New research in the Victorian Alps delves deeper into the understanding and management of environmental impacts of wild horses

Sandy Radke, Australian Brumby Alliance Inc.
July 2023

The recently published ***Use of density-impact functions to inform and improve the environmental outcomes of feral horse management* (Berman, et al, 2023)** presents a new approach to studying the environmental impacts of wild horse in the environment.

In the past, most studies have more or less said – *hey this stream has been severely trampled and there are 87 horse dung piles here. The horses must have done it and we need to get rid of them or the whole ecosystem will be destroyed*. This is, of course, a very simplistic parody. But does encapsulate what has been conveyed in studies and in the media to date. Pictures of tracks, roll pits, impacted vegetation, trampled areas are presented, the number of dung piles recorded and reported but very little quantification of the percentage of impacts over an area is reported.

Equally, dung piles are counted at one site and compared to other study sites or to the same site in a previous year/previous study but no rigorous attempt to translate the dung pile counts into a realistic estimate of horse numbers is undertaken. This only tells us that horses were here but not *how many* horses were here over a given time period.

Based on this inadequate evidence, governments spend time and tax payer's money, year after year, to try to eradicate the horses and fix the problem. But while horses are culled and community sentiment becomes heated and divided, outcomes for the environment do not appreciably improve and the cycle just continues.

The premise of this new study is that to better manage horses (or any species) on the land, we need to first *"….understand the relationship between horse density and environmental impact"*. Think of it like this: how much environmental impact is made by 5 horses in a square kilometer versus 10 horses?

This sounds so simple - and sensible. We see and understand this all around us – with people, livestock, kangaroos…. And yet, we have barely started looking at wild horse management from this perspective.

Maybe simple to understand in principle, but in practice, how do you relate animal density to environmental impact? And what sets this study apart from others?

The study recorded vegetation and soil disturbance as well as the sign of potential causes in two areas of the Victorian Alps: The Bogong High Plains (BHP) and the Eastern Victorian Alps (EVA). Mathematical density-impact functions were then calculated to identify how to better target control programs. ***The use of density-impact functions has never been used in the Australian Alps.***

There are two primary things that need to be worked out:

1) the Horse Density, say, per square km and

2) the percentage of environmental impacts over that same square km

Dung piles are usually used to indicate the presence of horses and counts are used as a surrogate for the number of horses. When this is the only consideration, the population is always over-estimated; it is important to incorporate measures such as animal defecation rate, dung decay

rates, and other parameters to derive a realistic translation from dung pile counts to horse numbers over a distinct period of time.

In this study, environmental impacts were recorded by walking a 500m rectangle as well as 50m along both stream banks at each study site. Impacts on vegetation and soil changes as well as signs of cause (horse, deer, pig, native animal, human) were recorded for each metre in the transect.


Tape marking one side of a 500m Site Transect in the Bogong High Plains (left) and marking 50 Stream Bank Transect (right) in the Bogong High Plains

Mathematical/statistical modelling was then carried out to determine a density-impact function.

Key Findings

- Horse density differed significantly between the Bogong High Plains (BHP) and the Eastern Victorian Alps (EVA). After translating faecal pile density to number of horses, it was found that horse density in the BHP was 0.64 horses per square kilometer and in the EVA it was 7.18 per square kilometer. Deer density was 21.24/km2 in the BHP and 45.02/km2 in the EVA.
- In the BHP, 99% of the sampling transects showed minimal impact and no site had more than 1% evidence of grazing or trampling.
- In the EVA, pile density and impact were significantly higher than in the BHP. However, less than 18% of the area surveyed had evidence of environmental impacts, leaving at least 82% of the area with no evidence of impacts.



At left is an example of the 82% of area studied In the Eastern Victorian Alps which had no horse impacts. The exclosure site at Native Cat Flat (centre) showing vegetation highly grazed by horses, deer and other animals and trampling at another site (right) are examples of the impacts present in 18% of the EVA study area where horse density it high.

- A key finding from the density-impact function was that evidence of grazing and trampling along Site transects was very low (<2%) until faecal pile counts were 200-250 per hectare. With counts higher than that, the evidence of environmental impacts increases exponentially.

  This threshold pile count translates to 9 horses per square kilometer and has important implications for the efficacy of management control programs. Where the level of horses in an area is below the threshold, control programs will have no significant impact on improving environmental outcomes. However, if horse populations are managed to the threshold limits, impacts (due to horses) will be minimised.

