



Office of
Environment & Heritage
NSW National Parks & Wildlife Service



Review of the 2008 Horse Management Plan and Wild Horse Management Program, Kosciuszko National Park

**A companion document to the 2016 Kosciuszko National Park Draft
Wild Horse Management Plan**

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Valuable information and comments were provided by NPWS staff, including botanists, ecologists, threatened species officers, pest management, science and research, community and stakeholder engagement and heritage management specialist staff. Local NPWS staff including managers, rangers and field staff with a depth of knowledge, skills and experience in wild horse management and other operational issues in the park were also integral to the preparation of this document.

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Summary

Key objectives of the *Kosciuszko National Park Horse Management Plan* (DECC 2008) – the ‘2008 Horse Plan’ – have not been achieved. In particular, there are still wild horses (*Equus caballus*) present in the key areas where exclusion was the aim. Also, the number of horses has not been reduced to a level where they are no longer impacting the park’s natural and cultural values or visitor safety.

Trapping using lures and removal – the only method employed during the life of the 2008 Horse Plan – was costly, time consuming and did not effectively reduce the wild horse population. One of the constraints has been a lack of demand for ‘rehomeing’ or domesticating captured wild horses. Of the 3183 horses removed from Kosciuszko National Park since 2002, 583 (18%) were domesticated and the other 2600 were sent to a knackery or abattoir.

A trial of low stress aerial mustering as proposed in the 2008 Horse Plan has not been undertaken due to limitations on rehomeing or disposal of larger numbers of horses that may have resulted from an aerial mustering operation. There has also been ongoing stakeholder opposition to use of this control method.

The current wild horse control method of trapping and removal is not reducing the impacts of wild horses on the environment. Wild horse populations are projected to double in the next four to 12 years in many areas of the park unless management is undertaken. Without control, the impacts will amplify and spread to other areas of the park.

This *Review of the 2008 Horse Management Plan and Wild Horse Management Program, Kosciuszko National Park* – ‘the Review’ – is a companion document to the *Kosciuszko National Park Draft Wild Horse Management Plan* (OEH 2016) – ‘the 2016 Draft Wild Horse Plan’. It provides background information, evidence and analysis to support the 2016 Draft Wild Horse Plan.

A summary of review findings

The following provides a summary of the key findings of this Review. The findings were used to inform the development of the 2016 Draft Wild Horse Management Plan, to establish the framework and rationale for the Draft Plan and guide its vision, objectives and strategies.

Community engagement, opinions

- The community values and strongly supports national parks and recognises their importance in protecting native plants and animals, and unique landscapes.
- Community members have a low level of knowledge about the impact wild horses are having on Kosciuszko National Park, and although people think they are well informed about the management of wild horses the evidence from the engagement project demonstrated that they are not.
- The spectrum of community and stakeholder views, perceptions and opinions on wild horse management are broad and deeply polarised.
- That spectrum of views extend from demands for complete eradication of wild horses from the park environment through to demands that wild horses be afforded iconic legal protection status and allowed to self-regulate their population in the park.
- Many people in the community and within stakeholder groups can agree that management of the wild horse population is required. The issues of how, and to what level are where disagreement and conflict begins.

- A balance must be found between the protection of the environmental and other values of the park and retention of the cultural values represented by wild horses. Objectives which are often in direct or indirect conflict.
- Increased community and stakeholder involvement, education, transparency and support for the park wild horse management program should be a key objective of the 2016 Draft Wild Horse Plan.

Kosciuszko wild horses have recognised cultural heritage values

- Regardless of their introduced or pest species status, the Kosciuszko National Park wild horse population as an 'attribute' has both tangible and intangible cultural and social heritage values to many people at a national Australian and local High Country community level.
- Permitting the presence of wild horses in the landscape is desirable to retain the identified cultural values. However, they should be broadly contained to specific locations, and in other areas they need to be managed to minimise impacts on key environmental assets.
- The continued expansion and increasing abundance of wild horses across the park is not required to retain any of the cultural values, and actions to remove or reduce populations to mitigate impacts on other values can be undertaken without damage to those cultural values.

Wild horses continue to impact park values

- Wild horses are an introduced species to the Australian continent.
- Wild horse populations are having significant negative impacts on the unique nationally and internationally listed species, ecosystems and environments, as well as cultural values and visitor safety within Kosciuszko National Park.
- The evidence of environmental harm is sufficient that wild horse populations must be managed in park.

Changes in wild horse numbers and distribution

- Due to required changes in survey methodology between the 2014 and previous surveys it is difficult to statistically identify wild horse population trends across the Australian Alps and within the park.
- The 2014 survey of wild horses in the Australian Alps showed that there is an estimated 6000 (4000–8000) wild horses in the park.
- The distribution of wild horses has expanded into new areas in the park and adjoining lands since 2008.

A range of control methods needs to be employed

- The eradication (elimination) of wild horses from the park is not achievable, although their complete exclusion (elimination) from certain parts of the park is possible.
- A range of control methods needs to be used to ensure an integrated and adaptive management response. The wild horse management program needs to be implemented in conjunction with other park management and control programs for pigs, deer, rabbits and other introduced species.
- Fertility control is only a viable option where horse densities are already low and the objective is to gradually reduce or maintain the population at a low density. Its

broad-scale effectiveness in the context of the park (or in any other wild population) is yet to be determined.

- There is a general understanding in the community and across stakeholder groups that a suite of different control methods is necessary to be able to effectively control horse population numbers in all circumstances.
- The aim is to reduce the wild horse population to a level where a combination of fertility control and non-lethal harvesting (trapping, mustering and removal from the park) better match community demand for wild horses, therefore reducing or negating the need to apply lethal control methods.

Wild horses have been, and will continue to be, treated humanely

- Animal welfare and the humane treatment of wild horses (including lethal and non-lethal control methods) remains as a key principal in the wild horse management plan and programs in the park.
- The concept of 'humaneness' and what is regarded to be 'humane' or in the best interest of animal welfare varies widely between major stakeholder groups as well as within the general community.
- Animal welfare and relative humaneness of population control methods and management are not the only criteria that require consideration when undertaking vertebrate pest and wildlife management. Issues such as community, stakeholder and socio-political acceptance; efficacy; staff, volunteer and visitor safety; and cost and resource requirements are all important considerations.
- NPWS has applied and followed all relevant animal welfare legislation, regulation, codes of practice and standard operating procedures. However, there is concern for animal welfare, particularly as more than 80% of the wild horses captured since 2002 have had to be sent to the knackery or abattoir. This involves the cumulative stress of trapping, long distance transport, lairage and eventual slaughter.

A new zoning system

- The Independent Technical Reference Group (ITRG) recommend a zoning system for the park to guide management of wild horses and allocation of resources. They support delineation of three broad regions of the park, and recommend further subdividing these regions into management zones. Within these zones, horses may be excluded or managed to reduce impacts.
- The ITRG consider that dividing the park into specific zones to facilitate management of wild horses will allow coexistence of diverse values in the park, and provides scientific criteria and options for how such zones may be delineated and applied. In these zones, different combinations of control methods would apply, using an integrated approach to increase effectiveness. The effect of management would ideally be monitored through the effects on agreed impact measures or thresholds of concern, rather than on horse numbers or densities.

Introduction

The *Kosciuszko National Park Horse Management Plan* (DECC 2008) has guided the wild horse management program in Kosciuszko National Park ('the park') since it was adopted in December 2008. The 2008 Horse Plan included an action to review the plan after five years, and in 2013 the then Minister for the Environment, Robin Parker, formally asked the NSW National Parks and Wildlife Service (NPWS) to review the plan.

This *Review of the 2008 Horse Management Plan and Wild Horse Management Program, Kosciuszko National Park* ('the Review') documents the outcomes of the review process that has been undertaken over the last two years. The process has involved five significant projects:

1. Extensive community and stakeholder engagement using contemporary techniques to identify the community's understanding of park values and its views on wild horse management in Kosciuszko National Park (see supporting document by Straight Talk 2015).
2. An assessment to better understand the national cultural heritage values associated with the Kosciuszko National Park wild horse population (see supporting document by Context 2015).
3. Formation of an Independent Technical Reference Group (ITRG) to provide independent and rigorous scientific and technical advice on the management of wild horses in the park (see supporting document by ITRG 2016).
4. A literature review focussing on a number of key documents and reports that have been produced since the 2008 Horse Plan or are directly related to the review of the plan.
5. Consultation with NPWS staff with experience and knowledge of the wild horse management program in the park, including horse removal, monitoring and research.

The Review is a companion document to the *Kosciuszko National Park Draft Wild Horse Management Plan* (OEH 2016). It provides background information, evidence and analysis to support the 2016 Draft Wild Horse Management Plan.

In this Review, NPWS refers to the horses as 'wild horses' in an effort to maintain balance between environmental and horse advocacy stakeholder groups that regard the terms 'brumby' or 'feral' as either romanticising or being derogatory, depending on the viewpoint. Use of such terms by NPWS, it is argued by stakeholders, could cloud or influence community opinion. This in itself is an indicator of the level of controversy, debate and emotion that is associated with this management issue.

NPWS wild horse management in the park before 2008

Formalised NPWS management and control of horses in Kosciuszko National Park began in the early 1970s. During the 1970s licensed horse roping (also called brumby running) was the main control method used. However, concerns over the animal welfare aspects of brumby running resulted in the activity being banned in NSW national parks in 1982.

By the late 1990s the environmental impacts caused by a growing horse population in the park became increasingly obvious (particularly in the alpine areas) as evidenced by new tracks, damage to streams and riverbanks, trampling of bogs and damage to native vegetation. In recognition of these increasing impacts, NPWS prepared a *Horse Management Plan for the Alpine Area of Kosciuszko National Park* (NPWS 2003). The aim of the Alpine Area Plan was to reduce the impacts of wild horses on the highly sensitive alpine vegetation of Kosciuszko's Main Range.

Of the nine control methods considered in the Alpine Area Plan, three were recommended to trial: trapping, roping and mustering. Trapping horses then roping and leading them for short

distances was trialled for a short time, but was discounted as a control method due to high risk to personnel and significant stress placed on horses. Trapping and loading horses directly onto transport has been the method implemented since then.

In 2006 the *Kosciuszko National Park Plan of Management* (DEC 2006) was adopted. One of the plan's objectives was to reduce the distribution and abundance of introduced animal species found in the park. The plan of management includes two management objectives relating to horses. One aims to exclude feral horses from a number of key areas (see below). The other objective requires implementation of the Alpine Area Plan and the preparation of a similar plan for the entire park. The *Kosciuszko National Park Horse Management Plan* (DECC 2008) is the plan for the entire park.

Review of the 2008 Horse Management Plan

The objectives of the 2008 Horse Plan

The 2008 *Kosciuszko National Park Horse Management Plan* ('the 2008 Horse Plan') was prepared in accordance with the *Kosciuszko National Park Plan of Management* following extensive community consultation. It was the first plan prepared for the entire park and established the following objectives:

- 'To exclude horses from:
 - the Main Range Management Unit
 - the Yarrangobilly Management Unit
 - the Cooleman Plain Management Unit
 - safety risk areas such as highways
 - areas of the park where horses have not been or have only recently been recorded (e.g. Jagungal)
 - areas of the park adjoining other Australian Alps national parks and reserves
 - feeder areas for all of these parts of the park.
- To reduce horse numbers in other specific areas to reduce the risk they pose. These areas would be where horses have an impact on public safety, the environment or on the cultural heritage of the park.
- To make sure that all horses are treated humanely throughout the removal process and their removal complies with current codes of practice.'

Overall success of the wild horse control program

When assessing the program against the above objectives it is apparent that despite NPWS's best efforts, few of the objectives have been met. In summary:

- Wild horses have not been excluded from the areas specified in the 2008 Horse Plan, including the three management units that are of exceptional natural and cultural significance.
- In relation to reducing horse numbers, at times horse numbers may have been reduced in a specific area but they have quickly repopulated or reinvaded from adjoining areas.
- One of the main factors limiting the achievement of the plan's objectives has been the lack of demand for 'rehoming' or domesticating captured horses. Less than 20% of captured horses have been domesticated. There are only limited options available for disposal of trapped wild horses.

- The other main factor is that only one control method has been implemented, that is, trapping using lures and then removal of wild horses from the park.
- In 2008 there was an estimated 3000 wild horses in the park, and by 2016 this number has doubled to an estimated 6000.
- Surveys indicate that horses have spread into areas where they did not occur in 2008.
- NPWS has applied and followed all relevant animal welfare legislation, regulations, codes of practice and standard operating procedures.

