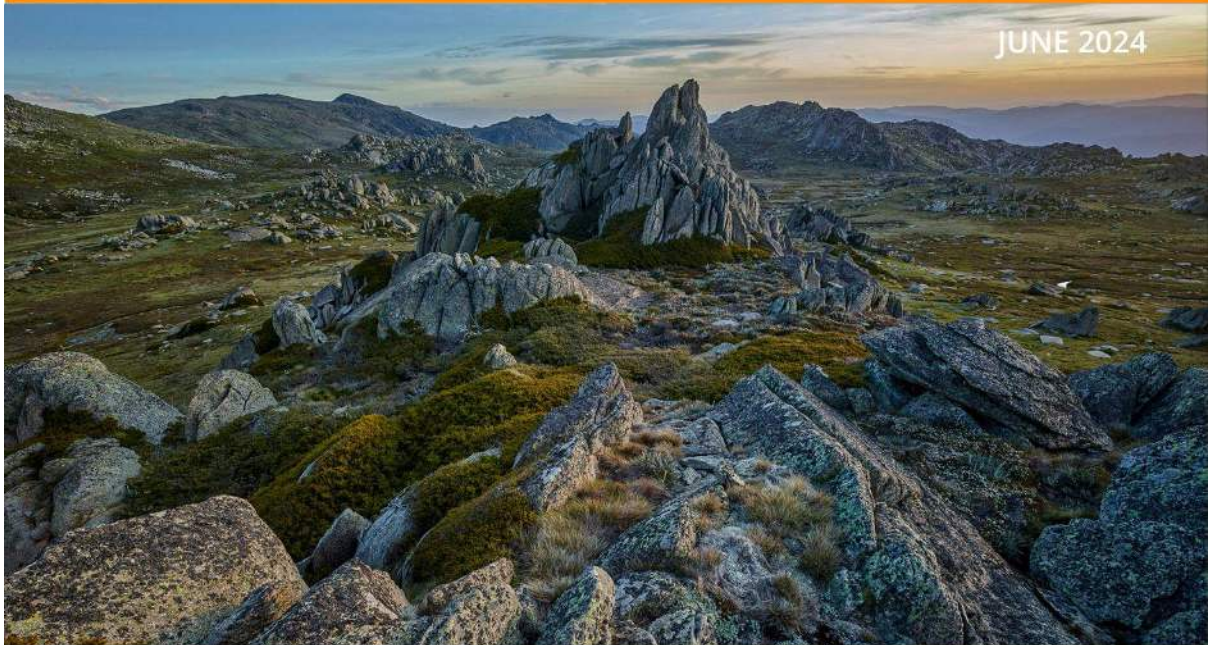


Counting horses in Kosciuszko: a critique of the 'independent' survey

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Counting horses in Kosciuszko: a critique of the ‘independent’ survey

By Linda Groom and Don Fletcher

On 25th February 2024, a light plane wove a complicated route over part of northern Kosciuszko National Park. On board were two cameras that took photos as part of a survey of feral horses, also known as brumbies. The survey was organised and funded by brumby advocates.

One aim of the brumby advocates’ survey was to support their claim that there were no more than 3000 feral horses in Kosciuszko before the start of the NSW government’s current program to reduce feral horse numbers. That claim has been demolished by the program’s outcomes: 6,179 horses were removed, by re-homing or by lethal means, between October 2023 and 22 May 2024 ¹. Both park visitors and park management report many horses still remaining. Though the brumby advocates’ survey did not achieve its ‘under 3000’ aim, how did it measure up generally as a survey method? Should its methods replace the Distance Sampling method currently used by the NSW government as part of its program to manage feral horse numbers?

This article aims to answer those questions, with as little statistical jargon as possible.

¹ Atticus Fleming. Evidence given 23 May 2024 to Animal Welfare Committee of the Legislative Council (NSW), Inquiry into Proposed Aerial Shooting of Brumbies in Kosciuszko National Park. Transcript at <https://www.parliament.nsw.gov.au/committees/inquiries/Pages/inquiry-details.aspx?pk=2991#tab-hearingsandtranscripts> . Page 58.

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Why counting horses in Kosciuszko is important

In June 2018, the NSW Coalition government passed the ‘Brumby Bill’, formally known as the Kosciuszko Wild Horse Heritage Act. The Act gave priority to the protection of feral horses over native animals and plants in Kosciuszko National Park. Deputy-Premier John Barilaro, who introduced the Bill, did not foresee the way that it would galvanise conservationists in defence of Kosciuszko’s natural values. Nor did he predict that the feral horse debate would continue, and by 2024 be focusing on the apparently obscure topic of how to count horses in wild landscapes.

The 2024 winter has now arrived. Many aspects of life in Kosciuszko National Park are continuing as normal. Kosciuszko’s famous frost hollows are frosty. The broad toothed rats have made under-snow grass nests where they will huddle together for warmth ². The buds that will burst into Anemone buttercups on the Main Range in spring have already formed; they will be protected by the winter snows from grazing animals ³. But other things have changed: the NPWS shooters who have, for many years, used the cooler months to control feral pigs and deer, are now including feral horses among their targets.

Shooting of feral animals in national parks is a strict operation, controlled by law. Shooting of feral horses in Kosciuszko is authorised by the Kosciuszko Wild Horse Management Plan. The Plan itself is an instrument of the Kosciuszko Wild Horse Heritage Act. Though the Act requires the government to retain a ‘sustainable number’ of feral horses in the Park, it does not define ‘sustainable’. That detail is allocated to the Plan.

The first version of the Plan was published in November 2021. NSW Environment Minister and Liberal MP Matt Kean oversaw the extensive public consultation process that led to the Plan. The Plan set the target number of horses at 3,000 on 30 June 2027. After the 2023 elections, the NSW Labor government continued to implement the Plan.

The Plan made no comment on the government’s interpretation of ‘sustainable number’. The term could be taken as referring to the number required to sustain the genetic health of the horse population. If so, there are two comparable and healthy wild horse populations that could be a

² Tanya Bubela. The social organisation and mating system of an Australian subalpine rodent, the broad-toothed rat, *Mastacomys fuscus*. *Wildlife Research* 20(4) Jan 1993.

³ Colin Totterdell. National recovery plan for the Threatened Alpine Flora. 2001. Section 4.1

guide: the Coffin Bay Ponies of South Australia, numbering ‘in the hundreds’⁴, and the Kaimanawa horses of New Zealand, with around 300 horses⁵.

