01-Nov-2011

Dear Associate Professor Pickering

I write further to your application for ethical clearance for your project NR: 2011 Survey of climate change adaptation and amelioration strategies and associated research and monitoring by Alps natural resources managers." (GU Ref No: ENV/44/11/HREC). This project has been considered by Human expedited review 1.

The Chair resolved to grant this project conditional ethical clearance, subject to you resolving the following matters:

This application has been reviewed administratively by the Office for Research via a mechanism for research that has been assessed as involving no more than negligible risk.

Whilst it is appreciated that there is a character limit on the fields within the online application process, the fields form the basis of the report from the review to the Committee. In future the applicants are asked the start their responses using the fields provided and place the balance of any additional text in reference attachments.

If data collection is anonymous, it is not necessary to include a privacy statement in the informed consent materials.

Given that the survey is anonymous, the information sheet should explain that, after a participant submits their survey, they won't be able to withdraw their consent – because not even the researchers will be able to associate surveys with individuals.

The contact officer signing sF1 of the Expedited Ethical Review Checklist.

An appropriate authorising officer, who is not a member of the research team, completing and signing sF2 of the Expedited Ethical Review Checklist.

This decision was made on 01-Nov-11. Your response to these matters will be considered by Office for Research.

The ethical clearance for this protocol runs from 01-Nov-11 to 01-Mar-12.

Please forward your response to Gary Allen, Manager, Research Ethics, Office for Research, as per the details below.

Please refer to the attached sheet for the standard conditions of ethical clearance at Griffith University, as well as responses to questions commonly posed by researchers.

It would be appreciated if you could give your urgent attention to the issues raised by the Committee so that we can finalise the ethical clearance for your protocol promptly.

Regards

Gary Allen
Manager, Research Ethics
Office for Research
G39 room 3.55 Gold Coast Campus
Griffith University
ph: 3735 5585
fax: 5552 9058
email: g.allen@griffith.edu.au
web:

Cc:

At this time all researchers are reminded that the Griffith University Code for the Responsible Conduct of Research provides guidance to researchers in areas such as conflict of interest, authorship, storage of data, & the training of research students.

You can find further information, resources and a link to the University's Code by visiting <http://www62.gu.edu.au/policylibrary.nsf/xupdatemonth/e7852d226231d2b44a25750c0062f457?opendocument>

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Appendix 3: Part of e-mail sent out to Park Staff regarding survey

2011 Survey of Australian Alps national park managers – we need you !

The Australian Alps Liaison Committee has engaged Catherine Pickering from Griffith University to conduct a survey of managers across the Australian Alps to find out what you think should be a priority for future research and monitoring to better understand and deal with the impacts of climate change. The Australian Alps program is particularly keen to support projects which deliver outcomes for managers, hence we want your help in determining the scope of these projects or questions which need answering

Your participation is strictly voluntary however the intent of the survey is to ensure future climate change research which is supported by the Alps Program has a management oriented focus.

We are asking you to complete the survey on climate change impacts in the Australian Alps, which should take no longer than 10 minutes of your time. The fastest way is to access an electronic copy of the survey at <http://www.surveymonkey.com/s/ozalpssc>.

If you would prefer a hard copy of the survey or require any other information about the project, please contact I Dr. Catherine Pickering (Griffith University) Telephone 07 5552 8059 07 5552 8059. e-mail: c.pickering@griffith.edu.au

A report and two factsheets for the Australian Alps Liaison Committee will be produced with findings of this research which will be available in June 2012.

You may withdraw your consent whilst completing the survey and discontinue participation without penalty. However, given the survey is anonymous, once you have submitted the answers you will not be able to withdraw your consent because researchers will not be able to associate surveys with individuals. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

If you have questions regarding your rights as a research subject, contact:

The Senior Manager, Research Ethics and Integrity at Griffith University Human Research Ethics Committee in Australia on +61 (7) 3735 5585 +61 (7) 3735 5585 or by email: research-ethics@griffith.edu.au.

Appendix 4: Copy of the consent information for survey

1. This project aims to assess the climate change research and monitoring requirements of protected area staff and researchers in the Australian Alps. This survey follows the recent research project for the National Climate Change Adaption Research Facility on limits to climate change adaptation. It will assess the level of knowledge of climate change and its impacts among protected area staff and researchers in the Australian Alps.

This research will assist the Australian Alps Liaison Committee (AALC) and Australian Alps National Parks in identifying priority areas for ongoing research and monitoring of climate change in the Australian Alps.

We are asking you to take part in a research study because we are trying to assess how/if a lack of research and monitoring and/or knowledge of existing monitoring is a limit to climate change adaptation in the region and the priorities for physical, biological and visitor research and monitoring relating to conservation issues for the parks. You were selected as a possible participant in this study because you are a park staff and/or a researcher in the Australian Alps area. Your participation is strictly voluntary.

You will be asked to complete a survey questionnaire on climate change impacts in the Australian Alps, which should take no longer than 10 minutes of your time.

A report and two factsheets for the Australian Alps Liaison Committee will be produced with findings of this research which will be available in June 2012.

If you have any questions or concerns about the research, please contact Dr. Catherine Pickering (Griffith University) Telephone 07 5552 8059, e-mail: c.pickering@griffith.edu.au

You may withdraw your consent whilst completing the survey and discontinue participation without penalty. However, given the survey is anonymous, once you have submitted the answers you will not be able to withdraw your consent because researchers will not be able to associate surveys with individuals. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

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