NPWS has a long history of consulting with stakeholders about the management of wild horses in the park. This has included consultation and engagement with both wild horse advocacy and environmental advocacy stakeholder groups. Both sectors expressed concerns with the 2008 Horse Management Plan. Their positions are strongly held and well known to NPWS given their involvement in formal and informal engagement for an extended period of time. Both sectors remain concerned that their key objectives, the protection of the wild horses and the protection of the park's natural environment, respectively, may not be the focus of the next management plan. The range and factions within stakeholder groups do not agree on the level of horses' impact or the most appropriate management methods.

Control methods used

The 2008 Horse Plan considered 10 different control methods:

- immobilisation using tranquillisers delivered by a dart rifle
- fertility control
- fencing
- aerial culling
- ground culling
- trapping horses using lures
- mustering using riders and/or helicopter to run horses into yards
- mustering using low stress behaviour technique to walk horses into yards
- brumby running under a contract system
- roping.

Two of these methods were endorsed for implementation:

- trapping using lures and then removal from the park was to be the primary method
- mustering using low stress techniques was proposed to be trialled.

At the time of writing the 2008 Horse Plan, these two methods were chosen as they were considered to be the most humane and most effective methods and were acceptable to the community in New South Wales. It was recognised that there were different opinions on the use of lethal methods ('culling techniques') to remove horses from the park.

Trapping using lures and removal of captured horses has been the only horse management and population control method used by NPWS under both the 2003 and 2008 wild horse management programs. The method is costly, time consuming and has not effectively reduced the wild horse population or extent of its impacts. The main constraints with this method are:

- it can only be used where there is vehicular access to remove horses
- it is very labour intensive and takes time because yards are in relatively remote locations and it requires horses to be lured to trap yards

- there is always a risk of interference with the trap yard sites and trapped horses because of the generally high level of visitation to the alpine and subalpine areas of the park.

The trial of low stress aerial mustering has not been undertaken due to limitations on rehoming or disposal of larger numbers of horses that may have resulted from an aerial mustering operation. Some stakeholder groups continue to oppose this method based on animal welfare concerns or its potential efficacy to reduce numbers.

A range of methods are needed

It is widely acknowledged that a range of control methods are needed for any wild horse control program to be successful (e.g. ITRG 2016; DoC 2006):

‘It was also agreed by the ITRG that using an integrated range of control methods, rather than limiting control to a single method, would provide the best and most efficient opportunity for achieving population reduction and associated mitigation of impacts. ... In order to make any effective reduction in current horse populations and their impacts, a range of control methods are needed that have the capacity, in combination, to remove large numbers of horses over a relatively short period of time with sustained follow up and maintenance.’ (ITRG 2016)

Based on the review of outcomes and constraints of the current wild horse program and the findings of the ITRG and literature review, the 2016 Draft Wild Horse Plan proposes the implementation of seven different control methods as part of an integrated wild horse management program.

NPWS staff involvement in the program

Since 2008, in northern sections of the park NPWS staff have primarily carried out the trapping and loading of horses, and contractors were used to transport the horses. In southern sections of the park both NPWS staff and a number of different local contractors have been used for the trapping and loading as well as transportation.

NPWS staff training has included low stress stock handling training. Whilst the basic concepts of such training are relevant, both the trainer and staff agreed that it had only minor application for dealing with wild horses. Other basic training involves annual induction review and refresher and job safety analysis processes for staff members involved in the program. This ensures that operations are undertaken in accordance with the appropriate animal welfare standards, codes of practice and standard operating procedures (see list below).

Staff are also accredited under the NSW NPWS firearms policy training and accreditation requirements if they are required to use a firearm to euthanase an injured or sick animal. Again, this is carried out according to the relevant codes of practice. Many of the staff involved in the trapping and removal program also have a rural/agricultural or animal/wildlife management background and/or depth of experience in dealing with wildlife, vertebrate pest control, stock and horse handling more generally.

It has been found that using staff to undertake the trapping and loading, and contractors to undertake transportation or haulage can be more efficient, as staff can concurrently undertake other park management duties.

Wild horses have been treated humanely, in accordance with current best practice

The trapping and removal program has been conducted in accordance with all relevant national and State animal welfare legislation, regulations, standard operating procedures and codes of practice including those listed below. These documents set the minimum

required standards for the humane treatment of pest animals generally, or wild horses specifically, for trapping and transportation, and euthanasia if required.

These include Commonwealth codes and procedures:

- *Australian Animal Welfare Standards and Guidelines: Land transport of livestock* (AHA 2012)
- *Model Code of Practice for the Welfare of Animals: Land transport of horses* (SCARM 2003)
- *Model Code of Practice for the Welfare of Animals – Feral Livestock Animals: Destruction or capture, handling and marketing* (SCAAHC 2002).

NSW codes and procedures:

- *Model Code of Practice Humane Control of Feral Horses* (Sharp & Saunders 2014) and associated standard operating procedures
 - *NSW HOR001 – Ground shooting of feral horses* (Sharp 2011a)
 - *NSW HOR003 – Mustering of feral horses* (Sharp 2011b)
 - *NSW HOR004 – Trapping of feral horses* (Sharp 2011c)
 - *NSW GEN 001 – Methods of euthanasia* (Sharp 2013)
- *Prevention of Cruelty to Animals (Land Transport of Livestock) Standards* (NSW Government 2013)
- *Development of a Model Code of Practice and Standard Operating Procedures for the Humane Capture, Handling or Destruction of Feral Animals in Australia* (DPI 2004).

The use of appropriately trained, skilled and dedicated staff, together with the overall management of the program, has ensured the humane treatment of wild horses in line with the animal welfare codes and standards listed above.

As a result, there have been minimal significant injuries and incidental deaths of horses as a result of the trapping and removal program. Since 2002, 22 of the 3183 wild horses have either died or been euthanased as a result of significant injury sustained during the trapping and removal process. This equates to 0.0069 or less than one per cent of the horses trapped during that period. Some of these 22 horses may have had pre-existing injuries/illness, thus not all can be directly attributable to the trapping, loading or transportation process.

There are concerns with some areas of animal welfare regardless of whether procedures comply with the relevant standards, including:

- transportation of stallions
- disruption of mob structures
- assessment of and transportation of heavily pregnant mares, or mares with young foals at foot.

NPWS staff, the RSPCA, some stakeholders and members of the community also are increasingly concerned about animal welfare and the relative humaneness of subjecting wild horses to the cumulative stresses of trapping, loading and long distance transportation for horses, regardless of meeting current animal welfare standards. This is a particular concern when the final fate of the horse subjected to such a multistaged process is to be slaughtered at a knackery or abattoir. This is supported by the Humaneness Assessment Panel report which stated:

'When considering the overall impact of a multistaged process, all stages must be considered as the cumulative effects of each procedure will compound the overall welfare impact.'

Apart from the formal wild horse trapping and removal program, a small number of wild horses are euthanased within the park each year due to injury, illness or poor condition. Wild horses encountered have sustained injury from natural fighting behaviour and also illegal brumby running or roping activity. Horses in poor condition due to stranding in snow at higher elevations or lack of feed in the lower Snowy River area are also encountered. The horses, which may be encountered by or reported to NPWS staff, are assessed by staff in consultation with RSPCA inspectors where appropriate as to their situation and viability/success for rescue, treatment or euthanasia. Due to their condition and situation, in most instances these horses need to be euthanased using ground shooting by appropriately qualified staff.

Trapping and removal of wild horses

There have been 3183 horses removed from the park since 2002-03 (see 0):

- 583 (18 per cent) wild horses removed were 'rehomed' or domesticated
- 2600 (82 per cent) were sent to a knackery or abattoir for humane slaughter.

Expenditure has been in excess of \$3.3 million which equates to an approximate cost of \$1116 per horse.

Trapping has generally been conducted between February and May in the south and June and September in the north. These periods minimise the chance of encountering heavily pregnant mares or mares with young foals at foot. In the north, June to September coincides with a period when public vehicular access is closed. This minimises public disturbance and vandalism of traps, equipment theft and illegal re-release of trapped horses, all of which have interfered with the program. In the south, trapping is conducted over the summer and autumn because these are the only periods when trap sites are accessible by vehicle due to the wet and snowy conditions during the winter and early spring.

Table 1. Summary of wild horse removal program in the park

Financial year	South KNP	North KNP	Total KNP	Rehomed	Rehomed %
2002/03	49	0	49	?	?
2003/04	17	0	17	?	?
2004/05	35	0	35	?	?
2005/06	32	0	32	?	?
2006/07	88	27	115	?	?
2007/08	86	45	131	?	?
2008/09	83	13	96	7	7%
2009/10	107	251	358	8	2%
2010/11	47	260	307	8	3%
2011/12	42	616	658	180	27%
2012/13	46	541	587	79	13%
2013/14	69	218	287	105	37%
2014/15	17	372	389	131	34%
YTD - 2015/16		122	122	72	59%
Total	718	2465	3183	583	18%

KNP = Kosciuszko National Park.

? = accurate rehoming records were not kept for the period 2002–2008.

Fate of captured horses

Captured horses were delivered and distributed to a number of third parties, including wild horse 'rehoming' and rescue groups and individuals; and stock contractors that have registered with NPWS to receive wild horses from the removal program. Some rehome or domesticate all horses they take while some only rehome a percentage they deem suitable and/or have demand for. Those unable to be rehomed are transported to knackery or abattoir for slaughter. Knackeries where wild horses have been sent include those in Victoria. Abattoirs that process horses are located in South Australia and Queensland.

Rehoming and domestication is only possible for a certain number of wild horses each year. This is driven by both the demand or otherwise of the community to adopt wild horses as well as competing against other sources of surplus horses such as the racing and thoroughbred industry 'wastage'.

NPWS attempts and encourages to rehome or domesticate wild horses via established rehoming or rescue groups and interested individuals within the community. Since 2010, NPWS has publicly advertised and maintained a register of individuals who are interested in rehoming a Kosciuszko wild horse. NPWS and wild horse rehoming groups have identified a number of issues and concerns around the rehoming and domestication process including:

- That the current trapping and removal program is constrained by the lack of public demand for rehoming or domestication or appropriate disposal options of unwanted wild horses.
- That trapped and removed horses have been illegally released back into the park and other adjoining conservation/public lands.
- That wild horses should only be made available to persons that are appropriately experienced and have appropriate property and facilities to deal with wild horses.
- There is a need to increase the rehoming or domestication rate by improving the promotion, marketing and access to information on the values of 'brumbies' and the wild horse rehoming process.
- There is a need to improve and streamline the holding and pick-up process of wild horses that are intended for domestication or rehoming.
- Rehoming and rescue groups are reliant on personal, community and volunteer support to operate.
- Concern for wild horses that may be utilised for rodeo or 'brumby catch' style events or festivals where animal welfare standards may be questionable.

The above issues present challenges to both NPWS and rehoming and rescue groups in terms of resourcing, capacity as well as relevant jurisdictional responsibility.

Tracking the longer term eventual fate of these horses is not always possible as the horses may change ownership and possession a number of times.

Where trapping has been undertaken

The focus of the control program has been on the wild horses in the areas listed in the 2008 Horse Plan objectives; in particular in reducing numbers of horses in the Yarrangobilly and Cooleman management units; stopping horses pushing into the Main Range Management Unit; and reducing horse numbers along high speed roads like Snow Mountains Highway and Alpine Way. As such, trapping and removal has been undertaken at 31 sites across the park focusing mainly on the Kiandra, Long Plain, Cooleman and Tantangara areas in the

north; and the Upper Thredbo, Cascades, Tin Mines and Snowy Plains areas in the south of the park.

Trapping and removal of wild horses requires appropriate vehicular access to be able to establish, set and check traps and remove captured horses. As such, the areas where this method can be deployed are limited and do not always coincide with where wild horses are distributed, or with the areas listed in the objectives as places to exclude horses.

A number of trapping sites were decommissioned due to their remoteness which required horses to be transported for longer distances over rough trails, thus reducing animal welfare outcomes.

