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NORTHERN KOSCIUSZKO IMPACTS

FERAL HORSE IMPACTS ON CORROBOREE FROG HABITAT IN KOSCIUSZKO NATIONAL PARK

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Introduced ungulates can substantially alter ecosystems and have both direct and indirect effects on native animal species (Suominen and Danell 2006; Nuñez et al. 2010). Direct impacts of herbivores on other animals include incidental consumption, trampling and interference (Pavel 2004). However, these effects are often minor compared to the indirect effects that herbivores can have on other species by modifying habitats and food resources (Pavel 2004) by way of changes in the structure, biomass and composition of vegetation, impacts on the physical environment (e.g. soil disturbance, compaction or erosion), and redistributing nutrients (Suominen and Danell 2006; Foster et al. 2014).

In the Australian Alps national parks, concerns have been raised about feral horse impacts, particularly in Sphagnum bogs and fens, which are recognised as an Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and which provide key habitat for several endemic species (Prober and Thiele 2007; Dyring 1990). In wetland and riparian environments, feral horse grazing and trampling can reduce vegetation cover, increase soil compaction, erosion and siltation, damage streambanks, and reduce water quality (Nuñez et al. 2010; Prober and Thiele 2007; Nimmo and Miller 2007; Belcher and Leslie 2011; Rogers 1991). Horses tend to preferentially use open, riparian habitats, meaning that even very low densities of horses can have a substantial impact when wetland or riparian areas are small in comparison with other habitat types (Rogers 1991; Crane et al. 1997).

Here, we report on the impact of feral horses on wetland habitats used by the Northern Corroboree Frog (*Pseudophryne pengilleyi*), a species with a highly restricted distribution in montane and sub-alpine regions of protected areas in south eastern NSW and adjacent areas of the ACT. The Northern Corroboree Frog has experienced major declines associated with the introduction of the amphibian disease Chytridiomycosis (Scheele et al. 2017), and is now listed as critically endangered under both NSW and Commonwealth legislation. From early January to mid-March, adults enter bogs and seepages from the surrounding forest to breed (Pengilley 1971, 1973). Males construct and call from terrestrial nests, which are located in the dense matrix of vegetation, moss and/or grass litter (hereafter litter matrix) surrounding the edges of small seasonal pools that are typically dry when eggs are laid (Pengilley 1971, 1973). Northern Corroboree Frogs construct nests in a range of vegetation types where the litter matrix surrounding pools is conducive to male calling activity and embryonic survival (Hunter et al. 2009; Osborne 1990).

Horse exclosure plots were established at eight Northern Corroboree Frog breeding sites in Northern Kosciuszko National Park in 2011. Exclosures prevented entry of horses, but allowed access for smaller herbivores, such as wallabies, wombats and feral pigs. In 2010, prior to plot establishment, and again in 2015, we measured the litter matrix depth inside and outside these exclosures. We focused on the depth of the litter matrix surrounding pools as this represents a critical component of the breeding habitat for the Northern Corroboree Frog. At each site, we collected 10 measurements inside and 10 measurements outside the horse exclosures (giving a total of 80 measurements inside and 80 measurements outside exclosures). In 2015, we also collected depth measurements at an additional three Northern Corroboree Frog breeding sites that were outside the region occupied by horses at the time of sampling, but within the distribution of feral deer and pigs. At each of these horse-free control sites, we established a quadrat the same size as the exclosures at a random point within the site and recorded 10 litter depth measurements within this quadrat using the same methodology as for the exclosure sites.

We used linear mixed models to compare the depth of the litter matrix surrounding pools from sites inside horse exclosures with those outside exclosures. We found that the depth of the litter matrix was strongly affected by the presence of horses (Figure 6), with the litter 1.9 times deeper in areas without horses than in areas accessible to horses. Neither scat nor tracks of feral deer or pigs were observed at the exclosure sites in 2015.

Our results provide clear evidence that the presence of feral horses in Northern Corroboree Frog breeding habitat is associated with a significant reduction in the depth of the litter matrix. In the presence of horses, the depth of the litter matrix was less than the mean nesting depth of Corroboree Frog nests (Scheele 2010). The reduced depth of the litter matrix associated with horse presence could force frogs to construct nests and deposit eggs in shallow nests that are sub-optimal for male calling and have increased risk of egg desiccation (Mitchell 2001). This, in turn, could exacerbate drought impacts and associated reproductive failure (Pengilley 1973; Osborne 1990; Scheele et al. 2012). Under severe grazing pressure, reduced vegetation and litter matrix depth may also prevent the construction of nests altogether.