‘Sustainable number’ could also be interpreted as the number that can be sustained by Kosciuszko’s environment. The Plan’s strategy of ‘let’s start reducing the numbers, monitor the environment and see how we go’ is practical, but still sheds no light on the choice of a target of 3,000 horses.

‘Sustainable number’ may have been the number that Mr Barilaro could sustain politically, in discussions with brumby supporters. In hindsight it may seem puzzling that those supporters would accept a target that would involve any reduction in horse numbers. It could well have been because they thought the target had already been reached. Brumby advocate Peter Cochran and others have consistently claimed the Park’s feral horse numbers were then, and still are, 3,000 or less (footnote xix has examples of these claims).

Counting horses has thus become a hot political issue. People on both sides of the debate sometimes say that the numbers themselves are not the issue – the real question is the extent of environmental damage. Some brumby supporters confidently make that statement because they believe that there is no environmental damage caused by horses in the Park. Some conservationists make the same statement because they believe that even a small number of horses in a national park can cause unacceptable environmental damage. But population numbers will remain an important practical measure for Park managers, for as long as the Act continues to refer to ‘sustainable number’. In particular, methods of calculating numbers are important.

In early 2024, brumby advocates sought to harness science to their cause by doing an ‘independent recount’. They funded a survey which produced high quality aerial photos, and which used Artificial Intelligence to recognise horses in the photos. In this article, their survey is referred to as the Air Photo Survey (APS). Despite its high-tech tools, the APS did not produce any credible challenge to the government’s calculations of

⁴ Coffin Bay Brumbies, Jan 17 2021 / Australian Brumby Alliance.
australianbrumbyalliance.org.au/coffen-bay-brumbis/ [sic]

⁵ ‘a total population base of three hundred horses is managed in the Ranges’ -
kaimanawaheritagehorses.org/history/

population totals. To understand what happened, it's useful to look first at what we know about counting animals in the wild.

Counting animals: broad principles

Counting populations of wild animals is difficult. They hide. They move around. From a distance, it can be hard to distinguish large animals from deer-shaped rocks, pig-shaped shadows, and horse-shaped bushes.

Since at least the 1970s, researchers have found that surveys of wildlife usually undercount the number of animals ⁶, often because some animals are hidden from observers or cameras. As a general principle, any survey result should be regarded as 'There are at least X animals in...' rather than as 'There are only X animals in ...'.

In the surveys of horses in Kosciuszko, there is an additional reason to regard the final total as an undercount: all surveys of Kosciuszko have excluded some areas known to have horses, particularly the steeper areas where flying a helicopter close to the ground is more dangerous ⁷.

A further principle is that survey methods gain credibility by repetition. Foundation texts warn against 'the collection and use of count data under ad hoc designs' ⁸.

One way to count: indexes of animal numbers

One way to deal with the difficulties of counting animals in wild places is to give up aiming for a complete count; instead, you count enough of the

⁶ For example:

- Graeme Caughley. Bias in aerial survey, *Journal of Wildlife Management* 38 (4) Oct 1974, p 921. www.jstor.org/stable/3800067
- Richard A Lancia and others. Estimating the number of animals in wildlife populations. Page 110. [cales.arizona.edu/classes/rnr321/Braun%20pp%20106-153%20\(Lancia%20et%20al%202005\).pdf](http://cales.arizona.edu/classes/rnr321/Braun%20pp%20106-153%20(Lancia%20et%20al%202005).pdf)
- National Parks Service (USA). Using Distance Sampling to Estimate Wildlife Populations. www.nps.gov/articles/000/guide-to-distance-sampling.htm
- Laake, J., & Hone, J. (2008). Visibility Bias in Aerial Survey: Mark-Recapture, Line-Transect or Both? *Wildlife Research*, 35, 299-309.

And also the studies listed at footnote ix.

⁷ [Stuart Cairns]. A survey of the wild horse population in Kosciuszko National Park, October 2023. www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Pests-and-weeds/Kosciuszko-wild-horses/kosciuszko-national-park-wild-horse-population-survey-october-2023-revised-feb-2024.pdf p 5.

⁸ Byron K. Williams. *Analysis and management of animal populations*. San Diego : Academic Press, 2002. p 261.

easily visible animals, or even just signs they leave such as tracks or faecal piles, to get an indication, or index, of trends in the numbers.

The result is known as ‘An index of abundance’.

Another way to count: measurement of total animal numbers

When absolute numbers are important – for instance, when a government has set a target of 3,000 – you will need to put in more effort. As well as choosing a method of observation, you will need to find a method to calculate the numbers of animals that the observers or cameras did not see. **It’s no use saying, well, how about for argument’s sake we just double the number we saw.** The relevant Minister or an adviser with a penchant for facts and evidence, will say, why double? Why not just add on 50%, or increase it fivefold, or tenfold?



*How many horses can you see – 20? 30? Look again – there are at least 40.
(Boggy Plain, KNP, 2024)*

Your first step should be a massive search of how others have calculated numbers of unseen animals in wild places. With luck, you will find a method that meets these criteria:

- has a way of calculating how many animals were present but unseen
- has been verified where the number of animals was already known
- fits within your resources.

The result is known as a ‘Measurement of absolute abundance’.

Horse Helicopter Index – an index of horse numbers

The NSW National Parks and Wildlife Service has, since 1998, done or commissioned two types of surveys of horse numbers in Kosciuszko. One type is called the Horse Helicopter Index (HHI). The HHI has shown a consistent increase in horse numbers. The most recent HHI survey⁹ found 3,699 horses in its survey area (see map) in northern Kosciuszko, of which 733 were found in the area that was surveyed in 2024 by the APS.

The HHI is the first type of count described above - an index of abundance. It has been limited to parts of northern Kosciuszko which contain the highest concentrations of feral horses in the Park, i.e. the open plains, which have a total area of only 395 sq km. It has been a useful working tool. It was never intended to calculate absolute abundance. The National Parks and Wildlife Service ceased these types of surveys from 2021, reportedly due to public confusion between this type of survey and the second type.

Distance sampling – a measurement of total horse numbers

The second type of official survey is called Distance Sampling (DS) and is a measure of absolute abundance. Distance Sampling, when used with observation from a helicopter travelling a route of pre-set parallel lines, is called Helicopter Line Transect Distance Sampling (HLT-DS). This method has been used nine times to calculate the total number of feral horses in Kosciuszko National Park’s known horse areas.

⁹ HHI 2021 data supplied to Don Fletcher by NPWS under GIPA.

Distance Sampling is widely used and well documented ^{10, 11}.

Distance sampling meets the three criteria mentioned earlier: it is cost-effective, it includes a method of calculating animals present but unseen, and it has been verified by counting many wildlife populations of known size ¹².