Rather than listing areas where the aim is to 'exclude horses', as the 2008 Horse Plan did, the ITRG endorsed the three management regions proposed by NPWS. The ITRG also recommends that the three regions:

'... be further subdivided into zones within which horse numbers can be managed to different levels, to facilitate resource allocation, coexistence of different values within [the park], prioritisation of management actions, and longer term planning.' (ITRG 2016)

Changes in the number and density of wild horses in the park

'Whether horse numbers are on the increase is an important question as it helps to establish whether past management efforts have been sufficient.' (ITRG 2016)

In 2002 there were an estimated 3000 wild horses in the park (Walter 2002). In 2014 there were an estimated 6000 horses in the park based on aerial surveys of the Australian Alps National Parks in May 2014 (Cairns in prep.). To derive the count for Kosciuszko National Park, NPWS used horse density estimates to separate the estimates relevant to the park. Table 2 shows the Kosciuszko National Park estimates.

Table 2. Kosciuszko National Park only results 2014

Source: NPWS estimates based on Cairns (in prep.)

Survey block	Area (km ²)	Number	95% confidence interval
North Kosciuszko	1549	4247	2777–5893
Snow Plain	123	124	13–293
Pilot–Byadbo	1978	1478	1190–1969
Total park:	3650	5849	3899–8155

The most recent, Cairns (in prep.), Australian Alps-wide aerial survey for wild horses is the most precise survey conducted to date (see details in Appendix A). It involved helicopter surveys of 2817 kilometres of transect across the known wild horse distribution in the Australian Alps.

The ITRG (2016) concluded that a figure in the order of 6000 horses in the park as of 2014 is a reasonable working estimate to guide future management.

Appendix A contains a detailed analysis of current abundance.

Comparing population estimates over time

In 2002 there were an estimated 3000 wild horses in the park (Walter 2002). In 2009 there were an estimated 4200 wild horses in the park (Dawson, nee Walter, 2009). By 2014 this

number has risen to 6000. This increase over time is despite NPWS removing more than 3183 horses from the park.

At a more local level, surveys also indicate increases over time. A series of small-scale surveys have been conducted by NPWS in the northern and southern sections of the park when resources permitted. These surveys and counts are associated with areas where the trapping and removal program has been conducted.

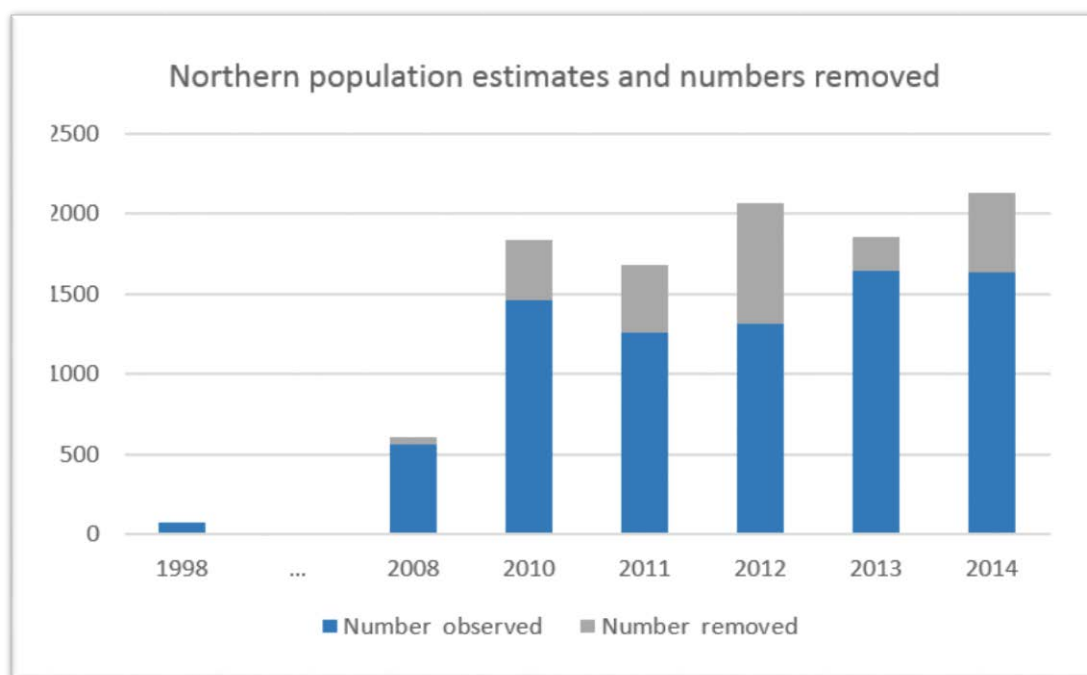
The survey results show that there has been an increase in horse numbers in the period since surveys and observational counts began. Moreover, the trapping and removal program is having little impact in meeting its objective of reducing wild horse populations and subsequent impacts in these areas. For example, based on the Big Boggy mark-recapture surveys the horse population has essentially more than doubled in both size (81 to 195 horses) and density (2.7 to 5.57 horses per square kilometres) in the nine years between 2006 and 2015. This is despite 228 horses having been trapped and removed from the survey area in that period.

The **northern observation flights** were conducted in the Long Plain, Tantangarra, Currango and Coolamine Plain areas. These flights are conducted as simple observational flights where horse numbers, mob description and GPS location are recorded then plotted on a map and analysed (see in Appendix B for flight maps for 1998 and 2014 surveys). Results for the northern surveys are shown in 0. The table also shows the number of wild horses that were removed in the period between the surveys.

'Taking [the observed numbers of horses in northern Kosciuszko National Park] at face value suggests an increase in the number of horses through time, with extremely high numbers since 2010. These raw counts are, however, not directly comparable to the estimates obtained from the aerial surveys' (ITRG 2016).

Table 3. Summary of results for northern Kosciuszko National Park observational flights

Survey	Number of wild horses observed	Number of wild horses removed between surveys
June 1998	75	0
August 2008	558	45
August 2010	1460	380
August 2011	1262	420
September 2012	1312	750
September 2013	1646	210
September 2014	1637	495



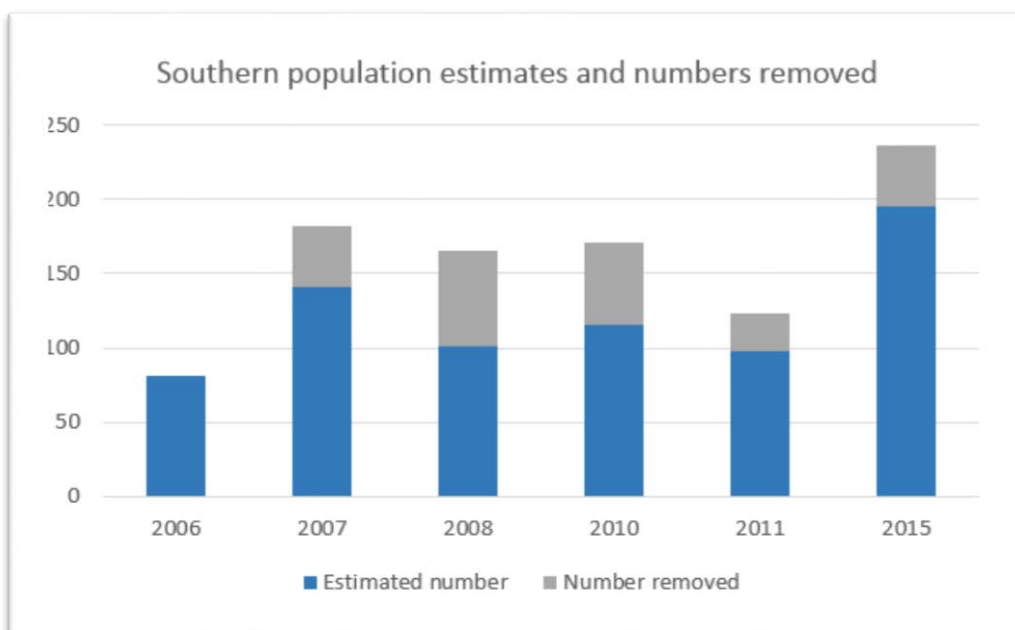
The **southern mark-recapture surveys** were conducted in the Big Boggy–Upper Thredbo River catchment area. This survey is conducted as simple mark-recapture aerial survey over two flights using two independent observers. Numbers, mob description and GPS location are recorded then plotted on a map and using a simple Lincoln-Petersen analysis method to provide a population estimate. See Appendix C for flight map, detailed results and statistical analysis.

Table 4. Summary of results for southern Kosciuszko National Park mark-recapture survey

Survey date or year of trapping program	Wild horse population estimate	95% confidence interval	Number of wild horses removed between surveys
May 2006	81	64–98	Data not available
June 2007	141	116–166	41
May 2008	101*	82–120	65
2008/09	-		25
May 2010	115*	100–131	31
June 2011	98	94–102	25
2011/12	-		13
2012/13	-		10
2013/14	-		7
May 2015	195	167–223	11

* lowest/lower estimate

- = survey not conducted



Density of horse populations

The ITRG (2016) considers that differences in survey area, design and analysis between the various surveys make it statistically impossible to infer trends over time in the overall density of horses. However, the survey results indicate that the population has been growing at rates of up to 4% per year for the North Kosciuszko Area since the previous Alps-wide aerial survey was conducted in 2009 (Cairns in prep.). This increase is still occurring despite trapping and removing over 1600 horses during the period between the two surveys. When analysing the survey trend results overall densities in the southern population appear to be decreasing but it is expected that this reflects the inclusion of a larger survey area and poorer horse habitat such as Byadbo.

Changes in the distribution of wild horses in the park

Of particular concern is the continued presence of wild horses in the three areas of exceptional natural and cultural significance where the objective was to exclude horses; namely Main Range, Yarrangobilly and Cooleman Plain management units. Horses are also still impacting visitor safety in the park (see Section 3.6).

The current distribution of wild horse populations across the park has been mapped and is estimated to occupy 331,000 hectares or 48% of the park. Wild horses currently occur within four disjunct populations within the park: North-east, Bago–Maragle, Snowy Plain and Pilot–Byadbo (see Figure 2 in the 2016 Draft Wild Horse Plan).

When comparing the 2008 and 2016 distributions, it is evident that there has been no significant reduction in their range. If anything, since 2008, wild horses have established themselves and continue to make incursions into the following areas:

- towards Jagungal, west into the Finns River catchment from the Snowy Plain population
- between Mount Kosciuszko and the western boundary of the park and in the Wilkinsons Valley, Rawsons Pass and Muellers Pass areas.
- in the Jagumba area
- in the far northern areas of the park bordering Micalong and Bondo state forests
- around Cabramurra

- onto private property to the east of the park in the Ingebirah, Numbla Vale, Mowamba and Little Thredbo River areas from the Pilot–Byadbo population.

Research (Beeton & Gaynor 2014) into developing a model to aid invasive species management is continuing under the National Environmental Research Program. This work aims to develop a new tool to assist cost-effective decision-making in the management of invasive species. The SPADE tool (Spatial Population Abundance Dynamics Engine) is a spatially specific model that predicts the spread of invasive species based on an understanding of habitat suitability, the biology of the species, and estimates of current population size.

The tool runs on a standard desktop computer or laptop. It can incorporate different target densities in different landscape zones, and compare the costs and benefits of alternative management methods. Its ability to model the movement of animals and diseases over large areas provides managers with a powerful means of exploring the likely outcome of different management interventions, decades into the future. The researchers are initially using the tool to examine the likely distribution and density of wild horses in the Australian Alps and fallow deer in Tasmania, and exploring its potential to model the invasive plant species, hawkweed.

Wild horses are still impacting park values

Overall impacts on park values

The Independent Scientific Committee, formed in 2006 to guide the drafting of a *Kosciuszko National Park Plan of Management*, found that while much of the park was in a good and stable condition, there were pressures needing to be addressed. These pressures included the expansion of development, inappropriate fire regimes, increased summer visitation, climate change, and, important for this discussion, introduced plants and animals. The park's plan of management outlines strategies to address all these threats.

The 2006 plan of management states:

'The detrimental impacts of introduced animals include:

- Vegetation damage and destruction
- Soil erosion
- Creation and proliferation of tracks
- Deterioration in water quality and the health of aquatic ecosystems
- Selective grazing leading to the decline or loss of palatable plant species
- Competition with, or predation on, native animal species contributing to reductions in numbers and local extinctions
- Genetic contamination of native animal species (e.g. dingoes)
- Competition with, or predation on, domestic livestock on adjacent pastoral properties
- Introduction and spread of exotic plants and pathogens
- Reductions in aesthetic quality where damage is obvious and extensive
- Threats to visitor safety.

Today, the most obvious and problematic introduced animal species found in the park and the surrounding region are dogs, horses, pigs, foxes, cats, goats, rabbits, hares, deer, starlings, black rats, house mice, several fish species and European bees.'

