FINAL REPORT

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The Australian Alps national parks

Natural Heritage Working Group

by

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SCOPING STUDY

Assessing the Impact of Feral Horses on Frost Hollow Communities

(bogs/fens, streams, wet heath and wet grasslands)

in the Australian Alps National Parks

AUSTRALIAN ALPS NATIONAL PARKS

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Executive Summary

The Australian Alps national parks have biological, geological and geomorphological natural values of national and international significance (Coyne 2001). The Alps encompass relatively undisturbed, high altitude and high rainfall environments in a continent characterised by low lying, dry landscapes. They are the source of many rivers including the Murray, Murrumbidgee and Snowy, which sustain south-eastern Australia- with town and city water supply, with irrigation and with hydro-electricity. The values of the Australian Alps are threatened by climate change. Warmer temperatures and less precipitation will lead to loss of flora and fauna and ecosystem function and an increase in pest species (Maunsell Australia Pty Ltd 2008). Other major threats to the Australian Alps are feral animals and plants, fire and tourism (Coyne 2001). Pest animals are a major cause of biodiversity decline globally, and Australia has the unenviable record of having nearly half of the known mammalian extinctions worldwide. Eleven of Australia's major introduced vertebrate pests (including feral horses) have economic, environmental and social costs of an estimated $720 million dollars a year (McLeod 2004).

Management of feral horses in the Australian Alps to date has been a difficult and complex issue because of the emotional and historical significance of horses. Resourcing research and management of feral horses has been identified as a high priority in the Australian Alps national parks (Coyne 2001). In spite of this, there is surprisingly limited research, even internationally, on feral horse impacts (Dawson *et al.* 2006). More peer reviewed research would illustrate the impact of feral horses in the Alps ecosystem, thus altering perceptions of whether horses belong in the Alps, increasing the perception of wild horses as a pest, and hence reducing the public controversy surrounding feral horse management (Nimmo and Miller 2007).

We are proposing a multi-faceted research program to evaluate the impact of feral horses on frost hollow communities (including bogs/fens, streams, wet heath and wet grasslands) in the Australian Alps. These communities have been targeted because 1) they are widespread, 2) they typically contain sphagnum bog communities, which are in decline, are endangered and are particularly susceptible to damage by horses

(Tolsma 2008 and references therein), 3) they play a vital role in the landscape storing and slowly releasing water, 4) they are biologically rich, and 5) horses preferentially use them (Dyring 1990).

It is envisaged that the proposed study would be conducted through a post-graduate research program with at least one doctoral student, and preferably more. The scale of the program would depend on funding. Ten to fifteen study sites (located across the ACT, NSW and Victoria) with a range in horse densities form very high to zero would be assessed. Initially a technique for measuring an index of horse density/activity needs to be developed at a scale relevant to the study. Then at each site attributes of the community would be quantified such as species richness and abundance, habitat quality, water quality, soil and bog condition and ecosystem function. The outcome of the project would be a demonstration of the impact feral horses have in the Alps, and the establishment of the relationship between feral horse density and the biotic integrity of frost hollow communities. These findings could then be used to set appropriate targets for feral horse management.

Introduction

The Natural Heritage of and threats to the Alps

The Australian Alps national parks (AAnps) are a remarkable system of reserves running from the ACT, through NSW and into Victoria. The AAnps protect over 1.6 million hectares of high altitude and high rainfall environments in a continent characterised by low-lying dry landscapes. The Alps is a large relatively undisturbed ecosystem in a landscape drastically altered for agriculture and other human use. It provides a fundamental role not only as a clean, reliable water source, but as a place for the protection of native plants, animals and communities. The Australian Alps are the source of many rivers which sustain south-eastern Australia, supplying water for towns and cities, irrigation and hydro-electricity. The flora and fauna of the Australian Alps is internationally regarded for its endemism as well as its evolution of cold climate adaptations in total isolation from other species elsewhere in the world (Coyne 2001). A memorandum of understanding between the Commonwealth, ACT, NSW and Victorian Governments aims to "pursue the growth and enhancement of inter-governmental co-operative management to protect the nationally important values of the Australian Alps national parks" (Coyne 2001).