Many brumby advocates, however, do not accept Distance Sampling as a suitable method for measuring Kosciuszko feral horse numbers. Their quarrel seems to be mainly with what some of them call the ‘fancy maths’ ¹³ that HLT-DS surveys use to calculate the number of unseen horses. The maths are the steps between the observed number and the calculated total. If you look only at the starting point (number of horses observed) and the end point (calculated total horses), it is true that the HLT-DS survey results seem to take an apparently large leap. To take one example, the most recent HLT-DS survey of feral horses in October 2023 reports 1,926 observed feral horses in all the areas of Kosciuszko that were surveyed, and from that number the survey calculated a total, i.e. including the unseen horses, of 17,393 ¹⁴.

¹⁰ Buckland, S.T. and others (2001). Introduction to Distance Sampling: Estimating Abundance of Biological Populations. London : Oxford University Press, 2001.

¹¹ Thomas, Len, and others: Distance software: design and analysis of distance sampling surveys for estimating population size. J. Applied Ecology 2010,47, 5–14.

¹² Examples of studies that have assessed and verified Line Transect Distance Sampling:

- Bergstedt and Anderson 1990). Evaluation of line transect sampling based on remotely sensed data from underwater video. Transactions of the American Fisheries Society 119(1), 86–91.
- Clancy, T. F. and others. (1997). Comparison of helicopter line transects with walked line transects for estimating densities of kangaroos. Wildlife Research 24, 397-409.
- Glass, R. and others (2015). Precision, accuracy and bias of walked line-transect distance sampling to estimate eastern grey kangaroo population size. Wildlife Research 42, 633–641.
- Hone, J. (1988). A test of the accuracy of line and strip transect estimators in aerial survey. Australian Wildlife Research 15, 493–497.
- Laake, J., Dawson, MJ. and Hone, J. (2008). Cited above.
- Southwell, C. J. (1994). Evaluation of walked line transect counts for estimating macropod density. Journal of Wildlife Management 58, 348-356.

¹³ Rocky Harvey (2024). Update on Go Fund Me page www.gofundme.com/f/independent-wild-horse-recount. 10 March 2024. Viewed 10 May 2024.

¹⁴ NSW National Parks and Wildlife Service (Oct 2023). Horse population estimate supplementary information, Oct 2023. www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/wild-horses/managing-wild-horses/kosciuszko-national-park-wild-horse-management/tracking-the-wild-horse-population/horse-population-estimate

Though distance sampling is widely used and well documented, it can take some time to understand how it makes that apparent leap. Here is a basic explanation.

How Distance Sampling works in Kosciuszko

To avoid double-counting, the HLT-DS transects are set far enough apart to make it unlikely the horses will move from one transect to another during the survey. In the most recent HLT-DS survey, the transects were 1.5 km apart ¹⁵. Observers on each side of the helicopter were instructed to count only horses that were within 150 metres. The observed area, 300 metres wide, was thus only a sample; the sample covered one fifth (1500 metres/300 metres) of the area between each transect.

Step 1 of the ‘fancy maths’ is thus a simple multiplication. In the Kosciuszko survey, the multiplication to allow for the area between the 300 m wide counting strips was times five.

Step 2 is more complex. It calculates how many animals the observers do not see, in the following way.

As many trials have shown, fewer horses are seen at greater distance. Tests in a variety of terrain have shown that at first there is little change in the number seen with distance. Then suddenly every extra metre makes a big difference. Then even further out, increased distance has only a minor effect. Of course, the exact relationship is different for different aircraft, vegetation cover, weather etc. The inventors of Distance Sampling realised that the relationship between distance and number seen can be described mathematically and provides a way to calculate the number unseen.

For a worked example in plain English, see the NPWS ‘Horse population estimate supplementary information’ page . Scroll down to ‘... the raw number of horses observed (1,926) needs to be adjusted in 2 ways’.

The calculations that are used are detailed in the official reports of HLT-DS surveys of horses in Kosciuszko ¹⁶ . If, however, you prefer to avoid detailed maths, here are a few points, hopefully in plain English, which may help

¹⁵ NSW National Parks and Wildlife Service (Oct 2023). Horse population estimate supplementary information. Cited above. Scroll down and hit ‘Sampling the 4 survey blocks’

¹⁶ For example: [Stuart Cairns] October 2023, cited above.

you judge whether Distance Sampling is a valid way to calculate Kosciuszko horse numbers.

Points to consider when assessing Distance Sampling as a method for measuring horse numbers in Kosciuszko

Senate Inquiry backs HLT-DS

The report of the inquiry by the federal Senate into management of feral horses in the Australian Alps heard both support for Distance Sampling and dissenting views. It concluded that Distance Sampling is

*backed by robust and peer-reviewed scientific methodology. While noting some dissenting opinions, the methods are widely used by the scientific community, and is supported by the TSSC [Threatened Species Scientific Committee]*¹⁷

HLT-DS can also show decreases in population

The 2019 Alps-wide survey of horses, which used HLT-DS, showed an increase in horse numbers in most survey areas but not in the Bago-Maragle area¹⁸. The fact that the same survey method can show decreases as well as increases testifies to its lack of bias towards higher numbers. (The decrease may have been due to horses leaving the Bago-Maragle area for higher, greener country during drought conditions.)

Horse removal numbers support HLT-DS measurements; they do not support brumby advocate claims

As mentioned in the introduction, the concerns of brumby advocates with HLT-DS have included a view, consistently stated since 2018, that Kosciuszko National Park contains fewer than 3,000 horses; some brumby advocates have in fact stated that there are fewer than 1,000¹⁹.

¹⁷ Australia. Senate. Impacts and management of feral horses in the Australian Alps, Report - October 2023.

www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/FeralHorses47/Report. Paragraph 2.31.

¹⁸ Stuart Cairns (2019). Feral Horses in the Australian Alps: the Analysis of Aerial Surveys Conducted in April-May, 2014 and April-May 2019. Armidale, NSW : Sept 2019. Page 1, point 8. theaustralionalps.files.wordpress.com/2019/12/feral-horses-in-the-australian-alps-the-analysis-of-aerial-surveys-conducted-in-2014-and-2019-cairns-s-2019.pdf

¹⁹ Some examples of brumby advocate opinions on the number of horses in Kosciuszko:

The most recent horse management figures, from the NSW government on 23 May 2024, record the removal of 8,718 feral horses from Kosciuszko since November 2021, by a range of means including shooting and re-homing. 6,179 of these were removed between October 2023 and 22 May 2024²⁰. And there are still large mobs of feral horses visible in many parts of the Park. Based on the removal program's results - both the 8,718 total removals and the rapidity of removals in the last 6 months - the figure of 17,432 horses calculated by the HLT-DS survey in October 2023 looks likely to be much more accurate than the claims of '3,000 or less' in the entire Park.