Many of the detrimental impacts identified in the plan of management are caused by wild horses and are still impacting park values today. Implementation of the 2008 Horse Plan has not adequately addressed or reduced these threats. The plan of management implementation report for 2010–2011 (OEH 2011) refers to the continued and increasing threat that wild horses pose to a number of park values:

- While impacts to natural heritage were generally noted as being stable, the inability to successfully reduce feral horse populations is reported as increasingly impacting on natural values within the Snowy River area and is therefore of concern.
- No significant change [to rocks and landforms] across much of [the park] although in Byadbo Wilderness Area, landscapes are still increasingly showing terracing from feral deer and horse impacts.
- Feral horse impacts on Cooleman Plain ... require further control and monitoring. Some management improvements to some areas of karst were undertaken. Continued increasing threats from feral horses ... require further management and monitoring.
- There are also impacts recorded in creek lines and wetlands from horses in the Pilot Wilderness and Long Plain areas.
- Head waters of the Snowy and Murray Rivers were in good to fair condition with impacts generally increasing as a result of wild horse ... numbers.
- Threats [to native vegetation] from grazing by increasing numbers of feral horses ... have been confirmed by various reports including [State of the Parks] 2010.
- Significant impact on Northern Corroboree Frog habitat and sites have been identified from feral horses. Enclosures and further control of feral horses and deer are necessary to protect these species. Enclosures have been placed around key Corroboree Frog sites to exclude feral horses (SOP 2010).

The plan of management implementation report for 2011–2012 (OEH 2013) included a five-year action plan which set out implementation priorities for 2012–2017, including 'Continuing actions' in the plan of management and 'New priority actions'.

Continuing actions:

- Improve feral horse control, including applying methods agreed in the 2008 Horse Plan in inaccessible areas such as Byadbo.
- Main Range, Yarrangobilly and Cooleman Plain areas of exceptional natural and cultural heritage: Increase feral horse control and better protect all karst areas.

New priority actions:

- Review and improve effectiveness of KNP Horse Management Plan and control measures.
- Significant park wide improvements in the control of feral horses, deer, rabbits, cats and foxes to protect values.

Other research undertaken since the adoption of the 2008 Horse Plan illustrates the ongoing impacts that wild horses are having on the park. The following review of recent literature provides an outline of these impacts.

Impacts on high mountain wetlands

High mountain wetlands occur in small, isolated patches across the alpine, subalpine and montane landscapes of the Australian Alps and Tasmania. They are variously described as bogs, fens, peatlands and swamps.

Alpine *Sphagnum* Bogs and Associated Fens is a nationally endangered ecological community. The recently released recovery plan (DoE 2015) describes two distinct components of high mountain wetlands: bogs and fens. **Bogs** are usually defined by the presence of *Sphagnum* spp. (they are absent or less obvious in fens and degraded wetlands). **Fens** are described as shallow, open water pools with or without emergent aquatic plants, and are often near to or surrounded by bogs. Bogs and fens are found in permanently wet areas, such as along streams, drainage lines, valley edges and valley floors (DoE 2015).

In New South Wales, high mountain wetlands are a component of a broader endangered ecological community called montane peatlands and swamps that occur in a number of bioregions, including the Australian Alps. Montane **peatlands** and **swamps** occur on undulating tablelands and plateaux, above 400–500 metres elevation.

The ITRG considered that the impacts of wild horses on bogs and waterways in the park are probably the greatest concern. These bogs and wetlands are extremely important as filters and storages for water. They are also important habitats for a range of Commonwealth and State threatened species (Roberston et al., cited in ITRG 2016), including: corroboree frogs (*Pseudophryne corroboree*), broad-toothed rat (*Mastacomys fuscus*), swamp everlasting (*Xerochrysum palustre*), Kiandra greenhood (*Pterostylis oreophila*), alpine tree frog (*Litoria verreauxii alpina*) and alpine water skink (*Eulamprus kosciuskoi*).

'The chief threatening process for peat communities in the Australian Alps is physical damage by trampling leading to loss of vegetation cover and alteration of local hydrology which leads to channelling of waterflow through the bog. ... Trampling by feral horses is an increasing threat in the ... Tantangara and upper Thredbo valley areas in NSW.' (McDougall & Walsh, cited in Hope et al. 2012).

Impacts on the water catchment values of the Australian Alps, of which Kosciuszko National Park is a significant and critical component, are highlighted by Worboys et al. (2015). Their report describes the impact of wild horses on Australia's Natural Heritage Listed alpine and subalpine environments. Horses selectively target rare wetland environments in the Alps and progressively degrade them. The report identifies that these wetlands are critical for delivering high quality water to the Murray Darling Basin. They consider that horse numbers are growing rapidly and the report maps the expansion of wild horse affected areas in the Alps during the period 2010–14.

Worboys et al. (2015) illustrate the impacts that wild horses are having on alpine environments, in particular wetland ecosystems and species. They list nine different impacts: vegetation trampling, soil compaction, animal habitat change, vegetation drying and composition change, stream bank collapse, peat drying and erosion, stream erosion, silting of deep river pools and weed introduction.

Mapping bogs and fens in the Snowy Mountains

The peat-forming bogs and fens of the Snowy Mountains in New South Wales were mapped after the 2003 fires (Hope et al. 2012). The detailed mapping showed there are 9120 individual peatlands in the Snowy Mountains region. They cover 7985 hectares, of which 6037 hectares (76%) are in Kosciuszko National Park. Some 72% of the mapped peatlands occurs in patches smaller than 0.5 hectare. Of the 6037 hectares in the park, 3656 hectares are *Sphagnum* shrub bog.

Hope et al. (2012) describe the bogs and fens as follows:

'Bogs and fens are common in the Snowy Mountains of south-eastern New South Wales (NSW) and form up to 2.5% of the higher altitude land cover in Kosciuszko National Park. At lower altitudes peat deposits beneath extensive sedge fens fill broad valleys on gentle slopes. With increasing altitude the hummock moss, *Sphagnum cristatum*, contributes to shrub-rich montane, subalpine and alpine bogs which follow drainage lines and seepage areas on slopes and saddles. ... While similar fens and bogs occur in Victoria and the Australian Capital Territory (ACT), the occurrences in the Snowy Mountains represents the most extensive expression of peatlands in mainland south-eastern Australia with major environmental significance as habitat and as regulators of water quality.'

They concluded that:

'The peatlands are vulnerable to hydrological changes from grazing and trampling by large mammals such as horses. They are also sensitive to climate change as they are near their climatic limits and have been greatly stressed by past disturbance and fire.'

Hope et al. (2012) note that horses:

- often graze in the fens and leave a dense network of tracks
- have broadened stream lines and almost completely removed a former subalpine *Sphagnum* shrub bog at Dunns Creek
- play a part in facilitating weed establishment by disturbing vegetation and enriching areas with dung.

They conclude that horse control, in particular, is becoming critical to the preservation of bogs, fens and moors in many areas.

Impacts on treeless plains

Monitoring and research conducted since the 2008 Horse Plan includes a study on the impacts of wild horses on the treeless drainage lines in the Australian Alps (Robertson et al. in prep.).

A summary of the results of this monitoring and assessment shows:

- Evidence of horse presence was detected at 128 (92 per cent) of the randomly located sites within the estimated horse distribution – the horse population is clearly widespread.
- There were highly significant differences between sites within the horse distribution compared with sites outside the horse distribution with respect to the structure of creek banks, the amount of pugging (soil compaction), the amount of sediment on the creek bed and the level of grazing. Horse present sites were significantly worse.
- Drainage lines that are the Federal and State listed Alpine bog community are as affected as sites that are not alpine bogs.
- Other feral species such as deer and pigs are not responsible for the condition of drainage lines.
- The condition of drainage lines is unrelated to fire history since 2003.
- 76 per cent of the length of stream banks in horse present sites have some level of degradation, compared with 11 per cent in horse absent sites.
- 71 per cent of the length of the streams in horse present sites show changes to the longitudinal form (such as a broadened channel), compared with four per cent in horse absent sites.

- 56 per cent of the length of stream beds have a moderate to high sediment load, compared with less than one per cent in the horse absent areas.
- 82 per cent of the length of streams have moderate to high levels of pugging in horse present sites, compared with one per cent in the horse absent sites.
- 84 per cent of the length of streams will show some evidence of grazing, compared with 8 per cent in the horse absent sites.

This research work was further reinforced by research carried out by Porfirio & Mackey (2015). They tested whether satellite data is sensitive enough to pick up the same level of impact of wild horses on native vegetation that park staff recorded in field surveys. Their research showed that changes in vegetation condition were related to the presence of wild horses. This provides further evidence that wild horses have an impact on vegetation condition and that managing wild horse populations is an important conservation issue.

Impacts on other communities and species

Other threatened communities aside from the alpine and subalpine communities in the park are being impacted by wild horses. White-cypress pine – white box woodlands are part of the Snowy River Catchment Endangered Ecological Community. A long-term study of the woodlands in Kosciuszko National Park (Bishwokarma et.al 2014) concluded that wild horses are now the major contributor to suppressing the recovery of these woodlands from historical degradation.

The Bishwokarma study involved six grazing exclosures with paired control plots. These were established in 1984 and revisited and assessed nearly 30 years later, during October 2013. Landscape Function Analysis surveys showed that indices of soil surface stability, water infiltration rate, and soil nutrient cycling were significantly lower in the grazed plots compared to the five ungrazed plots that were still reasonably effective at excluding horses. The exclusion of horse and deer grazing is the most likely reason for the greater soil surface indices in the ungrazed plots.

Impacts on Victorian high country

In 2011, the Victorian Government Scientific Advisory Committee listed the ‘Degradation and loss of habitats caused by feral Horses (*Equus caballus*)’ as a Potentially Threatening Process under the *Flora and Fauna Guarantee Act 1988*. The committee concluded that feral horse populations are threatening a number of species and natural communities in parts of the Victorian high country and in the Barmah forest. The Victorian high country wild horse population is contiguous with the Pilot–Byadbo population in Kosciuszko.

The committee found that:

‘Feral horses impact habitat in two ways:

- via direct herbivory (consumption of native plants), in particular grazing impacts on threatened species and ecological communities
- through degradation of natural habitats, in particular habitats important for the survival of threatened species and communities. This includes fouling waterways, accelerating gully erosion and trampling and consuming native vegetation.’ (FFG SCA 2011).

Feral horses are a serious threat to at least 23 plant species and at least 21 animal species (many of which are listed as threatened species by the Victorian and/or Commonwealth governments). There are also at least six plant communities that are threatened by feral horses in Victoria, and it is highly likely that there are many other communities (FFG SAC

2011). Many of the species and communities of concern mentioned in the Victorian listing are also listed as threatened species and communities in New South Wales.

The committee also note that:

- a) 'feral horses are not native to Australia;
- b) as a hoofed mammal, the spread of feral horses from settlements had effects on some vegetation and wetlands that had not existed in those places before their introduction;
- c) although feral horses are not the only introduced hoofed mammals to have such effects, their effects are distinguishable from, additional to and distinct from any threats posed by other herbivores;
- d) feral horses can be a major factor threatening certain species and communities in the places where horse concentrations are high and those species and communities are found;
- e) the survival and future evolution of the affected species and communities depends on appropriate management actions that will reduce local feral horse concentrations in the affected areas to levels that no longer pose a significant threat.' (FFG SAC 2011).

For a comprehensive overview of impacts and ecology of wild horses in the Australian Alps, reference should be made to the Parks Victoria Background Paper 1: *The Ecology of Wild Horses and their Environmental Impact in the Victorian Alps May 2013* (Parks Victoria 2013).

Impacts on macropods

Wild horses compete for resources with native herbivores, including eastern grey kangaroo, red-necked wallaby, swamp wallaby and possibly other native mammals such as wombats (Matthews, cited in Parks Victoria undated).

In an experiment conducted in Guy Fawkes River National Park, Lenehan (2010) showed that feral horses excluded macropods (kangaroos and wallabies) from high quality plateau habitat. There is also anecdotal evidence that there are fewer kangaroos in the horse occupied areas in Kosciuszko National park. Lenehan found that:

'The Paddys Plateau dung transects indicated that horses displaced macropods and probably deterred them from utilising forage resources at the district scale (100 ha). At four of the six sites, as horse deposits declined, the number of macropod deposits increased until macropod dung was more prevalent than horse dung. Importantly, the trend was staggered across sites depending on their relative proximity to trap locations and how quickly, and to what level, horse dung declined. Trends in catch per unit effort (CPUE) values reinforced patterns in dung transect counts and supported the argument that macropods were responding to changes in the abundance of horses, rather than the removal of horses simply coinciding with an increase in macropod numbers or activity..... The inverse relationship between horse and macropod dung was strongest in habitat types thought to be prime grazing areas for both herbivores. The majority of macropod dung detected in March 2006 was in grassy swales and grassy woodlands.'

