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RAIN SHADOW CATCHMENT IMPACTS

IMPACTS FROM INTRODUCED HERBIVORES IN WHITE CYPRESS PINE – WHITE BOX COMMUNITIES IN KOSCIUSZKO NATIONAL PARK

Jessica Ward-Jones,[1] Ian Pulsford,[1] Dr Richard Thackway,[1] Dipak Bishwokarma[2] and Dr David Freudenberger[1]

[1]Fenner School of Environment and Society, The Australian National University, Canberra;
[2]Practical Action Consulting, Kathmandu, Nepal

White Cypress Pine (*Callitris glaucophylla*) – White Box (*Eucalyptus albens*) communities dominate steep, dry slopes below about 650 m above sea level (asl) along the Lower Snowy River in Kosciuszko National Park in NSW and Snowy River National Park in Victoria. These communities are a unique and important representation of the broader White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands that is listed as a critically endangered ecological community (EEC) under the *Environment Protection and Biodiversity Conservation Act 1999*. Grassy Box-Gum communities are mostly found on relatively fertile soils of the lower slopes on the tablelands and western slopes of NSW. They have been drastically reduced in area, are highly fragmented and modified by clearing for cropping and grazing, urban development and transport infrastructure (Office of Environment and Heritage 2017).

Commencing in 1984, an investigation into the condition and history of disturbances to these White Cypress Pine – White Box communities was undertaken (Pulsford 1991). This was in response to concerns raised firstly by Costin (1954), who called for state intervention, and by Clayton-Greene and Worboys (Clayton-Greene and Ashton 1990; Worboys 1982). They reported on the severely degraded condition of these communities, large numbers of rabbits, and widespread sheet and gully erosion. Changes in vegetation condition were assessed by compiling a chronology of disturbance events from historical records, oral anecdotal evidence and field-based studies, providing a strong foundation for further investigations. This included tree ring analysis of *C. glaucophylla* to estimate stand age of regrowth and old growth and to corroborate evidence of disturbance events (Pulsford 1991; Pulsford et al. 1993).

Pulsford found that the grassy woodland with large, widely spaced trees and rich, dark chocolate–coloured soils described by early explorers had been replaced by tall, dense, locked regrowth stands of *C. glaucophylla* (Pulsford 1991; Mackaness 1941). Widespread massive sheet and gully erosion were evident, particularly on steep northerly aspect slopes. Topsoil had been eroded, leaving an often bare lithosolic surface (Costin 1954; Pulsford 1991). This was attributed to the impacts of 150 years of grazing by hard-hooved cattle and sheep, frequent lighting of fires and plagues of rabbits, which arrived in about 1900 (Harnett 1948).

In 1984, rabbit populations were the major concern requiring further investigation. Six 20 x 20 m herbivore-proof exclosures, each paired with a control plot, were constructed. The control plots were subject to grazing from any herbivores present. All plots were on north-facing 23º±3º slopes, between 300 and 450 m asl. In 2017, a new research project was undertaken, which aimed to assess if any ecological recovery within the exclosures had occurred since their establishment. Our expectation was that the cessation of livestock grazing by 1970, and an apparent reduction in rabbits, would by 2017 have produced measurable signs of ecosystem recovery. If grazing pressure had been substantially reduced, we expected few differences inside and outside the exclosures. This was not the case.

Inside the exclosures, soil-landscape functionality, understorey and midstorey vegetation were all moderately to significantly ($p<0.05$) improved. The exclosures exhibited significantly less bare soil and improved condition. Surface organic material was significantly higher, improving soil stability and reducing nutrient runoff. Increased surface condition in the exclosures supported greater abundance of ground dwelling and bio-turbating invertebrates. Improved nutrient cycling also increased nitrogen content in the soil.

The understory condition was significantly improved inside the exclosures but remains sparse and patchy after 33 years of herbivore exclusion (Figure 5). The exclosures on average exhibited 31% ground cover, more than double that of the grazed control plots. This cover was also on average significantly taller and more structurally diverse. The midstorey was denser and taller in the exclosures. However, the long-lived overstorey of *C. glaucophylla* remains generally unchanged.