The 'biologically impossible' claim has flaws

Brumby advocates sometimes claim that the population growth recorded between the HLT-DS surveys in 2014 and 2019 is biologically impossible. There are, however, two possible explanations.

- a. As well as natural breeding, between 2014 and 2019, horses may have moved from unsurveyed areas into the survey area. There are no scientific data on horse movement at Kosciuszko to either reject or validate this possibility.

-
- 'Now I suspect, and most others up here, the locals suspect, that there is in fact less than 3,000 there now' – Brumby advocate Peter Cochran on ADH TV, 14 March 2023.
 - 'Brumby advocates like Mr Lanyon maintain that the government's estimate of the number of horses is inaccurate, arguing that there's less than 3,000 horses in the Park now' – report of interview with brumby advocate Alan Lanyon, in the Gundagai Independent, 17 January 2023.
 - 'There is no way there is even 3,000 brumbies in that park' – brumby advocate Joanne Canning on radio 2GB, 15 August 2023
 - 'I would be confident in saying there would be around 3,000 or less' - Wes Fang, Nationals MLC, on ABC Radio with Sarah Morrice, 9 April 2024
 - 'new data puts these numbers at less than 3,000 and recent organised headcounts estimate the figures to be as low as 2,000' – Equine Voice Australia, 31 Aug 2023, submission 14 to Inquiry into Proposed Aerial Shooting of brumbies in Kosciuszko National Park (Legislative Council, Animal Welfare Committee) - www.parliament.nsw.gov.au/committees/inquiries/Pages/inquiry-details.aspx?pk=2991#tab-submissions
 - 'The northern Kosciuszko National Park has the highest sub-population with currently about 600 brumbies remaining' – Nikki Alberts, Director of White Alpine Equine, Submission 112 to Inquiry cited above, page 2, 12 Oct 2023

²⁰ Atticus Fleming. Evidence given 23 May 2024 to Animal Welfare Committee of the Legislative Council (NSW), Inquiry into Proposed Aerial Shooting of Brumbies in Kosciuszko National Park. Transcript at <https://www.parliament.nsw.gov.au/committees/inquiries/Pages/inquiry-details.aspx?pk=2991#tab-hearingsandtranscripts> . Page 58.

- b. Each HLT-DS survey's measured total is a mid-point bracketed by lower and higher numbers that are the boundaries of the confidence interval. The true number of horses may be anywhere within the confidence interval, so the true difference between two surveys can be smaller than the difference between the two mid-points.

The peer reviewers of the 2014 and 2019 surveys noted that 'rates of growth and inferences derived therefore appear to be properly computed'

²¹.

Claims that peer reviewers 'ripped into' the HLT-DS reports are unfounded

Ms Claire Galea, adviser to the APS project, stated to a NSW Parliamentary Inquiry in late 2023 that the HLT-DS surveys in Kosciuszko used an insufficient number of clusters and that peer-reviewers had 'really, really ripped into' the survey reports ²². These claims were referred by the Inquiry to Professor Richard Kingsford, UNSW, for assessment. His response indicated that he had no concerns about the number of clusters: 'The number of clusters recorded for Cabramurra and Snowy Plains was fewer than ideal, however it was better than omitting these areas, with their relative contributions not significantly influencing overall estimates'.

After being given access to the peer reviews, Prof. Kingsford's response to the 'ripped into' claim was that the reviewers 'had no concerns about design or field methods'. He found no adverse comments from the peer reviewers and quoted them as saying: 'The data analysis was consistent with standard practice ... **there was no reason to doubt the reported abundance estimates and the derived finite rates of population growth**'. He added that the peer reviewers said that the analyses of data 'have been carried out to a high standard' ²³.

²¹ Richard Kingsford (2024). Response to questions from the Animal Welfare Committee. Inquiry into proposed aerial shooting of brumbies in Kosciuszko National Park, Jan 2024.

www.parliament.nsw.gov.au/lcdocs/other/18951/Professor%20Richard%20Kingsford%20-%20AQoN%20-%20received%2031%20January%202024.pdf

²² Claire Galea. Testimony to: NSW. Legislative Council. Animal Welfare Committee. Inquiry into proposed aerial shooting of brumbies in Kosciuszko National Park. Transcript, corrected. 18 December 2023, pages 34, 39 and 41.

www.parliament.nsw.gov.au/lcdocs/transcripts/3192/Transcript%20-%2018%20December%202023%20-%20CORRECTED.pdf

²³ Richard Kingsford (2024). Cited above.

The Air Photo Survey (APS) of 2024

The planning for the Air Photo Survey began in late 2023. The main organiser was brumby advocate Rocky Harvey, with biostatistician Claire Galea as his adviser for the first part of the project. They raised an impressive \$78,000 through the Go Fund Me Platform, and hired a company, Airborne Logic, with extensive experience and undoubted expertise in analysis of aerial data, to take images from a fixed-wing plane of part of northern Kosciuszko and to use Artificial Intelligence to identify and count horses. The survey was done on 25th February 2024 and the results published in late April, in two forms: an update on the Go Fund Me Page ²⁴ and a report from Airborne Logic (<https://knp-horse-count.web.app/#info> - scroll down to 'Report') ²⁵.

The aerial survey found 569 horses in a survey area of 212 sq km (21,200 hectares) within northern Kosciuszko.

The organisers confidently claimed that 'the results from this survey will have such integrity that they will be next to impossible for the government to ignore' ²⁶. At the conclusion of the APS, organiser Rocky Harvey stated 'Parks know their numbers [i.e. the HLT-DS numbers] are wrong' ²⁷. Though there is no question about the technical excellence of the images produced by the APS, there are several reasons to question both the brumby advocates' interpretation of its results, and their claim that the APS shows that the HLT-DS surveys have been wrong.

The APS method was not verified

The best way to achieve recognition for the APS would have been to trial it, using a population of horses or similar animals with a known number. A friendly grazer with a large property of rolling grasslands and treed areas,

²⁴ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 30 Apr 2024. Viewed 12 May 2024.

²⁵ AirborneLogic (2024). Remote sensing horses: using aerial photography and machine learning for automated counting of horses in an open plain segment of Kosciuszko National Park, NSW, summary report. Report prepared for Rocky Harvey. [Adelaide], 30 April 2024, updated with peer review May 2024. knp-horse-count.web.app/documents/20240514_AirborneLogic_HorseCount_RemoteSensing_Summary_FINAL_compressed.pdf

²⁶ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 27 Dec 2023. Viewed 12 May 2024.

