



## Wild horses in the Australian Alps: using satellite data to monitor impact

Wild horses have been shown to have negative impacts on the composition and structure of vegetation, and subsequently on landscape structure and ecological processes. In the Australian Alps, monitoring their impact on vegetation safely and effectively is difficult and expensive because of the topography and the weather.

We have developed a monitoring method that combines field observations with satellite data to detect changes in vegetation condition. The method has been tested by park managers from Parks Victoria and the New South Wales National Parks and Wildlife Service.

## Research outcomes

- » Changes in vegetation condition in the Australian Alps are correlated with the presence of wild horses.
- » Vegetation changes can be detected using satellite data, and combined with data from on-ground field studies to give land managers better information about the impact of wild horses on vegetation.
- » Combining satellite data with data from on-ground field studies is a promising, cost-effective method of monitoring and deserves to be tested on a large scale.

## Wild horses are on the increase

Wild horses occur in around 300,000 hectares of Kosciuszko National Park, in the Bago and Maragle State Forests in New South Wales (NSW), and in about 330,000 hectares of Victoria. In 2009, the horse population in the Victorian East Alps was estimated at 7,700 horses, increasing annually at a rate of 22%; in 2012, it was estimated at 8,200–10,900 horses (plus or minus 25%).

## Native vegetation is at risk

The negative impacts of wild horses on vegetation and ecosystem processes in the Australian Alps are well known from the observations by park staff. Wild horses can have negative impacts on the composition and structure of vegetation, and subsequently on landscape structure and ecological processes.

Wild horses can compact the soil, causing more run-off; reduce the amount of vegetation; trample and rub against plants; damage growing buds; and affect the distribution of nutrients. Native grasslands and herbs are significantly impacted by wild horses. However, the biggest impact is on delicate alpine bogs through trampling affecting water quality and sensitive habitat.

## Field surveys are costly and cannot be extrapolated to landscape scale

To assess the impacts of wild horses on natural ecosystems, land managers commonly use field-based observations. Due to remoteness, difficult terrain and harsh weather, field surveying is labour-intensive and costly. For effective management, land managers need a time series of observations that they can extrapolate to a landscape scale.

## Remotely monitoring impact

Our objectives were to investigate if changes in vegetation condition are correlated with the presence of wild horses and, if so, determine whether these changes could be detected using satellite data.

We 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. To do this, we first determined if there was a relationship between field observations of vegetation condition in wetlands and riparian areas and the presence or absence of wild horses. We rigorously tested the relationship using statistical analysis to be sure that the poor condition of vegetation could be attributed to the presence of wild horses and was not related to topographic factors.

We then investigated whether this same relationship could be detected in satellite data. Again, we subjected the conclusions to statistical testing to be sure we were measuring the effects of horses and not topographic features.

# 22 %

is the annual rate of increase of the wild horse population in the Victorian East Alps, as measured between 2003 and 2009.



## How did we do it?

### Field-survey data

We collaborated with Parks Victoria and the NSW National Parks and Wildlife Service, both of whom had done field surveys. The park staff assessed features such as animal tracks (number of tracks and level of impact), stability of stream banks, sediment level in stream beds, pugging damage (damage caused by horses tearing up the soil structure), grazing disturbance on banks and in channels, percentage of vegetation cover, and percentage of native foliage cover. The field observations were ranked from 'poor' to 'very good', relative to a site in very good condition.

To make sure we were comparing sites of similar topography and vegetation type, we used a statistical technique called 'propensity score matching' for analysing the impact on native vegetation by horse presence versus horse absence. We used decision-tree models to confirm that differences in vegetation condition could be attributed to the presence of horses rather than differences in topographic features.

### Satellite data

The satellite data was collected by the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument aboard the NASA satellite, Terra. From this data, we used weekly records of the Normalized Difference Vegetation Index from April 2000 to April 2012. By analysing the seasonal variability in climate-sensitive life-cycle events such as bud burst, we identified major breaks in the vegetation growth pattern due to drought, fire and other forms of disturbance.

We calculated vegetation condition based on the rate of vegetation growth, which we deduced from the proportion of radiation taken up by plants for photosynthesis. We were also able to distinguish grasses and herbs from woody vegetation because of their different responses to weather conditions, especially rainfall.

### Comparing the two sets of data

We compared the vegetation condition data derived from the satellite data with the field survey observations.

**Pugging damage:** Wild horses have damaged this wetland by tearing up the soil structure, or 'pugging'.

## What did the results tell us?

### Wild horses and vegetation condition are linked

We found that changes in vegetation condition were related to the presence of wild horses. The propensity score matching and decision-tree analysis provided confidence that the changes we detected were not linked to topographic conditions, but to the presence of wild horses. Our results are consistent with other studies around the world that have examined the presence of invasive animals.

The results of the decision-tree models suggest that the presence of wild horses correlated with sites that have poorer and more variable vegetation condition. The results also indicate that sites were comparable in terms of topographic conditions, whether or not wild horses were present.

### Managing wild horse populations is important for conservation

Our results provide further evidence that wild horses have a negative impact on vegetation condition and that managing wild horse populations is an important conservation issue.

### Monitoring with satellite data is useful

Satellite data can provide land managers with useful information about wild horse impacts. We found that changes in vegetation condition detected in satellite data matched the park staff's assessments of vegetation damage in locations where wild horses were present.

While vegetation condition data derived from satellite data is limited in what it tells us, when combined with periodic field-survey observations it offers a valuable and cost-effective method of monitoring.



## Where to from here?

The method of combining satellite data with field-survey assessments to monitor vegetation condition is promising and deserves to be tested on a large scale in a purpose-designed investigation. We continue to collaborate with Parks Victoria and the NSW National Parks and Wildlife Service to identify opportunities to further test the method to support the on-ground activities of park staff.

Satellite-derived data also offers landscape-scale information that could contribute to Victorian and NSW State of the Parks reporting and to national State of the Environment reporting.

## Who are the researchers?

### Professor Brendan Mackey



Brendan is the Project Leader for the Bioregional Futures team in the Landscapes and Policy Hub. He is the Director of the Griffith Climate Change Response Program at Griffith University and is formerly of the ANU Fenner School, where he continues his association as an adjunct professor.

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Luciana is a geographer and remote-sensing specialist based at the ANU Fenner School in Canberra. She is part of the Bioregional Futures Team applying tools and techniques to study characteristics of landscape ecosystems and the patterns of diversity under scenarios of natural and human-induced change.

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## Who are the collaborators?

Australian Alps national park Program, Geoff Robertson (NSW Office of Environment and Heritage), Charlie Pascoe (Parks Victoria)

## Further reading

Porfirio LL, Robertson G, Hugh S, Gould SF & Mackey B (submitted) Feral horses and vegetation degradation: a case study in the Australian Alps. *Journal Title TBA*, Vol TBA, pp. TBA.

## About the NERP Landscapes and Policy Hub

The Landscapes and Policy Hub is one of five research hubs funded by the National Environmental Research Program (NERP) for four years (2011–2014) to study biodiversity conservation.

We integrate ecology and social science to provide guidance for policymakers on planning and managing biodiversity at a regional scale. We develop tools, techniques and policy options to integrate biodiversity into regional-scale planning.

The University of Tasmania hosts the hub.

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