The qualities of the AAnps that we value so highly are under threat in spite of its size and healthy state. The major threats are climate change, feral animals, feral plants, fire and tourism (Coyne 2001, Maunsell Australia Pty Ltd 2008). Global warming is predicted to cause warmer temperatures and less precipitation in the Alps, which will lead to loss of flora and fauna and ecosystem function, and an increase in feral species (Maunsell Australia Pty Ltd 2008). One of the feral animals of concern is horses. The size and extent of the feral horse population is increasing rapidly with the population estimated to be over 7000 horses in 2009 (Dawson 2009). They are likely to benefit from global warming and increase their range further if numbers are not managed (Walter 2002).

I propose frost hollow communities (including bogs/fens, streams, wet heath and wet grasslands) are targeted for horse impact research. They are treeless valleys subject to cold air drainage and are well represented across the Alps. These areas often have

the most obvious impact from horses where they graze heavily, disturb streambanks, where their tracks cross boggy areas and where they wallow. They are also the source of rivers, storing and slowly releasing water. They contain peat bogs which are unusual in Australia (Whinam *et al.* 2003) and in decline across the Alps. Only about half of the bog and fen areas remain in Kosciuszko National Park, less than half remain in the Victorian Alpine National Park and small functional areas remain in Namadgi National Park, ACT (Good 2006). Peat bogs are particularly susceptible to damage by horses (Tolsma 2008 and references therein). Frost hollow communities contain endangered ecological communities and are important for flora and fauna. The mosaic of vegetation provides primary habitat for threatened species of plants, frogs, reptiles and mammals (see Appendix).

Feral Horses and their Management in the Alps

Feral horses are a high priority threat to the natural values of the Australian Alps (Coyne 2001). The high priority rank of feral horses was assigned based on threat status, distribution, rarity, impact and management potential. Feral horses occur in the ACT, NSW and Victorian AAnps, and are an issue in all jurisdictions. In Namadgi National Park (ACT), horses are reinvading for the first time in decades and are of concern because if they establish they threaten the main water source for Canberra and Queanbeyan, internationally significant wetlands, and endangered fauna (ACT Parks, Conservation and Lands 2007). A 2009 aerial survey showed that the feral horse population now exceeds 7000 in the NSW and Victorian AAnps, with dramatic increases since the 2003 fires (Dawson 2009). They occur in 5 separate populations, which are spreading in some areas. Feral horses are considered to have a significant impact that can be eliminated or ameliorated by management (Coyne 2001).

Feral horses present a complex management problem because they have emotional and historical significance (appearing on the Australian $10 note). Many people *know* that feral horses have an impact but there has been little scientific evidence gathered. More peer reviewed research would be beneficial in reducing the public controversy surrounding management of feral horses (Nimmo and Miller 2007). Research into feral

horse impacts in the Australian Alps would provide empirical evidence to refine and justify management practices. There is surprisingly little research even internationally on feral horse impact (Dawson *et al.* 2006). There is, however, a lot of evidence to suggest that large grazing herbivores have a huge influence not only on vegetation and soils but on the function and structure of entire ecosystems (Owen-Smith 1988).

Different approaches are taken to feral horse management across the states and territories of the Australian Alps with consultation across borders. Management plans have been recently developed in the ACT (ACT Parks, Conservation and Lands 2007) and in NSW (NSW National Parks and Wildlife Service 2003, 2007). In the Victorian Alps, feral horses and brumby-running are managed under the Alpine National Park Management Plans (Pascoe and Foster 2004). The effect of these various control strategies on horse impacts has not been studied.