²⁷ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 30 Apr 2024. Viewed 12 May 2024.

i.e. similar terrain to northern Kosciuszko, would have been handy. A trial, or preferably multiple trials, would have given the APS organisers at least some indication of the quantities of animals present but unseen in the air images. The organisers did not undertake such a trial. The APS reports did not mention any such trials undertaken by others.

The APS organisers pre-judged their results

A basic tenet of scientific surveys is that you ask an open question, such as ‘How many horses are in area X?’ If you want your survey results to be widely accepted, you don’t pre-judge the results. But brumby advocates, including the survey organisers, did just that.

Interviewer: And roughly right now what would you estimate is out there [in Kosciuszko National Park] currently?

Claire Galea: I'd be amazed if there's five, six hundred at most, judging by National Parks numbers ²⁸.

Claire Galea made the above statement on 2 November 2023. In the final weeks of the APS project, Rocky Harvey made this prediction:

So far only 236 horses have been manually counted in our 212km² area ... don't expect a significant increase on what has been visually observed to date. Rocky Harvey, 18 Mar 2024²⁹.

But as stated above, Airborne Logic found 569 feral horses in the air photos, more than twice as many as Rocky Harvey and many of his supporters had found from staring at photos online.

The APS surveyed only a small area

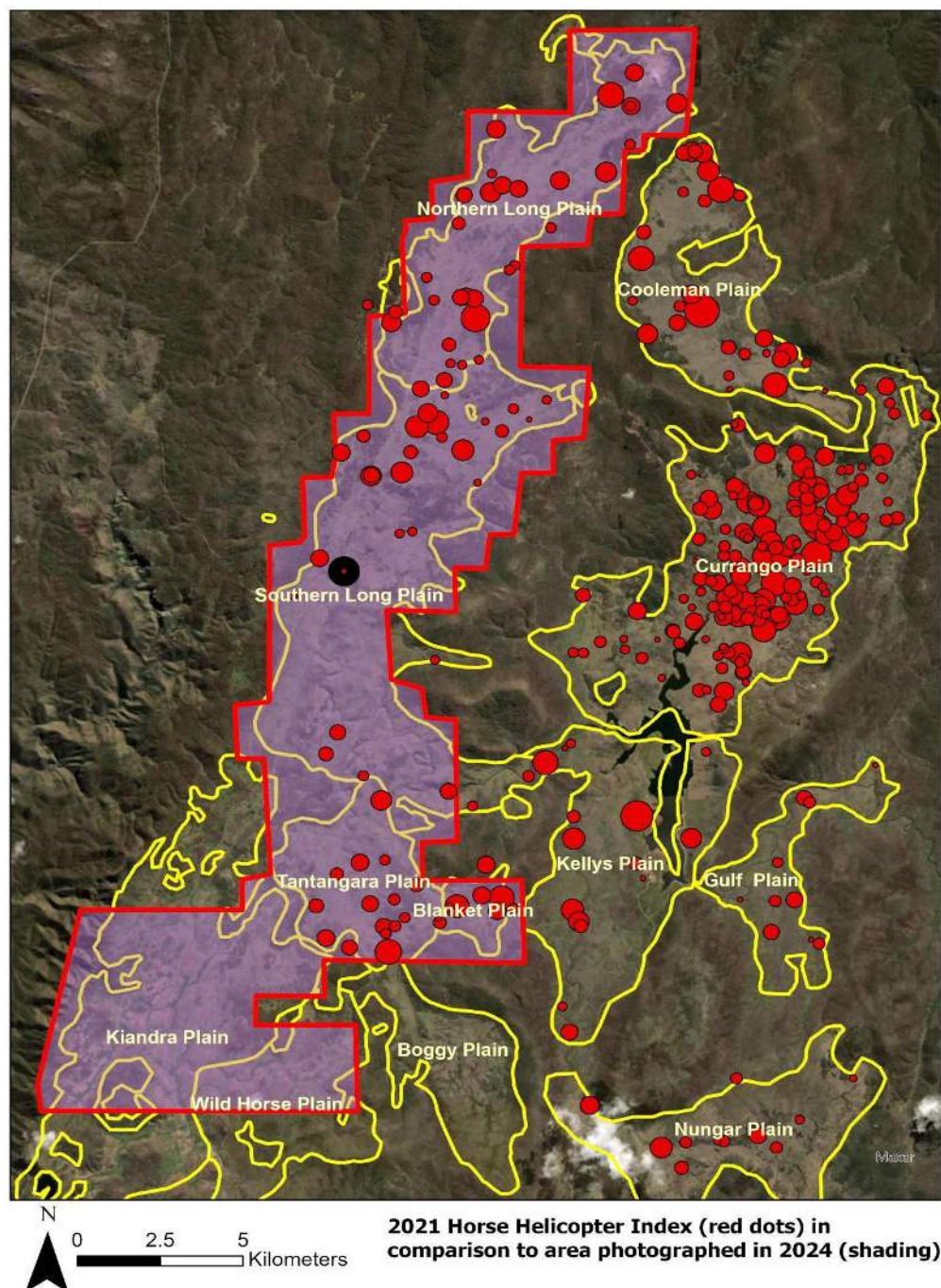
The APS survey area was 212 sq km (21,200 hectares) - only 3.1 % of the entire Park (6,900 sq km). The HHI surveyed 395 sq km according to data supplied by NPWS under GIPA. The HLT-DS surveyed 1229 sq km in northern Kosciuszko and 2675 sq km in total within Kosciuszko NP ³⁰.

²⁸ Oneegs community live call www.youtube.com/watch?app=desktop&si=TdAoqAMFGno2Ri--&v=tttna6egWQo&feature=youtu.be Listen from approx. 20 minute mark.

²⁹ Rocky Harvey. Update Go Fund Me page. Cited above. 18 Mar 2024. Viewed 9 May 2024

³⁰ NSW National Parks and Wildlife Service (Oct 2023). Horse distribution and survey blocks, Kosciuszko National Park, October 2023. The area surveyed is described at www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/pest-animals/wild-horses/managing-wild-horses/kosciuszko-national-park-wild-horse-management/tracking-the-wild-horse-population/horse-population-estimate and the map is downloadable from the same page.