It is possible that horses exclude kangaroos from other habitat types as well, but horse removal was ineffective in other locations.

Horses are still causing safety issues

The risk that horses pose to motorists using the Snowy Mountains Highway, Elliott Way, Alpine Way and other roads within the park were highlighted in the 2008 Horse Plan.

NPWS has records of 26 reported vehicle collision incidents within the park involving horses since 2003 (including 17 since 2008) primarily on the Snowy Mountains Highway between the Eucumbene River crossing and Yarrangobilly River crossing, as well as incidents on Elliot Way, Barry Way and Alpine Way. Fortunately none of these incidents have resulted in significant injury or death, however some have had vehicles damaged beyond repair. It is considered that many incidents or 'near miss' incidents involving vehicle-wild horse interactions go unreported.

As part of the review of the 2008 Horse Plan, a risk assessment was undertaken using the standard NPWS Risk Assessment and Management Matrix (see below). This matrix uses relative measures of 'likelihood' combined with the 'consequence' to achieve a risk score or ranking. The risk score for adverse wild horse interactions with high speed traffic in the park when using a conservative assessment of 'possible to likely' likelihood with 'minor to major' consequence is ranked moderate to high risk (see shaded boxes).

Hazard & Safety Risk Matrix					
<i>Multiply Likelihood x Consequence to achieve risk score.</i>					
Consequence	Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	<i>May have little or no impact on health and safety</i>	<i>May have some impact on health and safety, but will be able to recover from or repair the damage within a relatively short term</i>	<i>A moderate permanent disability or long term impairment</i>	<i>A single fatality or severe permanent disability</i>	<i>Multiple fatalities or significant irreversible effects on the health of a large number of people</i>
Likely <i>There is a very good chance this event will occur in the near future</i>	Moderate	Moderate	High	Extreme	Extreme
Probable <i>This event has occurred several times or more in corporate experience</i>	Low	Moderate	High	Extreme	Extreme
Possible <i>This event might occur once or twice in corporate experience</i>	Low	Low	Moderate	High	Extreme
Unlikely <i>This event does occur somewhere from time to time, but very seldom</i>	Low	Low	Moderate	Moderate	Extreme
Rare <i>It is theoretically possible for this event to occur, but extremely unlikely that it will</i>	Low	Low	Low	Moderate	Moderate

Wild horse – visitor safety issues are not restricted to high speed road interactions. NPWS received a growing number of complaints and concerns from park visitors who feel that their personal safety has been threatened by wild horses through risk of trampling when camping, or being challenged by a territorial stallion or mare whilst walking. Signage is being considered for sites within the park such as the Blue Water Holes following a number of

concerns and complaints from campers. It is noted that the US National Park Service at Assateague Island National Seashore has had to instigate visitor education programs to mitigate adverse visitor – wild horse interactions including biting and kicking of visitors who try to approach, feed or interact with the wild horse population.

Documents supporting the Review

Community engagement report

Straight Talk, a community engagement consultancy, undertook an extensive community and stakeholder engagement using contemporary techniques to identify the community's understanding of park values and its views on wild horse management in Kosciuszko National Park. See supporting document by Straight Talk (2015): *Community Engagement Report – Wild horse management plan review*. The community and stakeholder engagement identified the following key themes:

- 'The community values and strongly supports national parks and recognises their importance in protecting native plants and animals, and unique landscapes
- Community members have a low level of knowledge about the impact wild horses are having on Kosciuszko National Park and although people think they are well informed about the management of wild horses, the evidence from the engagement demonstrated that they are not
- The majority of people regard feral (wild) horses in a different light to other feral animals, particularly in relation to appropriate population control methods, and there is a low level of awareness that horses are feral animals (non-native and introduced) in national parks
- No population control method for horses is universally supported or opposed by the community, however when given accurate information about control methods and time to reflect community members often did change their initial views
- There is a general understanding that a suite of different control methods is necessary to be able to effectively control horse population numbers in all circumstances
- The effectiveness of control methods is the most important consideration, and cost is the least important, for the community. The perceived humaneness of control methods is one of the key factors in determining how well supported different control methods are by the community
- Community members need to have confidence there is a legitimate need to manage horse population numbers in order to feel comfortable about the use of lethal control methods, and a formal management plan with well-articulated aims and objectives is also required
- Once community members understand the issue, they want NPWS to manage it proactively and effectively
- The views of environmental and horse advocates are polarised at either end of the wild horse management spectrum and do not reflect the views of the general public. Unlike community members, these stakeholders are not open to revising their views
- In relation to control methods, the views of the broader community are more closely aligned with environmental advocates than those of horse advocates

- Although environmental advocates indicated effectiveness was the most important consideration in a control method, both they and horse advocates identified humaneness as being important. However, there is not a shared view of what humaneness means.'

National cultural heritage values report

Context heritage consultants conducted an assessment to better understand the national cultural heritage values associated with the Kosciuszko National Park wild horse population. See supporting document by Context (2015): *National Cultural Heritage Values Assessment and Conflicting Values Report: The wild horse population Kosciuszko National Park*. The summary of the report states:

'Cultural heritage legislation in Australia, and particularly at the national level focuses on places – sites, buildings, landscapes – using specific criteria to consider the nature and degree of cultural significance inherent in that place, and defining the attributes that are considered to be essential to the retention of the identified heritage values. In this study, the wild horse population is considered as an attribute of the place – Kosciuszko National Park – or parts of that place. The National Heritage List criteria and assessment guidelines were used to frame the assessment of cultural heritage significance...

The key value themes arising from the historical analysis and used to set the context for the consideration of cultural heritage values of the Kosciuszko National Park (KNP) wild horse populations were:

- Nature and a sense of 'wildness', linked to the cultural concepts around an 'untamed' Australian landscape and the influence of 'the bush' on the development of Australian national identity and character
- The High Country cultural landscape in relation to pastoral occupation and land uses
- The 'Snowy Mountains' mythologies.

The heritage assessment contained in Section 6 [of the Context report] offers a preliminary assessment based on existing materials and using the National Heritage List criteria and thresholds. No new values research was undertaken. The assessment is designed to enable NPWS to understand cultural heritage values associated with the wild horse populations so that these can be considered in the development of the next Wild Horse Management Plan and in the wider context of park management.

The heritage assessment found that the wild horse population is an attribute associated with the cultural heritage significance of Kosciuszko National Park in relation to five criteria: (a) events and processes, (d) representativeness, (e) aesthetic characteristics, (g) social value and (h) significant people. Section 6 [of the Context report] provides this analysis, noting the extent and the range of attributes for each value. For example, in relation to the history of pastoral land use and transhumance, the North-East Kosciuszko landscape is already recognised as having national heritage values as part of the 'Australian Alpine National Parks' listing. Part of this history is the establishment of wild horse populations. A diverse range of tangible and intangible attributes remain today to help us understand this story: wild horses are only one of these attributes, and like the other attributes, are now disconnected from the activities of pastoralism and transhumance.

The report concludes with a chapter designed to explore the relationship of cultural and natural heritage values broadly, and to consider how conflicting values may be considered in the context of protected area management. Conflicts between values are not uncommon in the cultural heritage domain, often based on differences in

perceptions and values arising from individual and collective cultural frameworks and experiences....

It concludes that the cultural heritage values identified should be addressed, and that this implies retaining a wild horse population in an appropriate location or locations within the KNP as one of the attributes of the identified cultural heritage values. But equally, the impact of an expanding wild horse population on both natural and cultural heritage values across a widening landscape must be addressed to ensure that these values are not put at risk.'

Independent Technical Reference Group report

An Independent Technical Reference Group (ITRG) was formed to provide independent and rigorous scientific and technical advice on the management of wild horses in the park. (See supporting document by ITRG 2016). The key findings of the ITRG report are:

- I. 'The Independent Technical Reference Group (ITRG) has not been able to reach a conclusion on trends over time in horse numbers or densities in Kosciuszko National Park (KNP) because of problems of comparability between successive horse surveys.
- II. The ITRG considers that a figure of about 6000 horses in KNP in 2014 from the draft aerial survey report (Cairns 2015 [in prep.]) is a reasonable working estimate to guide future management of horse impacts.
- III. The ITRG finds, based on published scientific criteria (Bomford and O'Brien 1995; Simberloff 2003), that eradication of wild horses from KNP is not achievable, although their complete exclusion from certain parts of the Park is possible.
- IV. The ITRG concludes that the evidence of environmental harm is sufficient that wild horse populations must be managed in KNP.
- V. A significant majority of stakeholder organisations who provided submissions and presentations to the ITRG, including some of those who are essentially pro-horse, provided submissions supporting the contention that some management of wild horses was necessary in KNP.
- VI. The ITRG has carried out a thorough consideration of the humaneness and utility of various control methods for horses in KNP. Of those methods utilizing live capture, passive trapping and mustering in small groups had the lowest relative impact on animal welfare, when considered up to the point of removal from the park.
- VII. Of the *in situ* lethal control methods assessed, aerial shooting under a 'best practice scenario' had the lowest overall animal welfare impact, followed by ground shooting using head shots.
- VIII. Fertility control is only a viable option where horse densities are already low and the objective is to gradually reduce or maintain the population at a low density. Its broad-scale effectiveness in the context of KNP (or in any other large wild population) is yet to be determined.
- IX. The ITRG considers that dividing the park into specific zones to facilitate management of wild horses will allow coexistence of diverse values in KNP, and provides scientific criteria and options for how such zones may be delineated and applied. In these zones, different combinations of control methods would apply, using an integrated approach to increase effectiveness. The effect of

management would ideally be monitored primarily through the effects on agreed impact measures or thresholds of concern, rather than just on horse numbers or densities.

- X. The ITRG has identified a series of recommendations immediately below, and a set of research projects/priorities to fill critical knowledge gaps, to assist the Department in managing wild horses in KNP.'

Humaneness Assessment Panel

The ITRG held a panel to assess the humaneness (i.e. the impact on the welfare of the affected horse) of various control methods. See supporting document: *Assessing the Humaneness of Wild Horse Management Methods* (HAP 2015) which includes an assessment of 12 different methods. Each individual assessment includes two parts:

Part A: Overall welfare impact is based on the overall impact on welfare (from no impact to extreme) and duration of the impact (immediate to weeks). Scores range from 1 (lowest welfare impact) to 8 (highest welfare impact).

Part B: Assessment of mode of death applies to lethal methods only and examines the effects of the killing method on welfare by evaluating the intensity of suffering (no impact to extreme) and duration of suffering (immediate to weeks). Scores are ranked from A to H (lowest to highest).

Both Part A and Part B are used to assess the overall humaneness of lethal control methods. For non-lethal methods, only Part A is used to examine the impacts on an animal's welfare. Importantly, where there are multiple stages in a process, the model can be used to assess the impact of each stage the animals go through from the application of the first method to a specific end-point.

The outcomes of the assessment:

'Each assessment is based on a number of specific assumptions including that the method is carried out in accordance with best practice through compliance with a standard operating procedure. It is important to note these assumptions when considering the relative humaneness for any given method as any deviation from them will alter the outcome of the method. Some methods, such as those that include the risk of free-running animals becoming injured without being able to be followed-up, have the potential to result in significant adverse impacts if best practice is not followed. The notes, assumptions and summary of evidence for scoring the assessment against each domain, as well as any comments in relation to the overall humaneness score are provided in individual HAP Worksheets which accompany this report (Appendix 2). A summary of the assessment scores are shown in Table 1.

All potential methods for the control of wild horses were found to have some adverse impact on horse welfare. Choosing appropriate methods should therefore require careful consideration of how to mitigate those impacts. The severity and duration of impact both affect the final score, thus a long-lasting method with a mild impact can result in the same score as a faster-acting method with a severe impact.

When considering the overall impact of a multistage process, all stages must be considered as the cumulative effects of each procedure will compound the overall welfare impact. Where initial methods have similar scores, the adverse impact of those methods involving multiple stages will be greater than those with only one stage. Thus in seeking the most humane outcome, it is important to minimise the number of stages involved wherever possible, for example by minimising the number of times horses are subjected to loading and transport.