Evidence for Impact of feral horses

Impacts on streams and streambanks

Livestock have strong influences on riparian ecosystems and wetlands (Kauffmann and Krueger 1984). These ecotones usually have very high diversity and productivity, but are typically fragile and vulnerable to livestock grazing: livestock grazing can affect streamside vegetation, stream channel morphology, shape and quality of the water column and the structure of the soil portion of the streambank, which has flow on effects for instream and terrestrial wildlife (see Kauffmann and Krueger 1984). Horses appear to have a strong influence on streams, in particular stream banks in the Australian Alps. Prober and Thiele (2005) have observed a striking effect of feral horses on streams in the Victorian Alps with significantly more incision and damage outside of feral horse exclosures. Dyring (1990) also noted that feral horses disturbed streambanks most noticeably in open area with easily penetrated vegetation in the NSW Alps.

Impacts on peat bogs

Feral horses and other grazing animals have been implicated in the degradation of peat bogs and their water storing capabilities in the Australian Alps (Whinam and Chilcott 2002; Whinam *et al.* 2003). Trampling by grazers cause channeling, leading to changes in water flow, which may completely alter the drainage flow (Helman and Gilmour 1985 in Whinam and Chilcott 2002). These systems are likely to face further strain as climate change alters their functioning.

The level of impact in these systems has been measured in Victoria by Toslma (2008). In the East Alps Unit of the Alpine National Park, 97% of mossbed systems were impacted by horses in 2008. The mean area impacted (i.e. compacted, trampled or pugged) was 25%. Only two mossbeds were not impacted: one was fenced on Davies Plain, the other was near Wombargo Track (this area is probably not currently occupied by horses (pers. obs.)).

Impacts on ecological communities

The effect of horse grazing on ecological communities has not received much research attention, but is particularly important in conservation reserves like the Australian Alps national parks. Beever and Brussard (2004) found that horse occupied sites possessed less community completeness (biotic integrity) than sites where horses had been removed in the Great Basin, USA. A study of effects of feral horse grazing on estuarine communities in the USA found that horse-grazed marshes had less vegetation, a higher diversity of foraging birds, higher densities of crabs, and a lower density and species richness of fishes than ungrazed marshes (Levin *et al.* 2002). Conversely, pampas grassland areas in Argentina with low or no horse grazing showed greater bird species richness and total bird abundance than heavily grazed sites; the presence of feral horses was also associated with a higher rate of egg predation (Zalba and Cozzani 2004).

Stock grazing in the Australian Alps national parks (AAnp) is no longer permitted due to its impact. Cattle grazing ceased most recently in Victoria (in 2006) because 60 years of scientific research showed that cattle damage soils, trample moss beds and

watercourses, threaten rare native flora and fauna, and spread weeds (The State of Victoria 2008). Horses fill a similar ecological niche as cattle (Berman 1991) so are likely to have a similar impact.

Impacts on plant communities

Grazing by herbivores can have profound and extensive impacts on plant communities (Milchanus and Lauenroth 1993). In a semi-arid environment in the USA, Beever and Brussard (2000) and Beever *et al.*(2008) compared sites with and without horses (using exclosures and sites where horses were removed) and found that horses-free sites had greater plant cover and height (shrubs and grasses), and greater plant species richness. The story of horse grazing on plant communities in the Australian Alps needs to be clarified. There was lower plant biomass in the Alps at higher horse densities (Walter 2002), however, there were only minor changes in floristics after five years of feral horse exclosure (Prober and Thiele 2005). Horse trampling compacted soils and contributed to changes in vegetation with fewer species and fewer plants found on trampled sites (Dyring 1990).