In contrast, outside the grazing exclosures, organic material and ground cover were sparse and sheet erosion of soil was active and extensive. Soil condition was poorer and there were fewer ground-dwelling invertebrates. There was a decreased presence of midstorey species in the grazed control plots.

Comparison of measurements made in 1987 and in 2018 indicate a fourfold increase in herbivore dung density. In June 2018, 84% of the dung was from horses, 13% from deer, 2% from macropods and 1% from rabbits. In 1987, small amounts of rabbit and macropod dung were present, and no horse or deer dung were recorded. The presence of horses and fallow deer (*Dama dama*) and sambar deer (*Rusa unicolor*) was further confirmed by camera traps at the exclosure/control sites. Horse and deer dung and numerous networks of tracks are apparent throughout the landscape. We observed substantial widespread trampling disturbance to streambanks, grazing and intense browsing of hill slope and riparian vegetation, and highly grazed 'lawns' on cool south aspect slopes and along the banks of the Snowy River.

We conclude that this community continues to be greatly affected by introduced herbivores, predominantly large numbers of horses and deer trampling, grazing and browsing, reducing ground cover, compacting and baring the fragile soils and inhibiting regeneration. This unique occurrence of a *C. glaucophylla – E. albens* woodland is under siege by a new wave of introduced horses and deer that are suppressing recovery of this fragile ecosystem.

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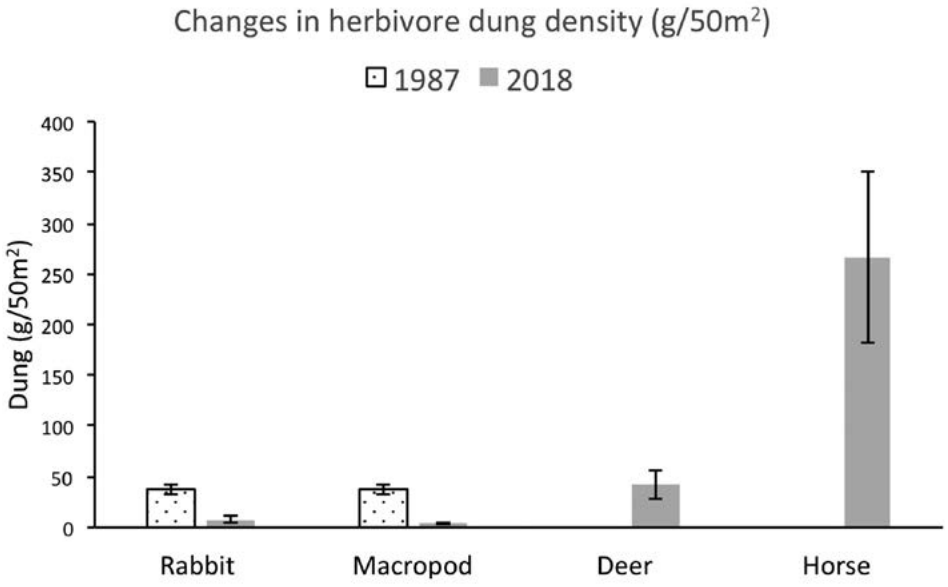

Figure 5. Density of mammalian herbivore dung in 1983 compared to 2018 in a White Cypress Pine – White Box community along the Lower Snowy River in Kosciuszko National Park.
Source: Ward-Jones (2017).

A typical fence-line contrast: Inside the exclosure (left) plant cover remains sparse and patchy on these steep (23°) and highly sheet- and gully-eroded slopes. Note the absence of topsoil and exposure of loose eroding lithosols.

Source: Ian Pulsford, 13 April 2017.

Contrasting inside an exclosure (left) with immediately outside the same exclosure (right) where introduced herbivores graze.

Source: Ian Pulsford, 13 April 2017.