Further research and the development of standard operating procedures are required for those methods where there was insufficient information to conduct an assessment (these were: domestication practices; on-site humane killing; and delivery of fertility control). ...

Given the importance of ensuring best practice in improving the relative humaneness of control methods, consideration should be given to instigating an auditing or inspection process to measure compliance.'

Literature Review

The following web-based reference is a comprehensive summary of international scientific peer reviewed research on wild horses, their biology, ecology, environmental and social impacts and control:

- www.cabi.org/isc/datasheet/119345 – Invasive Species Compendium: *Equus caballus* [ISC] (horse) (CABI 2016).

The Invasive Species Compendium is an encyclopaedic resource that brings together a wide range of different types of science-based information to support decision-making in invasive species management worldwide. It comprises detailed datasheets that have been written by experts, edited by an independent scientific organisation, peer reviewed and enhanced with data from specialist organisations, images, maps, and a bibliographic database of abstracts and full text articles. New datasheets and data sets continue to be added, datasheets are reviewed and updated, and new scientific literature is included on a weekly basis.

Reviewing wild horse management in other areas

As well as the literature on recent research into the impacts of wild horses (see Section 3 of the Review), a review of wild horse management in other areas was also undertaken to inform the preparation of the 2016 Draft Wild Horse Plan. The review looked at recent advances in management approaches, knowledge, control methods or technologies, our understanding of cultural values and associations that may assist or inform future management. This work is summarised below.

It is estimated that there are over 400,000 wild horses in Australia. NSW NPWS has significant wild horse management issues in other parks it manages, including Guy Fawkes River, Barrington Tops, Blue Mountains and Yuragir national parks. So the issues and challenges of wild horse management are not unique to Kosciuszko National Park.

Case studies, research and reference material was reviewed relating to the following areas:

- Guy Fawkes River National Park, NSW
- Barmah National Park, Victoria
- Coffin Bay, South Australia
- Assateague Island, United States of America (USA)
- Kaimanawa, New Zealand
- Dartmoor, England
- Bureau of Land Management Mustang and Burro program, USA.

A summary of overseas case studies is provided below. While many of these situations and case studies have different frameworks, legislation, objectives and unique issues to consider relating to how wild horses are viewed and managed, each situation provides a useful reference point that has assisted the heritage assessment processes and in turn NPWS in

formulating the 2016 Draft Wild Horse Plan. Further discussion and reference can be found in Context (2015).

The Assateague Island (USA) and Kaimanawa (New Zealand) wild horse populations are the most relevant examples to Kosciuszko National Park. In both of these examples the wild horse management program attempts to balance the often competing and conflicting values of cultural heritage and environmental values in a conservation reserve setting. To achieve this they have set objectives to significantly reduce wild horse populations to minimum viable population levels of 100s rather than 1000s of wild horses.

Assateague Island National Seashore wild horse population – United States

Source: *Feral Horse Management at Assateague Island National Seashore* (USNPS 2006).

Being a conservation reserve, the Assateague Island National Seashore wild horse population more closely aligns to the management objectives for Kosciuszko National Park. This population is one of the few wild horse populations to occur within US National Park Service lands. Most other US public land populations are in multiple-use grazing rangelands managed by the US Bureau of Land Management.

The US National Park Service has identified and refer to the Assateague population as ‘a desirable feral species’. Their management approach established a short-term target of 80–100 horses, with the understanding that this target will be adjusted through adaptive management as the impacts of changing population size on horse and ecosystem health are monitored. Their management objectives acknowledge the environmental impacts of wild horses on native ecosystems and suggest maintaining a relatively small herd of approximately 125 on the Maryland section of the park and a separated herd of a maximum of 150 animals on an adjoining wildlife refuge in Virginia. It was also noted that these herds were managed using fertility control at gathers and selling excess stock.

Management objectives established by the US National Park Service for the Assateague herd include:

- Reduce the negative impacts of horses on key species, communities and natural processes to levels compatible with legal mandates and the continued evolution of Assateague Island toward a natural condition.
- Maintain a free-roaming herd of feral horses that exhibit natural characteristics and are subject to natural processes.
- Maintain a healthy population of horses capable of successful reproduction.
- Educate the public about the Assateague horses, including their history, behaviour, ecological impacts and scientifically-based management.
- Recognise and utilise the population as a valuable research resource, however, management strategies will not be modified in the interests of research.
- Provide a reasonable opportunity for visitors to view horses safely.

The Kaimanawa wild horses – New Zealand

Sources:

- *Kaimanawa Wild Horses Plan* (DoC 2006)
- *Kaimanawa Wild Horses Working Plan 2012–2017* (DoC 2012).

The New Zealand Department of Conservation (NZ DoC) are challenged with managing the Kaimanawa herd of wild horses on Defence Department land adjoining Tongariro National Park. With a herd size of about 174 horses in 1979, it grew rapidly when land was set aside in 1981. By 1994 the herd was estimated at 1500 horses ranging over 70,000 hectares.

NZ DoC has been managing the herd by mustering or 'gathers' using helicopters with the aim of reducing the population to 300 horses over a 25,000 hectare range. Both rehoming and direct to slaughter strategies are applied to captured horses.

Research demonstrated a need to remove all horses from about 70% of their current range and relocate 300 horses to an area outside of the current range to see if a relocated herd retains the intrinsic values currently associated with the wild herd. Management was then necessary to ensure the remaining horses stay out of the zero density areas and to ensure the horse population does not threaten ecological values in the areas where they are retained.

Genetic researchers have advised that a minimum effective population of 300 horses will maintain the genetic variability of this herd.

Public comments reveal a wide public interest in the Kaimanawa wild horses. A variety of values associated with these horses and perspectives on their management were identified. NZ DoC chose to convene a working party of representatives of the main interest groups to clarify associated values and perspectives and to develop their plan. The Kaimanawa Wild Horse Working Party concluded there were four aspects to resolving the conflicts surrounding management of the Kaimanawa wild horses. They were:

- eliminating the impacts of the horses on important conservation values
- ensuring all treatment of the horses is humane
- establishing ways to preserve and control the horse herd long term to eliminate the negative and retain the positive values they have
- deciding who is best to carry out long-term management.

Many of the recommendations proposed within the plan relate to policy rather than practical applications of wild horse management. These recommendations therefore require follow-up work before they can be implemented.

The *Kaimanawa Wild Horses Plan* states:

'It was concluded that a variety of methods will be required to reduce and control the population, therefore, rather than recommending specific programmes, criteria for assessing the relative humaneness of techniques were developed.'

'A key objective of the plan is to ensure that the treatment of the Kaimanawa horses is humane. Manipulations of the horses, including those causing the death of the animal, must be able to achieve the objectives of the Kaimanawa Wild Horse Plan without the horses experiencing undue physical and behavioural trauma.

There is no single technique that is without disadvantages. Therefore, a range of methods must be available so that the most appropriate method can be used for each situation. Issues such as public perception, practicality and cost, while secondary to humaneness, must be considered.' (DoC 2006)

A number of methods were identified for use, including ground shooting, aerial shooting (which was deemed preferable to ground shooting), mustering for transport to slaughter, mustering for transport to sale. As there was no data available on the effect of immunocontraception on the behavioural patterns of either individual horses or bands in this population, the widespread use of immunocontraception was not recommended.

It is understood that the proposed review of the plan to analyse all aspects of relocation and in situ management is yet to be undertaken. The primary control method continues to be helicopter mustering or 'gathers' with captured horses being removed for domestication, where possible, or transport for slaughter.

There has been a great deal of work to try to establish an appropriate density for the Kaimanawa herd, with much debate about thresholds, carrying capacity, vulnerability index etc. This highlights the difficulty in establishing and monitoring such concepts for land managers particularly when there is such variance across ecosystem type, seasonal and long-term variations.

In Kaimanawa, the suggested precautionary density reference point or threshold level is less than one horse per 250 hectares, or less than 0.4 per square kilometre, below which environmental values are unlikely to experience deleterious effects. This small, low-density population coincides well with other objectives of reducing both ongoing animal welfare issues of large 'culls' or 'harvests' for a larger retained population as well as reducing ongoing resourcing and management costs. The Kaimanawa wild horse population inhabit subalpine grass and shrublands similar to the environmental and ecosystem types found in Kosciuszko National Park. Like Kosciuszko, Kaimanawa evolved without the presence of large, hard-hooved grazers.

A 1994 report by Rogers on the environmental impacts of the Kaimanawa feral horses stated that:

'Some rare plant ecosystems are more vulnerable to horse impacts than tussock grasslands. A density of 1 horse per 250 ha recommended for the Ngawakaakauae and Awapatu sectors is set more in terms of reducing the probability of deleterious impacts on vulnerable rare plant habitats than on compatibility with the long-term recovery of tussock grasslands from their modified condition. Nevertheless, at the densities experienced between 1989 and May 1994 horses impacted negatively on grassland and rangeland condition in both northern sectors.'

The Kaimanawa working party considered the following comments by Rogers (1994) and the recommendations from a number of other sources, including the Massey University researchers and the army land manager to determine the number of horses to be retained in specified areas of the southern sector.

'A strategy of selective horse control is based on the premise that there is a population density below which the horses' undesirable effects are acceptable, i.e. a threshold level. A threshold population density is in turn linked to a threshold level of effect. Threshold levels of effects would be suitable performance standards for control operations, especially if they could be monitored using indicator species, vegetation stature or composition. For example, monitoring of vulnerable plant species is based on the assumption that, providing these key indicators are not being visibly or measurably damaged by horses, it is likely that the ecosystem as a whole will retain its integrity.

In practice, such thresholds have been experimentally confirmed for few feral populations. Present knowledge suggests that thresholds vary markedly between ecosystems and even individual communities. The linkage between threshold impact and population level is unlikely to be linear and therefore impact thresholds are difficult to calibrate. Once threshold population - impact levels are known, definite target densities can be set in different plant communities.

With present levels of understanding of ecosystem dynamics in N.Z., the only practicable approach to establishing impact thresholds would seem to be empirical monitoring of ecosystem responses to different horse population levels. Such an approach is of course long term and, in the case of critically threatened plant species and ecosystems, potentially very risky.

Thresholds are related to, but not the same as, vulnerability to horse damage. We can do vulnerability rankings on plant communities in the Moawhango from past

environmental research. The more vulnerable the community, the lower the threshold number of horses allowed in order to protect the community.’ (Rogers 1994)

United States Bureau of Land Management Wild Horse and Burro Management Program

Sources:

- *Using Science to Improve the BLM Wild Horse and Burro Program - A way forward* (National Research Council 2013)
- *Code of Federal Regulations Relating to the Protection, Management and Control of Wild Free-roaming Horses and Burros* (BLM no date).

The US Bureau of Land Management (BLM) is tasked with managing ‘Mustangs and Burros’ since the *Wild and Free-Roaming Horse and Burro Act 1971* was passed by the US congress. Their approach to protecting wild horses is to prohibit any lethal control or disposal at abattoirs in the USA, and to establish reserves on public multi-use rangelands where horse numbers are managed via ‘mustering and gathers’.

There is now an estimated 40,800 horses and 8500 burros living ‘on range’ with another 47,300 horses/burros in both short- and long-term holding facilities. BLM targets are to reduce the population to approximately 26,684 animals across the 12.8 million hectares that they have set aside as herd management areas. The program is costing around US\$71.8 million per year with a recent report indicating if they continue to follow this program that it could cost US taxpayers US\$1.1 billion up until 2030.

They are hoping that advances in fertility control may be the answer to their dilemma. It should be noted that, similar to the Kosciuszko National Park and Australian situation, management intervention, including mustering using helicopters and fertility control are not universally accepted by the community or wild horse advocacy groups.

While the management objectives, legal frameworks, landscapes, environments and levels of resource allocation are different to the Kosciuszko National Park situation, the report contains a wealth of useful information and reference material that should be considered in future management approaches for the Kosciuszko population. It is relevant to note that there are many common issues and challenges including:

- That the US wild horse populations are growing at 15–20% a year, not dissimilar to the estimates for areas within the park.
- Management practices are facilitating high horse population growth rates. Regularly removing horses holds population levels below food-limited carrying capacity. Thus, population growth rate could be increased by removals through compensatory population growth from decreased competition for forage.
- The primary way that equid populations self-limit is through increased competition for forage at higher densities, which results in smaller quantities of forage available per animal, poorer body condition, and decreased natality and survival.
- Rangeland health is also affected by density dependence. Equids invariably affect vegetation abundance and composition. Reduced vegetation cover, shifts in species composition, and increased erosion rates often occur on rangelands occupied by equids.
- Predation will not typically control population growth rates of free-ranging horses.
- The most promising fertility-control methods for application to free-ranging horses or burros are porcine zona pellucida (PZP) vaccines, GonaCon™ vaccine, and chemical vasectomy but all these currently require gathering and handling of horses to be effective.