  Threshold limits may differ from area to area and changes in climatic conditions, for example a wetter or drier year, may vary the threshold within the same area. Ongoing experimental monitoring would manage these variances.

- Paths have been a major focus in some previous work as they significantly compact the soil and make it hard for vegetation to recover, particularly if they are actively used. The impact of paths in this research was also taken seriously; path widths were measured, lengths within the site areas were walked with GPS tracking and the path was mapped and compared to the area of the whole site.

Horse path in the BHP. The proportion of horse paths in the EVA was the same as in the BHP despite higher horse density in the EVA. In both areas, the impacts of paths was very low.

It was found that the proportion of area travelled by horses on paths did ***not*** differ between the BHP and the EVA, despite a higher horse density in the EVA. Furthermore, the actual path impact on soil and vegetation was less than 0.2% at sites where paths were detected at all. This is quite different to the relationship between horse density and grazing/trampling impacts in which high horse density results in higher levels of impact; for paths, once established, higher horse density does not increase the extent of path impact which, in this study was very low.

Paths were not exclusively used by horses; signs of deer, native wildlife and humans were also present.

Examples of walking tracks used by humans in the Bogong High Plains.

- Another key finding was that the combined impact associated with deer, pigs, humans and fire was large in comparison to impacts associated with horses. Horse related impacts were less than 4% of total environmental impact in the BHP and less than 34% of total impact in the EVA.

Vehicle tracks (left) and fire damage to bush (centre) and sphagnum moss (right)

Detection bias

Many horse impacts are more visible and easier to detect than those from other sources and without careful consideration of detection bias impacts of horses can be exaggerated compared to other species. The study was careful to mitigate against detection bias and you can read how this was handled in the Appendix to this article.

Why should this study be believed? All other work concludes horses impact the environment

Firstly, this study acknowledges that horses can impact the environment. However, the work demonstrates that it is the number of horses, or the horse density, that determines the level of environmental impact and in most of the study area, that impact is minimal.

Previous studies cite high feral horse impacts in this area. However, these results were based solely on the proportion of sites with an indication of horse presence (hoof prints, faeces, trampling etc) but did *not* report of the % of impact to the area. That means that if one site had 4 dung piles it was given the same weight as a site that had 80 dung piles as well as soil/vegetation impacts. This sampling bias distorts the picture and does not provide the information needed for cost-effective management control.

Where environmental impact was found, the cause of the impact was also recorded to differentiate what impacts were caused by horses, deer, pigs, native species, humans or other causes. Some impacts like paths and stream trampling were caused by multiple species. This level of observational detail is important to help develop successful environmental managements plans.

There are some other recent studies (in different areas) that compare horse and deer density to impacts but they treated the counts of deer pellets and horse piles in the same way and, while they used decay rates for horses, they did not use decay rates for the deer pellets which decay 5/6 times faster than horse dung. Detection bias was also not considered. These methodologies distort the relative impacts of horses and deer.

What does this imply for wild horse management?

This research provides a basis for improved planning and targeting of animal control programs to better achieve environmental outcomes.

If robust density-impact function analysis is undertaken and detection bias is taken into account, control programs can be designed to target areas of high animal density and maintain animal populations to the derived threshold, rather than attempt to cull anywhere there are simply signs of horse (or deer) presence.

Threshold are likely to differ from area to area and density-impact functions need to be carried out before a control plan is developed.

Thresholds are also likely to differ over time when, for example, there is higher or lower rainfall, bushfire or other factors that affect the ecosystem. Experimental monitoring is important to avoid unexpected outcomes and ensure the target threshold continues to be appropriate.

This work demonstrates that understanding the relationship of horse density to environmental impacts caused by horses can save time and money and achieve better outcomes for the environment.

Managing horse populations to the appropriate threshold horse density limit is the most cost-effective way to reduce animal impacts. At the left, a heavily grazed area of high horse density in the Eastern Victorian Alps and, at right, a low horse density, low impact area in the Bogong High Plains. Only 18% of the study area in the EVA and less than 1% in the BHP showed significant horse impacts.

Berman D.M, Pickering J., Smith D., Allen B.L, 2023, Use of density-impact functions to inform and improve the environmental outcomes of feral horse management, *Wildlife Biology*, e01107, Version of Record online: 21 June 2023, https://doi.org/10.1002/wlb3.01107

Appendix – Study Background

The information below is background information on the study, particularly the research methodologies that were used. Understanding how research is planned and conducted and as well as what the context, scope and limitations of the work are, help the reader understand the integrity and robustness of the study and its conclusions. Below is not a comprehensive background to the study but aims to provide a bit more detail to underpin the key findings. For those very keen, we recommend you read the full published article on the **Wiley Online website** and hope that this article provides a useful introduction to the research.