Impacts on fauna

A suite of herpetofauna are dependent on bog, grass and wet heath habitats in the Australian Alps and may be threatened directly or indirectly by feral horses (Clemann *et al.* 2001). The alpine water skink *Eulamprus kosciuskoi*, alpine she-oak skink *Cyclodomorphus praealtus* and alpine bog skink *Pseudemoia cryodroma* are believed to be at risk of horse impact, and there are calls for more research on the topic (Clemann *et al*. 2001; Clemann 2001; Meredith *et al.* 2001). Structural complexity of habitat is a requirement for many reptile and frog species with litter cover, ground cover and soil compaction important elements for reptiles (e.g. Brown 2001; Jellinek *et al*. 2004) as well as vegetation structural complexity which may be advantageous or disadvantageous (Castallano and Valone 2006). Similarly, most amphibian species in the Australian Alps rely on structural complexity formed by vegetation along the margins of streams and ponds for male calling and oviposition sites (Osborne 1990;

Green and Osborne 1994). While there is no quantitative data demonstrating negative impacts from horses on amphibian species in the Australian Alps, field observations suggest the likely impacts on several nationally listed threatened species, including the southern corroboree frog (*Pseudophryne corroboree*), northern corroboree frog (*Pseudophryne pengilleyi*) and the alpine tree frog (*Litoria verreauxii alpina*) (David Hunter and Rod Pietsch pers com). Accordingly, feral horse impacts have been identified as a potentially threatening process to these species in recent draft recovery plans (Clemann and Gillespie 2004, Hunter *et al.* 2007). An interesting but poorly understood species which may also be threatened by feral horses is the alpine spiny crayfish, which has a limited distribution across the Alps and is found in streams above 1000m (Van Praagh 2003).

Small mammal communities may be affected by grazing of livestock indirectly through alteration in vegetation structure, water quality and other site characteristics (Giuliano and Homyack 2004). Removal of livestock (mostly cattle) grazing from streams and associated riparian zones led to an increase in mammalian species richness and abundance within 2 years in a study in south west Pennsylvania (Giuliano and Homyack 2004). A similar result was shown in the central Kimberley across several habitats after the removal of cattle (Legge *et al.* 2007). In a study of horse impacts using exclosures, qualitative differences were observed in small mammal activity (Beever and Brussard 2000). There are a limited number of small mammal species in the Australian Alps, and complexity of vegetation structure is associated with habitat quality for these species (Carron 1985). A species of particular concern is the broad-toothed rat *Mastacomys fuscus* (Green and Osborne 2003 and references within).

Project aim

The primary aim of this research is to determine if there are any significant relationships between feral horse abundance and measures of species and community ecology in frost hollow communities in the Australian Alps national parks. This will involve:

1. Developing a method to determine horse usage/density at a site level (i.e. less than 10km^2) that can be used across the Alps (e.g. dung counts or remote cameras);
2. Determining the impact of feral horses on flora, fauna and associated habitat quality; and
3. Determine the impact of horses on ecosystem function within the Alps that may include soil/bog damage, streambank morphology and water quality.

Building on established research programs

It is advantageous to build on the wealth of research already carried out within the Australian Alps national parks. Some of the relevant programs to build on include:

- Experimental exclosures established to assess the impact of feral horses on floristic composition and structure of grasslands, and on bank condition and structure of streams draining these areas (Prober and Thiele 2005) in Victoria.
- Large exclosures established in Victoria to protect Alpine Water Skink from the effects of cattle and horse grazing (cattle have subsequently been removed) (N. Clemann pers. comm.).
- Impact of feral horses on sub-alpine and montane habitats in the Pilot Wilderness Area (Dyring 1990).
- Bog monitoring sites across the Alps (R. Good, G. Hope, M. Evans pers. comm.)
- Herpetofauna monitoring sites in ACT and NSW (D. Hunter, R. Peitsch and M. Evans pers. comm.)
- Frost hollow community native fauna monitoring site, Victoria (J. Edwards pers. comm.)
- Assessment of horse riding impact in northern Kosciuszko (NSW National Parks and Wildlife Service 2006)
- AUSRIVAS stream health surveys which have baseline data of aquatic invertebrates across the Australian Alps (R. Norris pers. comm.)
- Population ecology of wild horses in the Australian Alps (Walter 2002)

- Population monitoring of feral horses in the Australian Alps national parks (Walter 2003; Walter and Hone 2003; Laake *et al.* 2008)
- Population monitoring of horses in the Bogong High Plains (Dawson and Miller 2008)
- Management (removal) of horses in ACT, NSW and Victoria.
- Assessment of mossbeds and their management needs across the Victorian Alps (Tolsma 2008).