The APS excluded the area with the highest concentration of horses



Map 1: The plains of northern Kosciuszko are outlined in yellow. The red circles = locations of horse groups in the most recent (i.e. 2021) HHI survey. The black circle with the red centre = the helicopter landing point and a horse sighting. The lavender shading = the area photographed by the APS survey 2024. Open plains outside the lavender shading were included in the HHI but not the APS. Map compiled by Don Fletcher from NPWS data available under GIPA and from maps provided online by Airborne Logic.

In Map 1, the concentration of red dots (horse sightings) on Currango Plain indicates that the Parks Service's most recent HHI survey found a higher number of horses there than on other plains.

The APS, however, excluded Currango Plain, for a range of reasons listed in the Updates on the Go Fund Me page³¹. Initially, the quoted reason was a report of horse carcasses found in early October 2023 in the Currango area after ground-shooting³². The APS organisers assumed that it would be hard to distinguish carcasses from horses lying down, in air images. This assumption ignored the fact that carcasses of horses shot before early October would deteriorate significantly and visibly over the summer months. Later, Rocky Harvey also quoted budget limits as a reason to exclude Currango.

In a project that starts with stated intentions of proving that the official numbers are incorrectly high, it is a major flaw to exclude an area that is likely to contain the highest concentration of horses.

The survey design would have been far more credible if it had started with the area with the likely high number of horses and then continued out from that area as far as the project budget permitted.

The APS results are not comparable to the Distance Sampling surveys

Northern Kosciuszko is a mixture of grassy plains and treed areas. Updates posted on the Go Fund Me site by Rocky Harvey state that Airborne Logic advised that the kind of colour imagery to be employed for the survey would not reliably detect horses in treed areas. Approximately one quarter of the area photographed in the APS survey was treed. The APS organisers declined to use any method to calculate horses present but unseen, presumably to avoid 'fancy maths'³³.

Therefore, from the beginning, it was certain that the APS survey could not produce a total of all the feral horses in the area surveyed. Therefore the APS was limited to being an index of abundance. Therefore it could provide

³¹ Rocky Harvey (2024). Update on Go Fund Me page. Cited above.

³² 'We were concerned about the carcasses on the Currango Plain possibly being counted as live animals and so thought it best avoided' - Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 8 Jan 2024. Viewed 12 May 2024.

³³ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 10 Mar 2024. Viewed 10 May 2024.

no valid comparison to the results from any measure of absolute abundance, such as the HLT-DS surveys.

The APS organisers have not, to our knowledge, made any clear statement recognising this major limitation. Their comments that touch upon it are contradictory. In his project update on 23rd January, Rocky Harvey wrote ‘Any comparison other than to the Cairns’ estimates [i.e. to the HLT-DS surveys] will have little impact. Cairns does not survey the open plains and treed areas separately so to demand that we use the same survey area as Cairns is naïve.’ In other words, the organisers aimed for a comparison with HLT-DS surveys but simultaneously considered that aim ‘naïve’.

Once the APS data began to be analysed, the process revealed indications that not all horses were likely to be detected. Initially, repeated and intensive manual searching revealed 405 horses ³⁴, then the AI was trained to detect more. The best of the machine learning models then recorded an additional 2,242 horses with greater than 70% confidence. Manual inspection rejected 96% of those as false positives, leaving 91 additions to the count.

A second round of manual counting in the vicinity of the 91 horses then found 73 more horses which had not been detected by AI ³⁵. If the AI process had used a different model or different confidence settings, the final count may have differed from 569.

Many of the horses added after the initial 405 were out in the open grassland. Many were well illuminated by the sun. This is a reminder that human observers generally fail to detect some animals, even when the observers are repeatedly inspecting photos in the most ideal viewing conditions possible.

³⁴ AirborneLogic (2024). Cited above. Page 17.

³⁵ Javen Qinfeng Shi (2024). Review of the Horse Counting Project Report conducted by AirborneLogic, appended to Airborne Logic (2024) cited above. Page 25.

The APS organisers' conclusions include a mis-interpretation of 'open' terrain



Northern Kosciuszko has extensive grassy woodlands which are attractive to horses. Horses can sometimes be seen from the air through gaps in the trees, and sometimes not.

The APS organisers announced their conclusion as 'Hi-tech count finds 569 horses in area where parks say there are 5122'. Part of their logic included equating the APS survey area of selected 'plains' to the area defined by the HLT-DS as 'open'.

The HLT-DS surveys describe 618 sq km of northern Kosciuszko survey block in the category of 'open'³⁶. The HLT-DS surveys carefully record the terrain type for each horse sighting, and define any clearing, however small, as 'open' if a horse was sighted in it. The APS organisers write: 'Conservatively, the area of open terrain in the northern survey block is estimated at 400km²'³⁷. Although 400 sq km is a reasonable estimate of the named plains in northern Kosciuszko, it does not use the same

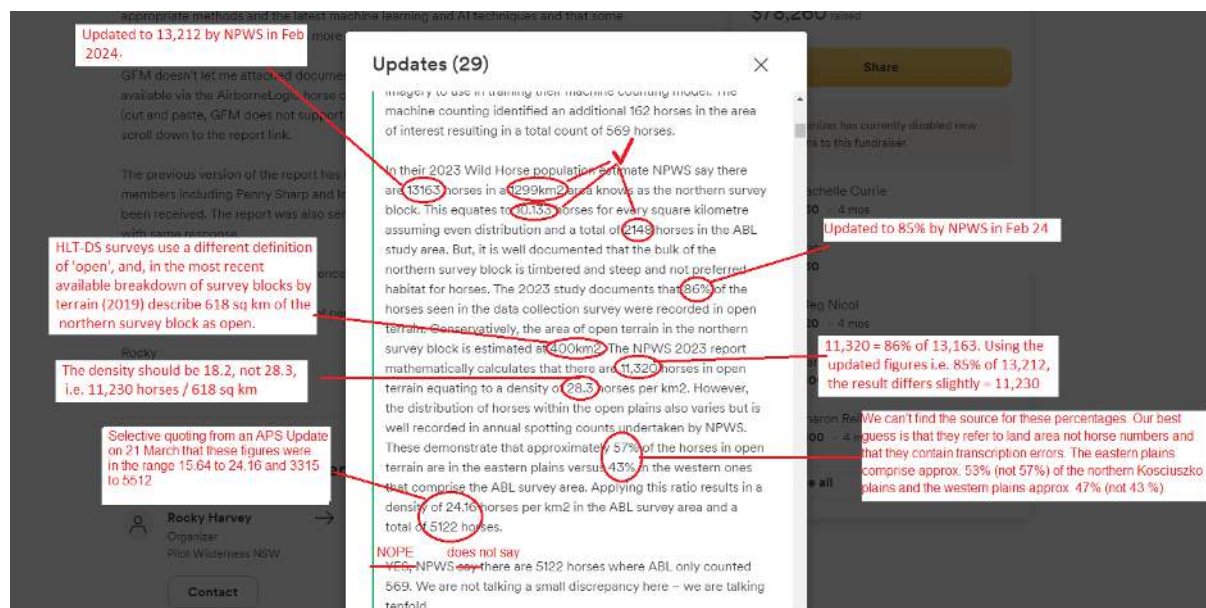
³⁶ Stuart Cairns (2019). Cited above. Page 6, Table 1.