More on the study areas

The Bogong High Plains (BHP) comprise about 132 km2 and, according to the latest studies at the time of publication, had a population of around 109 horses in an area from 1400-1800m a.s.l. Temperatures range from -9 to 30 degrees Centigrade and in 2021, total rainfall was 1499mm; snow cover can be present for up to 4 months per year above 1200m

The Eastern Victorian Alps occupy 1906 km2 and most recent estimates of horse numbers is 3282. The study surveyed a subsection of 720 km2 within 3 km of sites used in a 2019 study (also used in this study). Elevations ranged from 900-1700m a.s.l., temperatures range from -6 to 38 degrees Centigrade and total rainfall for 2021 was 1018mm.

Both the BHP and EVA have a history of pastoralism and grazing; cattle, sheep, deer and pigs have all been introduced.

More on how it was done

Site selection

A total of 47 sites were selected, 16 in the BHP and 31 in the EVA. All sites were selected within the same vegetation classification (Alpine Treeless Drainage Lines) and most sites were chosen from previous studies of the area which concluded horses were causing significant impact. This allowed some comparison with other studies in the areas of interest. Six further sites were non-randomly selected in areas of known high horse activity to ensure a full spectrum of data from low to high horse numbers for the density-impact function. However, the non-random nature of only a small number of sites made statistical comparison between the BHP and EVA difficult so they were not used for this purpose. Two of the six sites were at locations of exclosures built in 1999 which provided good reference points for areas with high horse densities.

At each site a rectangular transect was walked and evidence of environmental impact was recorded and attributed to horses, deer, pigs, native fauna and humans. This resulted in a 500m transect at each site (a Site transect). In addition, 50m Steam transects were walked along both banks of watercourses, totalling 100m of Stream transect.

Estimating Animal Density

It is common practice to use dung pile counts as a surrogate for animal presence and numbers. But to more accurately reflect actual horse numbers, a number of things need to be considered and undertaken. In this study:

- Horse dung piles were counted along the site and stream bank transects and their distance from the observer was also recorded.
- Stallion piles were counted as one single pile

- An average number of pellets in a pile was derived by counting pellets in piles that were sufficiently intact (not decayed).
- The above data were statistically analysed to convert dung pile counts into horse density and percentage error, including detection bias.
- A decay rate of 426 days and a defecation rate of 8 defecations/day were used in the computations

A similar process was used for converting deer pellet groups into deer density, using a decay rate of 71 days and 12 defecations/day

Identifying Environmental Impact

Environmental impacts were recorded as present/absent for each meter of the site and stream bank; distance from the observer was also recorded.

Evidence of trampling and grazing included:

- vegetation that was broken, bent or trodden in to the ground
- soil disturbed by hooves of feet or animals rolling/wallowing or vehicles
- bitten grass that was identified by square ends that were shorter than the blades with pointed ends
- grass pulled out of the ground

Potential agent(s) of impact were also recorded for each record of trampling or grazing and allocated a sign (foot/hoof prints, faeces, wheel tracks, etc) of the presence of feral or domestic horses, deer, pigs, rabbits, hare, cattle or humans. Where applicable, multiple causes were assigned to records with no attempt to quantify relative contribution.

Correlating density and impacts

Various statistical methods were used to:

- Calculate Detection Bias
- Translate faecal pile counts to horse (or deer) density
- Determine and plot a density-impact function for each area
- Determine margins of error for the calculations

More About Detection Bias

Many horse impacts are more visible and easier to detect than those from other sources. Paths with horse hoof tracks and horse dung is easier to spot than deer tracks and dung. Coupled with a slower decay rate for horse dung versus deer pellets, it is easy to understand that without careful observations the impacts of horses can be exaggerated compared to other species.

The study was careful to mitigate against detections bias. Firstly, the sampling/detection method incorporated a rectangular strip transect from which impacts were continually recorded and the perpendicular distance of detected impacts from the observer was also captured.

Detection probability was derived using Distance Sampling which indicated a higher probability of detecting horse faecal material than for deer faecal material.

Other studies do not even consider detection bias and often either exclude reporting of non-horse impacts or assume they are negligible because horse signs are more visible.