Proposed methods

Proposed study design

It is proposed that the core of the research would be a broad-scale comparative observational study focussing on ten to fifteen frost hollows in the Australian Alps. At each site a series of variables would be assessed (potential variables are outlined in the table below). It would also compare ecosystem function between sites (incorporating many of the variables listed below) (CSIRO Sustainable Ecosystems 2008).

Variable Type	Variables Measured
Predictor (independent)	Index of horse density/activity
Response (dependent)	Flora and fauna species richness
	Flora and fauna abundance
	Habitat quality
	Water quality
	Streambank morphology
	Soil/bog damage
Possible covariates	Rainfall
	Soil type
	Elevation
	Aspect
	Deer/pig/rabbit abundance
	Fire history
	Grazing history

Establishing an Index of horse density

An index of feral horse density/activity at a scale relevant to the sites needs to be established. This could be obtained by using dung counts at each site based on that used for feral pigs for 23 years in Namadgi National Park (ACT) as described by Hone (2002). Alternative indices may be established using remote cameras or trampling.

Measuring response variables

There are a range of well established protocols for measuring the proposed response variables. A research program that captures data across all of these variables will provide a more meaningful representation of disturbance caused by feral horses. Resources that could be drawn on to establish survey protocols are:

1) Ecosystem Function Analysis developed by CSIRO Sustainable Ecosystems. This uses indices such as soil surface condition (comprising stability, infiltration and nutrient cycling), vegetation dynamics (the density, species composition and size of specified vegetation) and habitat complexity (for mammals) (Tongway 1995, CSIRO Sustainable Ecosystems 2008). This has also been referred to as Landscape Function Analysis and is used in the Australian Alps for rehabilitation projects (Good 2006).

2) Protocols for assessing mossbed damage by horses (Tolsma 2008).

3) The Australian Guidelines for Water Quality Monitoring and Reporting (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000 or latest edition). Measurements can be taken using a hydrolab and turbidimeter. The variables of interest are likely to be water temperature, electrical conductivity, pH and turbidity. Phosphorous, nitrogen and faecal counts may also be measured and require off site analysis. A study on the impact of recreational riding in northern Kosciuszko used these variables (NSW National Parks and Wildlife Service 2006).

4) A baseline AUSRIVAS database has been established across the Australian Alps and can be used to assess biological aspects of water quality using macro invertebrates and water turbidity (see AUSRIVAS website and Turak *et al.* 2004).

5) Established methodologies for herpetofauna survey are outlined in Clemann *et al.* (2001), Jellenik *et al.* (2004), Clemann and Nelson (2005) and Brown *et al.* (2007).
6) Indicators of quality of small mammal habitat have been identified in the Australian Alps specifically (Carron 1985), and for small mammals in urban areas of Brisbane (Garden *et al.* 2007b).
7) Indicators of habitat quality for herpetofauna can be species specific, such as for corroborree frogs (Osborne 1990). More general indicators are also available (e.g. Brown 2001, Jellinek *et al.* 2004, Garden 2007b).
8) Edwards (2006) has established techniques for sampling Alpine Spiny Crayfish.

Potential study sites

Potential sites for the comparative study have been identified through discussions with scientists and managers (see below). These are a guide only. It is not desirable to select sites completely randomly because they must be reasonably accessible by road. In identifying potential sites, factors considered were:

- That they lie between 1200 and 1600 m above sea level to minimise the natural variation between sites and because horses and frost hollow communities are frequently found at these elevations.
- Capturing extremes in horse densities.
- Incorporating paired sites where possible.
- Covering the full range of feral horse distribution across the Australian Alps national parks.
- Including sites that have been the focus of long term study for other projects to give a greater depth of understanding at each site.
- That horse populations may be manipulated through management.