- Resolving conflicts with polarised values and opinions regarding land management rests on the principles of transparency and community-based public participation and engagement in decision-making. Decisions of scientific content will have greater support if they are reached through collaborative, broadly based, integrated, and iterative analytic-deliberative processes that involve both the agency and the public.

Dartmoor Ponies - England

Source: Context 2015, *National Cultural Heritage Values Assessment and Conflicting Values Report: The wild horse population Kosciuszko National Park Context report* (Context 2015).

'Dartmoor National Park is an area of moorland located in south Devon, England, and is home to an equine breed commonly known as the 'Dartmoor Pony'. Unlike the wild horse population in Kosciuszko National Park, horses are native to the British Isles. There are fossils dating back to 700,000 BP and strong evidence that wild horses remained in Britain after it became an island separate from Europe by about 5500 BC. Ponies at Dartmoor were domesticated by 3500 BC and used as transport, a practice that continued during the Industrial Revolution of the 19th century, when they were used in local granite and coal mining activities (Stuart 2006; DNPA 2006:4). The Dartmoor Ponies are also the only heritage-listed wild horse population in the world.

Ponies within Dartmoor National Park are owned by local farmers and roam 'Common Lands' leased within the park in a semi-wild state (DNPA 2006:4). The animals are fertility controlled and currently number fewer than 1500 – a substantial reduction to their post-war population of around 30,000 – and are now considered a rare breed with less than 700 breeding mares remaining (DNPA 2006:4). As the Dartmoor National Park's management authority describes:

'The ponies on Dartmoor are an integral part of the landscape and many visitors to the National Park come specifically to see these animals in their natural environment. The healthy survival of the pony on the moor is in the minds of many people.' (DNPA 2006:5)

This statement highlights a strong community value attributed to the Dartmoor Pony for the local and national community as well as recreational users, given their continuing associations with a national park as their historic habitat. Unlike at Kosciuszko, Dartmoor Ponies are considered a significant contribution to the park's ecosystem, having already been part of it for several thousand years, and also feature on the park emblem. Mobile pony herds are dispersed into other areas of the park during late summer to early autumn as part of the 'conservation grazing' strategy, which increases floristic biodiversity by grazing land that would otherwise scrub over (DNP 2014). Management authorities have recognised that this species is a valuable asset to the park for recreational, cultural and ecological reasons.

Stakeholder consultation has established community-held values for the Dartmoor Ponies but this information is not publicly available. Based on the historic and archaeological record, it is possible that the Dartmoor Pony is not viewed in the same pastoral context as Australian wild horse populations. At Kosciuszko this is defined by associations with colonial occupation, land use and way of life. Unlike the Kosciuszko wild horses, the Dartmoor Pony is an indigenous animal viewed as an attribute of the natural landscape that has important associations dating back to Europe's prehistory. The Dartmoor Ponies are also visual reminders of important historic themes of the Industrial Revolution when they were used for transport. While not a colonial association, this link with a highly significant and defining moment of the nation's history is comparable to the pastoral land-use narratives that the Kosciuszko wild horse population inspires.

As a native animal, the Dartmoor Pony does not present the same conflicting values as does the wild horse population in Kosciuszko in terms of their impact on indigenous ecosystems. The Dartmoor Pony does, however, occupy a strong and dominant place in what is regarded as a wild and untamed landscape as a once-wild species. The Dartmoor Pony may also be closely aligned with ideas of a pristine, wild, natural environment being an integral natural asset of the park, as defined by the management authority (DNPA 2006:5).'

Appendix A: Estimating changes in the number of wild horses over time

Methods of estimating the number of horses

To effectively manage a population it is important to estimate its size and distribution.

Aerial surveys are often the only practical way of estimating the population size of large animals ranging over large areas (Walter & Hone 2003). Despite the obvious advantages of using aerial surveys to estimate abundance, the method also has several shortcomings. One of the main challenges is to improve the accuracy of surveys, as undercounting commonly occurs (Walter & Hone 2003). Errors in counting can occur because of vegetation cover, species characteristics, flying height, speed, weather conditions, and lack of observer experience (Walter & Hone 2003).

Several methods of aerial survey have been used in the United States, New Zealand and Australia to estimate the abundance of horses. These methods include:

- line transects
- strip counts
- mark-recapture methods (Walter & Hone 2003; Linklater & Cameron 2002).

Strip transects are the simplest way of estimating abundance. With this method, aerial surveys are conducted along a fixed line and all animals within a specified distance of the aircraft are counted. It is assumed that all animals in this 'strip' are seen (Montague-Drake 2005). Although this method is easy to carry out and analyse, the reality is that even trained observers see only 60–70% of the animals present in the strip (Montague-Drake 2005).

Line transect sampling is similar to strip transect sampling except that it accepts that all the animals within a nominated survey strip are not observed. This method uses the data on how far observed animals are from the transect centreline to mathematically compensate for the diminishing sightability of animals further away from the aircraft on the survey strip.

In the **mark-recapture** method, two observers travel along the same fixed transects and record animals independently of each other (Walter & Hone 2003). Analysis can then be undertaken using the number of animals seen by only one of the observers and the number seen by both. This method is commonly combined with either line transect or strip transect surveys to improve the accuracy of these methods (Walter & Hone 2003).

Abundance estimates and distribution

Aerial surveys of feral horses in the Australian Alps have been conducted in 2001 (Walter 2002), 2003 (Walter 2003) and 2009 (Dawson {née Walter} 2009). Aerial surveys were conducted in Kosciuszko National Park in 2005 (Montague-Drake 2005).

Walter (2002), using the line transect approach, estimated that the total population of horses in the Australian Alps National Parks was about 5200, with approximately 3000 in Kosciuszko National Park. Following the 2003 bushfires, Walter (2003) conducted further surveys and estimated that the horse population had been reduced by half in the southern region of the park, but that the northern horse population was intact and continuing to increase. It was estimated that there were 2369 horses in the park. Dawson (2009) estimated there were 7679 horses in the Australian Alps National Parks in 2009.

Montague-Drake undertook a survey of horse numbers in the park in 2005 so that separate estimates could be given for the populations in the northern and southern sections of the park. Similar methods to Walter were used, although the data were analysed as strip transects rather than line transects. There were estimated to be 590 horses in the southern

part of Kosciuszko (a density of 1.56 horses per square kilometre), and 1120 animals in northern end (a density of 1.67 horses per square kilometre). This gave a total of 1700 horses in the park (Montague-Drake 2005).

The most recent Australian Alps-wide aerial survey for wild horses was conducted in April-May 2014. A different researcher and aerial horse observers were used to demonstrate independence from the previous surveys. They are highly experienced at the techniques of aerial survey and the data they provide on kangaroos are used to calculate the commercial and non-commercial kangaroo cull as part of the Kangaroo Management Program in New South Wales. Dr Stuart Cairns, a lecturer and researcher at the School of Environmental Science and Rural Studies at the University of New England was engaged to undertake the survey design and analysis of data and results and provide a report to the Australian Alps Liaison Committee.

The surveys were conducted as helicopter line transect surveys in four survey blocks in the Australian Alps National Parks. The surveys were designed using DISTANCE 6.0. A number of design options were assessed and the most appropriate designs for each survey block selected following consultation with the staff of the NSW OEH and Parks Victoria.

Further information on the DISTANCE 6.0 package used to design and conduct the survey and its analysis and the principles of applying sampling surveys for estimating population size can be obtained at: <http://distancesampling.org/> and <http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2009.01737.x/pdf>.

The 2014 survey involved surveying a total of 2817 kilometres of transect across the known wild horse distribution across the Australian Alps using helicopters flown at a ground speed of 93 kilometres per hour at a height of 61 metres. Two trained observers were seated in the rear seats on either side of the aircraft. Sightings of clusters (cluster is a DISTANCE term and means one or more animals) of horses were recorded into five distance classes in a 150-metre wide survey strip. A total of 305 sightings were made of clusters of horses.

A single global detection function model was fitted to the data and was used to estimate horse population densities and abundances in the four survey blocks. In statistical terms, there is a 95 per cent chance that the true population of wild horses is between 7500 and 11,500 across the entire Australian Alps with between 4000 and 8000 in Kosciuszko National Park. An analysis of the results of the survey has estimated about 6000 wild horses in Kosciuszko National Park alone, an increase on the 2009, 2003 and 2001 estimates.

Comparing population estimates over time

In comparison with the 2014 estimates, the 2009 survey estimated about 4200 horses in Kosciuszko National Park. In the intervening five years NPWS removed more than 2000 horses, yet the population estimate has still increased during this time.

The rates of population increase were estimated in relation to the results of the survey conducted in 2009. However the 2014 survey area for the Alps was almost doubled from 2860 square kilometres to 5429 square kilometres to include state forests in NSW and Victoria where wild horse populations occur. There were also some changes in the way the data were analysed that make a statistical comparison with the 2009 figure difficult. As a consequence, the 2009 raw data were reanalysed taking account of these survey differences and using the most conservative approach. This analysis shows that the finite rate of increase of the populations in North Kosciuszko 1.04 (4%) and an overall decrease in the southern Pilot Byadbo /Victorian East Alps of approximately 5% per year (Cairns in prep.). Whilst the 2014 survey results and population estimate is regarded to be statistically sound, it is acknowledged that the use and comparison of the 2009 and 2014 survey results to interpret population and density trends should be used with caution due to the changes in survey design and its overall scale.

The 2014 survey results have a level of precision of 11.3% and the 2009 results have a 25.4% precision (lower indicates high precision). The 2014 survey is the most precise survey to date. Experts agree that we are unlikely to improve on this degree of precision.

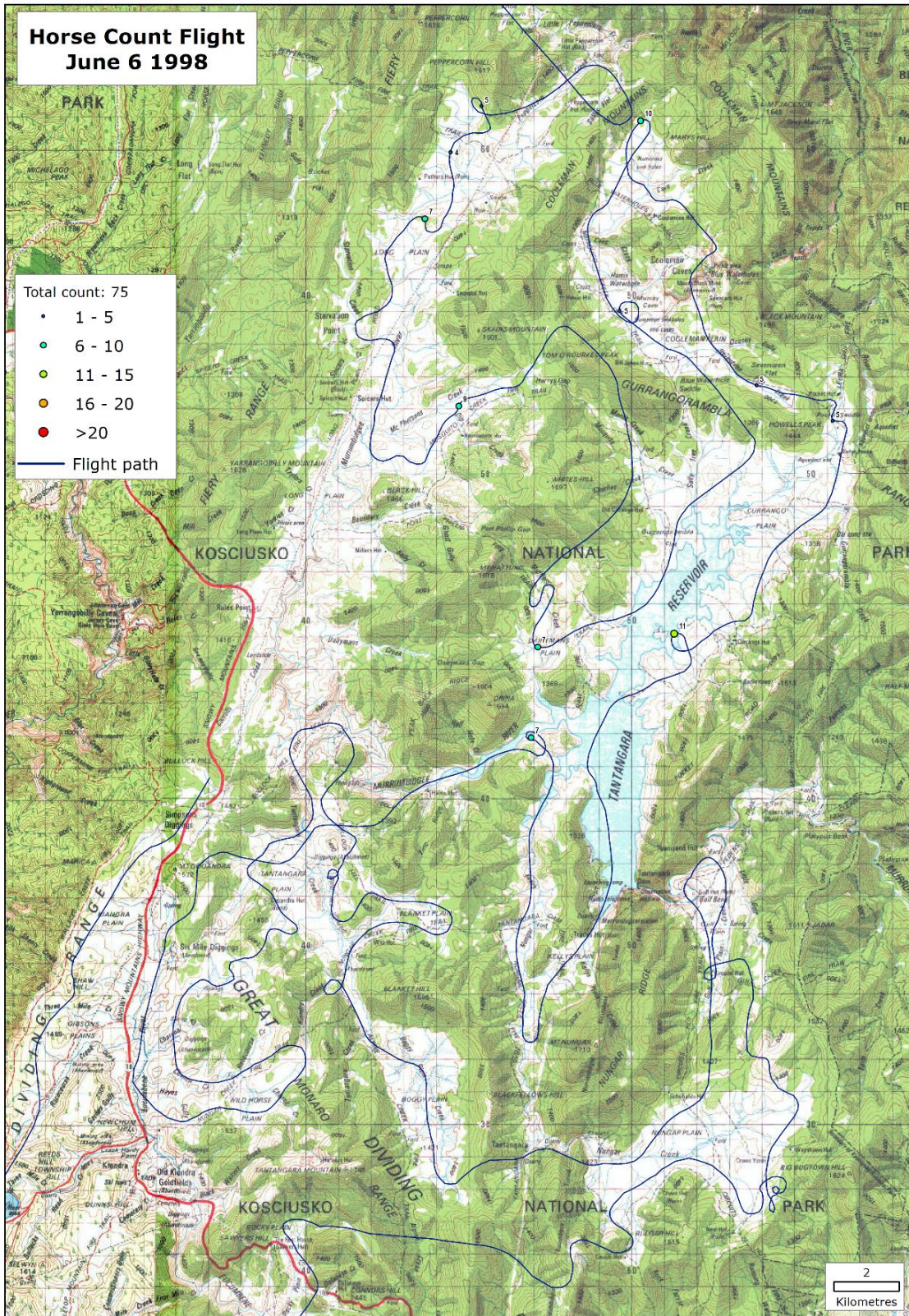
Table 5. Australian Alps Wide Survey 2014 results