³⁷ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 30 Apr 2024 . Viewed 12 May 2024.

definition of ‘open’ that was used in the HLT-DS surveys. The APS organisers later used the ‘open’ area in density calculations when comparing the APS and HLT-DS results. The bottom line: any conclusions that assume that 400 = 618 are bound to be flawed.

The APS organisers were aware that the definition of open terrain was a relevant factor. In their 21st March Update³⁸ they wrote ‘Depending on how ‘open Terrain’ is quantified, it can be extrapolated that Cairns calculates a density of between 15.64 and 24.16 horses per km² for our survey area. This equates to a population total of between 3,315 and 5122 horses’. In their Update at the end of the project on 30th April, they chose to forget the 15.64 and 3315 figures and use the 24.16 and 5122.

We have tried to follow the APS organisers’ numbers and logic, as reported in their 30th April Update. Our annotations on the screenshot show our concerns.



Screenshot from the APS Go Fund Me Page, with annotations

But, setting aside the questionable logic and mathematics, the APS organisers’ analysis is trying to compare an Index of Abundance with a Measurement of Total Abundance. It is not comparing apples with apples; it is comparing apples with pumpkins and concluding that pumpkins cannot possibly exist because they would be much larger.

³⁸ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 21 Mar 2024 . Viewed 12 May 2024

The APS lacks a Confidence Interval

All attempts to count feral horses in a wild area as large as the horse-frequented areas of Kosciuszko will have a degree of uncertainty. The uncertainty can involve under-counting, when the number of unseen horses is underestimated. It can involve over-counting, if horses moved more quickly than expected from one transect/observation point to the next or if the number of unseen horses was overestimated.

Survey organisers normally quantify the factors that contribute to uncertainty, or imprecision, in their survey results. For instance, the most recent HLT-DS survey of Kosciuszko measured the population as 17,393 with 95% confidence that the number of horses in Kosciuszko at the time was between 12,797 to 21,760 ³⁹. In other words, if the survey were repeated 20 times in very similar circumstances, the HLT-DS organisers predict that in 19 of those 20 times, the results would be within 12,797 to 21,760.

With a Confidence Interval of 95%, there is only a 2.5% chance that the result of a repeat survey would be lower than 12,797 and a 2.5% chance it would be higher than 21,760. Most of the 19 repeat measures will fall closer to the 17,393 than to the extremes of 12,797 or 21,760. So it is usually more appropriate to refer to such estimates by their 'central' value, than by the confidence bounds alone.

The Confidence Interval is useful information for Park managers. They can use the upper and lower figures, adjusted for natural increase rates, to predict the minimum and maximum likely numbers of horses they will need to remove to meet the target of 3,000 in 2027.

When there is only one count using a particular method, lack of a Confidence Interval undermines its credibility. **The omission by the APS organisers of a Confidence Interval means there is no statistical evidence that the next count might not be a massively different number. Recognition of imperfection, and honesty about it, are hallmarks of good science.**

³⁹ NSW National Parks and Wildlife Service (Oct 2023). Cited above.

Peer review of the Air Photo Survey

On 14th May 2024, a review was published as an addition to the report by Airborne Logic ⁴⁰. It departed from the standard academic peer review process in three ways: there was only one reviewer (normally there are at least two plus the editor); the reviewer was selected by the reviewee; the reviewer was not anonymous.

The review, by Javen Qinfeng Shi, professor at the University of Adelaide School of Computer and Mathematical Sciences, examined Airborne Logic's procedures and in particular the use of AI. This article does not in any way question the reviewer's expertise, which is clearly apparent.

The review did not comment on the use of the Airborne Logic data by Rocky Harvey or on Harvey's claim that the Air Photo Survey disproved the NSW government's surveys. Despite its limited scope, the review does shed some light on the APS organisers' claim that 'This automation of the data collection and analyses results in almost complete removal of human error and potential bias – the polar opposite of techniques currently used by NPWS' ⁴¹. The review in fact does mention human error: 'the manual process of building the training dataset involved many hours of human labor, which, due to factors like fatigue and inattentiveness, resulted in some larger herds being missed' ⁴². The review also noted that the AI process could be improved: 'These findings exhibit great promise. However, it's important to note that these results may not extend to the entire imaged area due in part to the restricted small size of the training set' and goes on to recommend four ways in which the AI process could be improved ⁴³. In other words, the review supports our suggestion, earlier in this article, that with improvements to the AI process, the '569' horses result of the APS might have been different.

The APS peer review's findings echo the caution we expressed earlier that surveys of wildlife often undercount. The words 'Hi-Tech' in the headline for the APS organisers' announcement of 30th April ('Drum Roll... Hi-Tech Count Finds 569 Horses') are no guarantee of perfection.

⁴⁰ Javen Qinfeng Shi (2024). cited above. Pages 23-26.

⁴¹ Rocky Harvey (2024). Update on Go Fund Me page. Cited above. 13 January 2024. Viewed 14 May 2024

⁴² Javen Qinfeng Shi (2024). Cited above. Page 25.

⁴³ Javen Qinfeng Shi (2024). Cited above. Pages 25, 26.

Is the Air Photo Survey comparable to the Helicopter Horse Index?

Yes. Both the APS and the HHI are indexes of abundance. It is possible, using information obtained through GIPA, to isolate the numbers of horses seen in the same area as the APS. In the most recent HHI survey in 2021, 733 horses were seen in the area in which the APS saw 569 horses in 2024.