Sites should also be selected based on aspect and slope to reduce natural variation between sites.

Site	**State/ Territory**	**Horse abundance**	**Comments** {recommended by}
Cheyenne Flat	ACT	None	Part of Ginini RAMSAR wetland. Long term study site {M. Evans}

Snowy Flat	ACT	None	Long term study site {M. Evans}
Murrumbidgee Headwaters	NSW	Low	*Mastacomys* present. Good northern site {M. Dawson}
Boggy Plain (near Kiandra)	NSW	Moderate/High	Long term bog study site {R. Good}. May be target for horse population reduction
Bull's Peak (Jagungal)	NSW	None	Extensive bog system without horses {R. Good}
Upper Cascade River	NSW	High	Continuous high horse use.
Alexs Yards	NSW	High	J. Dyring's study site
Ingegoodbee	NSW	High	J. Dyring's study site
Murray River headwaters	NSW/Victoria	High	M. Dawson study site (upstream from Cowombat)
Davies Plain	Victoria	High	Study site for threatened flora and herpetofauna {C. Pascoe, F. Coates}
Davies Plain	Victoria	None (exclosure)	Large grazing exclosures {F. Coates}
Native Cat Flat	Victoria	High	Established horse impact study site
Native Cat Flat	Victoria	None (exclosure)	Small grazing exclosures
Forlorn Hope Flat (Buchan R. headwaters)	Victoria	Very High	*Mastacomys*, alpine water skink and spiny crayfish study site {J. Edwards}
Rocky Plain (Playgrounds)	Victoria	High	Threatened flora study site {F. Coates}
Bogong High Plains (Youngs Top)	Victoria	Moderate	Focus of long term cattle impact research

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Appendix: Endangered ecological communities and fauna found in frost hollow communities

Community/Species	Common name	Status			
		Commonwealth (EPBC Act)	NSW (TSC Act)	ACT (NC Act)	VIC (FFG Act) (Advisory list)
Ecological communities					
Alpine Sphagnum Bogs & ass. Fens		Endangered			
Alpine Bog					Threatened
Fen (Bog Pool)					Threatened
Montane Swamp Complex					Threatened
Montane Peatlands and Swamps			Endangered		
Frogs					
Crinea signifera	Common froglet				
Litoria verreauxii alpine	Alpine tree frog	Vulnerable	Endangered		Threatened (critically endangered)
Geocrinea Victoriana	Victorian smooth froglet				
Limnodynastes dumerilii	Eastern banjo frog				
Pseudophryne dendyi	Dendy's toadlet				
Pseudophryne bibronii	Brown toadlet				Threatened (endangered)
Pseudophryne pengilleyi	Northern corroborree frog	Vulnerable	Vulnerable	Endangered	
Pseudophryne corroboree	Southern corroborree frog	Endangered	Endangered		
Reptiles					
Austrelaps ramsayi	Highland copperhead				
Drysdalia coronoides	White-lipped snake				
Tiliqua nigrolutea	Blotched blue tongue lizard				
*Bassiana duperey*i	Eastern three-lined skink				
Eulamprus kosciuskoi	Alpine water skink				Threatened (critically endangered)
Eulamprus tympanum	Southern water skink				
Cyclodomorphus praealtus	Alpine she-oak skink				Threatened (endangered)
Pseudemoia cryodroma	Alpine bog skink				Threatened (endangered)
Niveoscincus coventryi	Coventry's skink				
Mammals					
Mastacomys fuscus	Broad-toothed rat		Vulnerable		
Antechinus agilis	Agile antechinus				
Rattus fuscipes	Bush rat				
Antechinus swainsonii	Dusky antechinus				
Aquatic fauna					
Euastacus crassus	Alpine spiny crayfish				Threatened