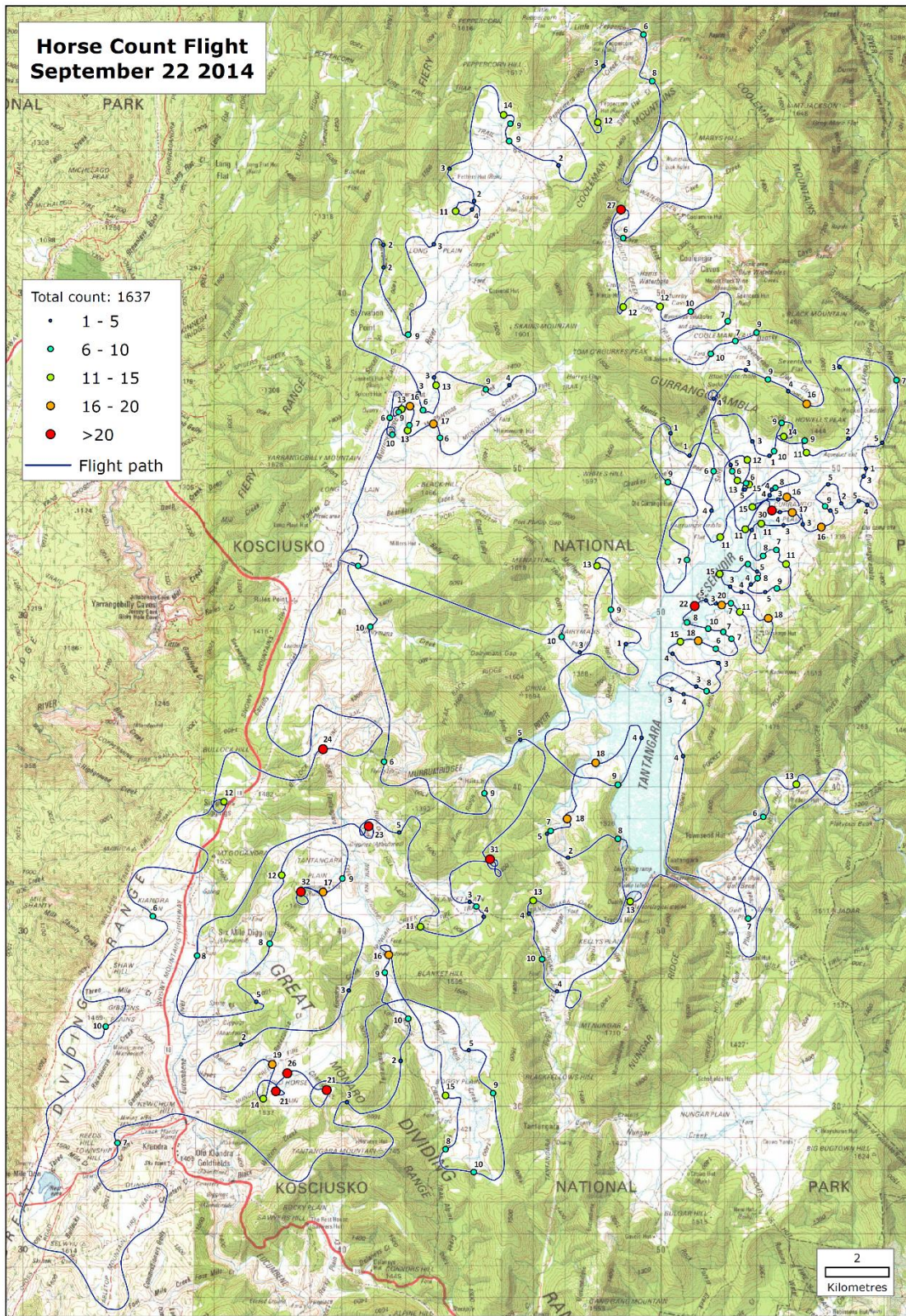
The population estimates (No. horses) and whole-block density estimates (D) of wild horses per square kilometre in each of the three survey blocks in Kosciuszko National Park and the total area surveyed in the Australian Alps. Given with these estimates are the 95% confidence intervals and the coefficients of variation (CV_{boot}).

Survey block	Area (km ²)	No. horses	95% confidence interval	Density (H/km ²)	95% confidence interval	CV (%)
North Kosciuszko	1,549	4,247	2,777 – 5,893	2.74	1.79 – 3.80	18.7
Snowy Plain	123	124	13 – 293	1.01	0.11 – 2.38	65.2
Bago-Maragle	948	1,263	588 – 1,964	1.33	0.62 – 2.07	29.1
Byadbo-Victoria	4,946	3,821	2,868 – 5,090	0.77	0.57 – 1.03	14.5
Australian Alps	7,566	9,455	7,484 – 11,595	1.25	0.99 – 1.53	11.3

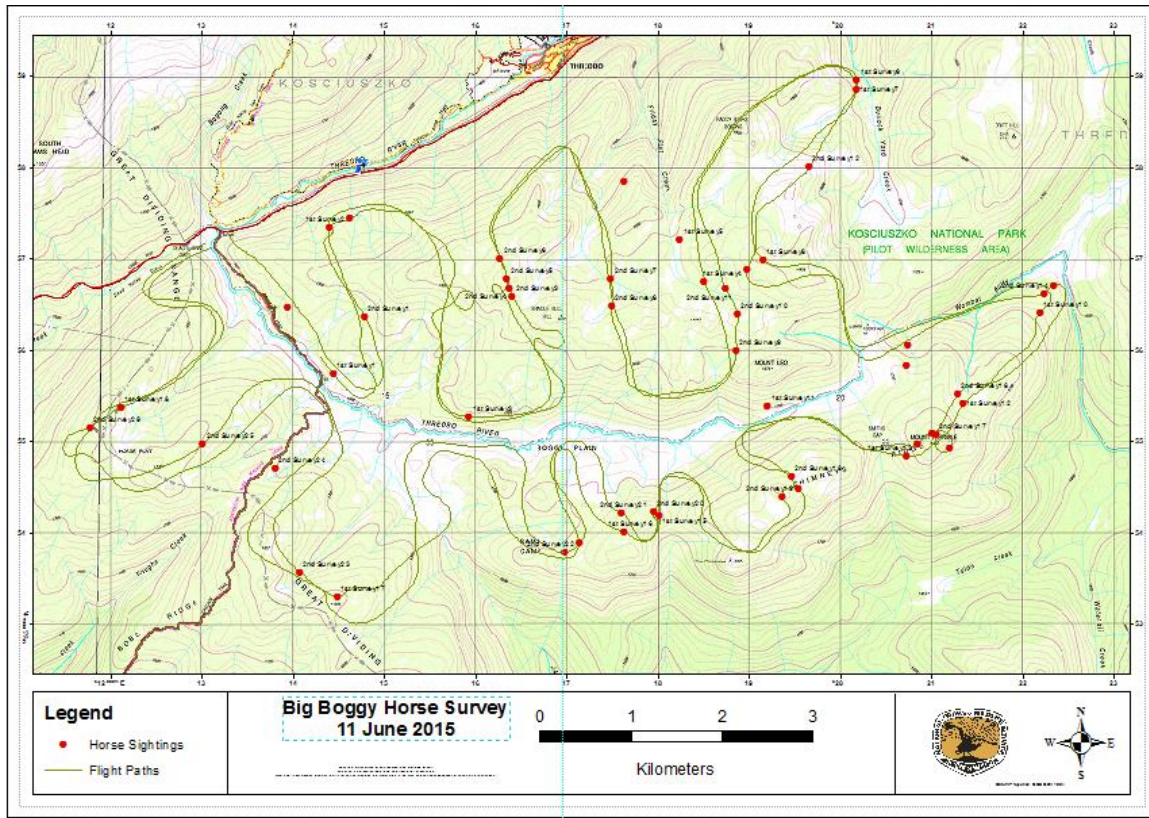
Appendix B: Maps of horse count flights for June 1998 and September 2014

In 1998, 75 horses were counted. In 2014, 1637 horses were counted.





Appendix C: Big Boggy flight map, detailed results and statistical analysis



Big Boggy, Southern KNP - Wild Horse Aerial Survey, June 2015

Statistical analysis of sighting data for Big Boggy Aerial Surveys

$$\text{Lincoln-Petersen Estimate} = \frac{(n_1 + 1)(n_2 + 1)}{m + 1} - 1$$

Where: n_1 = Number of horses observed in survey 1
 n_2 = Number of horses observed in survey 2
 m = Number of horses observed twice

And:

$$\text{Standard Error} = \sqrt{\frac{(n_1 + 1)(n_2 + 1)(n_1 - m)(n_2 - m)}{m^2}}$$

$$\sqrt{\frac{(m + 1)^2(m + 2)}{m}}$$

$$\text{Coefficient of Variation} = \frac{\text{Standard Error}}{\text{Estimate}} \times \frac{100}{1}$$

$$\text{Probability of Sighting} = \frac{n_1 + n_2}{2 \times \text{Estimate}}$$

Date	Location	n1	n2	M	Sighted once	Estimate	S.E.	95% CI	C.V. %	Probability of sighting %	Survey Area (ha)	Horses/ha	Horses/km ²
19/05/2006	Big Boggy	42	39	20	41	81	8.61	64 - 98	10.64	50.06	3000	0.02697	2.7
6/06/2007	Big Boggy	70	65	32	71	141	12.60	116 - 166	8.93	47.87	3500	0.04029	4.03
5/5/2008	Big Boggy	52	51	26	51	101	9.37	82 - 120	9.27	50.95	3500	0.02888	2.89
5/05/2008	Big Boggy *	52	51	18	67	144	20.70	103 - 185	14.37	35.75	3500	0.04116	4.12
20/05/2010	Big Boggy	58	78	38	60	119	7.83	103 - 134	6.61	57.38	3300	0.03591	3.59
20/05/2010	Big Boggy *	58	76	38	58	115	7.53	100 - 131	6.52	58.02	3300	0.035	3.5
2/06/2011	Big Boggy	88	71	64	31	98	1.96	94 - 102	2.01	81.47	3300	0.02957	2.96
2/06/2011	Main Range	3	0	0	3	3	0.00	3 - 3	0.00	50.00	1000	0.003	0.3
11/05/2015	Big Boggy	95	99	48	98	195	13.84	167 - 223	7.10	49.76	3500	0.05569	5.57

Table: Summary of results for Southern KNP Big Boggy survey 2006 -2015. This survey is conducted as simple mark-recapture aerial survey over 2 flights utilising 2 independent observers. Numbers, mob description and GPS location are recorded then plotted on a map and using a simple Lincoln-Petersen analysis method to provide a population estimate. (Refer attached Map 2015 and Appendix 2 for statistical analysis.)

* Note there are two results provided from the analysis of data for both the 2008 and 2010 surveys due to difficulty in identifying and distinguishing a number of individual horse sightings as to whether they had been previously marked (sighted) or not. Data was analysed and presented to account for both scenarios. This highlights the challenge in conducting aerial surveys utilising mark- recapture methods in a population where it is often difficult to distinguish individuals based on recognisable markings.

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