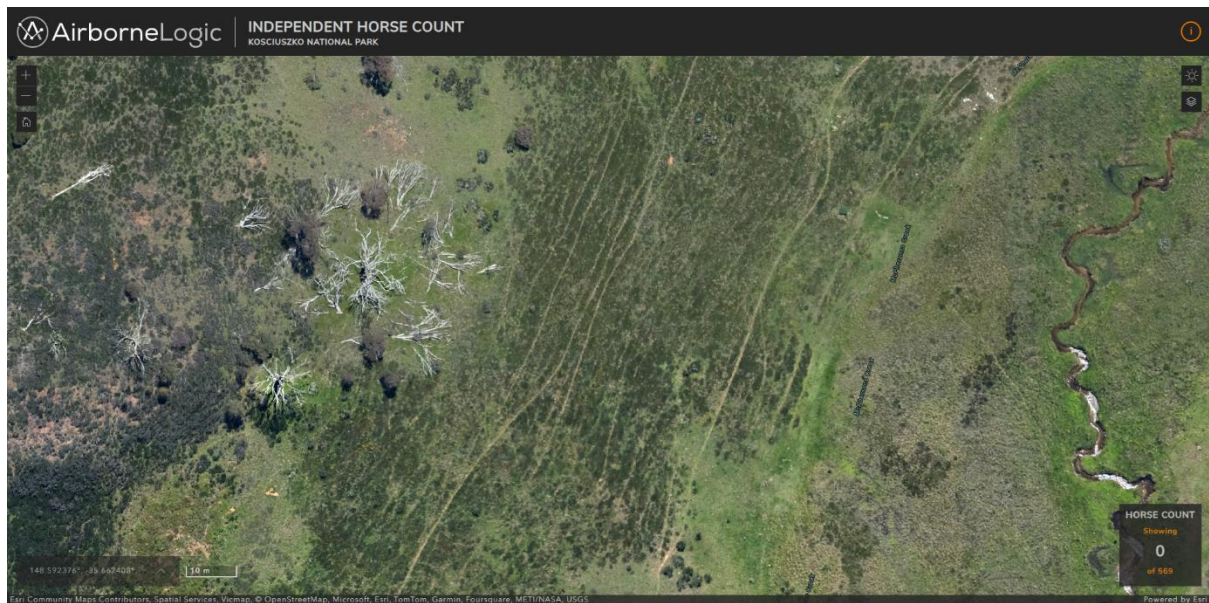
Though these two numbers differ, it is only a 28% difference. It is possible that actual horse numbers have dropped 28% since 2021. It is also possible that the actual numbers are similar to or higher than those of 2021, and that the difference is due to other factors. One possible factor is that the Parks staff doing the HHI survey in 2021 were flying much lower than the APS aircraft, which remained at 915 m above ground. Parks staff were looking obliquely at horses, some of which could attract the eye through movement. The Parks staff flew wherever they wanted, to investigate each group of horses more closely, count it exactly and record its location.

Whatever the reason for the difference between 733 and 569, the APS result of 569 number does not come as a surprise. It broadly confirms, rather than discredits, the HHI surveys and makes no valid comment on the HLT-DS surveys.

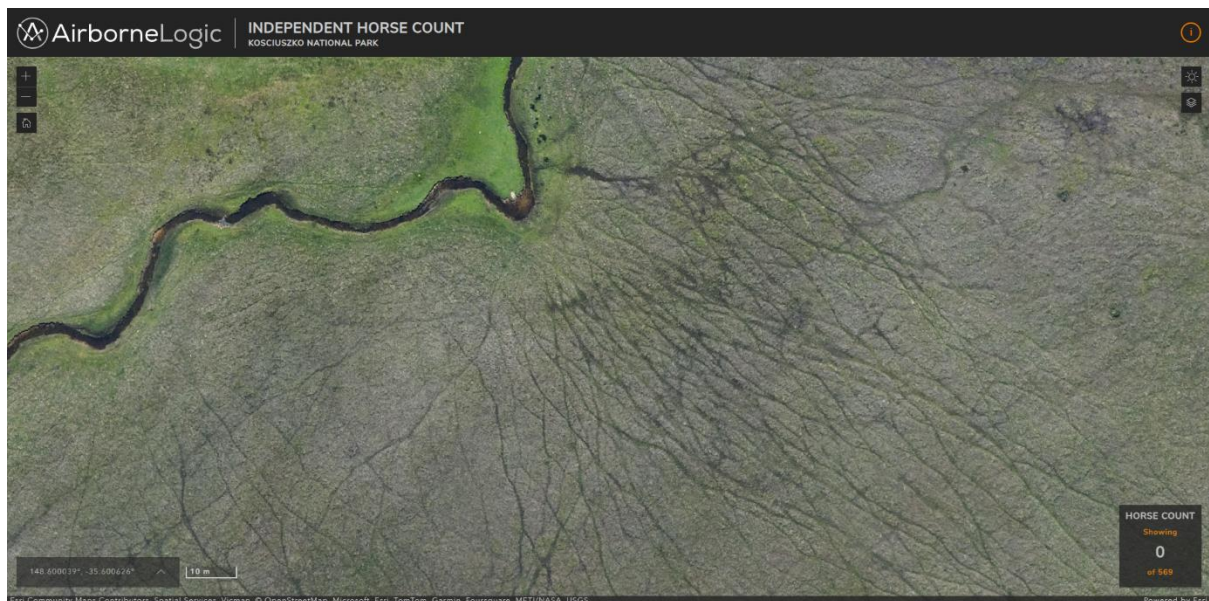
Did the Air Photo Survey have any unexpected benefits?

Yes. It produced air images of northern Kosciuszko which were more detailed than any other publicly-available air images. They showed horse tracks, roll pits and other damage in crisp detail.

Horse tracks can drain sphagnum bogs, expose ancient peat beds to fire, facilitate the movement of other feral animals e.g. foxes into pygmy possum habitat, sever the protective grass tunnels made by native broad-toothed rats, and cause other ecological damage. The density of tracks in some of the APS images is very concerning.



Horse tracks near Mosquito Ck, Kosciuszko NP



Horse tracks leading to the upper Murrumbidgee, Kosciuszko NP

Conclusion

Though the Air Photo Survey used a new method for making and recording observations, it did not use any method, new or old, for measuring horses present but unseen. Distance Sampling, by contrast, has been trialled on known populations of many types of wild animals. The APS is thus not comparable to the HLT-DS surveys.

Even as an index of abundance, the APS's usefulness is limited: it surveyed only 3.1% of the Park, and excluded the most densely horse-populated part of the Park.

In summary, the \$78,000 collected by brumby advocates to fund their recount has produced some excellent air images, and helped train AI software to be useful for distinguishing horses from horse-shaped objects. It has not, however, produced any kind of credible challenge to the official counts.

About the authors

Linda Groom is a retired librarian, and a volunteer with the Invasive Species Council.

Don Fletcher is a retired senior ecologist whose prior jobs included park manager, vertebrate pest and weed control officer, and ranger; his responsibilities included managing wildlife surveys.