While the decline of the Northern Corroboree Frog is due primarily to the disease Chytridiomycosis, preventing degradation of its breeding habitat is critical to the long-term future of the species. Captive-breeding populations have been established for the Northern Corroboree Frog, with reintroductions to the wild dependent on the maintenance of high-quality habitats.

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References

Belcher, C. and Leslie, D. (2011) Broad-toothed Rat *Mastacomys fuscus* Distribution in Buccleuch, Bago and Maragle State Forests, NSW. *Australian Zoology* 35: 555–559.

Crane, K. K., Smith, M. A. and Reynolds, D. (1997) Habitat Selection Patterns of Feral Horses in South Central Wyoming. *Journal of Range Management* 50: 374–380. doi:10.2307/4003303.

Dyring, J. (1990) *The Impact of Feral Horses (*Equus caballus*) on Sub-alpine and Montane Environments in Australia*. MAppSc thesis, University of Canberra.

Foster, C. N., Barton, P. S. and Lindenmayer, D. B. (2014) Effects of Large Native Herbivores on Other Animals. *Journal of Applied Ecology* 51: 929–938.

Hunter, D., Osborne, W., Smith, M. J. and McDougall, K. (2009) Breeding Habitat Use and the Future Management of the Critically Endangered Southern Corroboree Frog. *Ecological Management & Restoration* 10(S1): S103–S109.

Mitchell, N. J. (2001) Males Call more from Wetter Nests: Effects of Substrate Water Potential on Reproductive Behaviours of Terrestrial Toadlets. *Proceedings of the Royal Society of London, Series B, Biological Science* 68: 87–93.

Nimmo, D. G. and Miller, K. K. (2007) Ecological and Human Dimensions of Management of Feral Horses in Australia: A Review. *Wildlife Research* 34: 408–417.

Nuñez, M. A., Bailey, J. K. and Schweitzer, J. A. (2010) Population, Community and Ecosystem Effects of Exotic Herbivores: A Growing Global Concern. *Biological Invasions* 12: 297–301.

Osborne, W. (1990) *The Conservation Biology of Pseudophryne Corroboree Moore (*Anura: Myobatrachidae*): A Study of Insular Populations*. PhD thesis, The Australian National University, Canberra.

Pavel, V. (2004) The Impact of Grazing Animals on Nesting Success of Grassland Passerines in Farmland and Natural Habitats: A Field Experiment. *Folia Zoologica* 53(2): 171–178.

Pengilley, R. (1971) The Food of Some Australian Anurans (Amphibia). *Journal of Zoology* 163: 93–103.

Pengilley, R. (1973) Breeding Biology of Some Species of *Pseudophryne*. *Australian Zoology* 18: 15–30.

Prober, S. and Thiele, K. (2007) *Assessment of Impacts of Feral Horses (*Equus caballus*) in the Australian Alps*. Report to Parks Victoria, Melbourne.

Rogers, G. M. (1991) Kaimanawa Feral Horses and their Environmental Impacts. *New Zealand Journal of Ecology* 15: 49–64.

Scheele, B. C. (2010) *Climate Drying causes the Rapid Decline of a Threatened Frog Species in South-eastern Australia*. Honours thesis, The Australian National University, Canberra.

Scheele, B. C., Driscoll, D., Fischer, J. and Hunter, D. (2012) Decline of an Endangered Amphibian during an Extreme Climatic Event. *Ecosphere* 3(11): 1–15. https://doi.org/10.1890/ES12-00108.1

Scheele, B. C., Hunter, D. A., Brannelly, L. A., Skerratt, L. F. and Driscoll, D. A. (2017) Reservoir-host Amplification of Disease Impact in an Endangered Amphibian. *Conservation Biology* 31: 592–600.

Suominen, O. and Danell, K. (2006). Effects of Large Herbivores on Other Fauna. In K. Danell, R. O. Bergstom, P. Duncan and J. Pastor (eds), *Large Herbivore Ecology, Ecosystem Dynamics and Conservation,* pp. 383–412. Cambridge University Press, Cambridge.

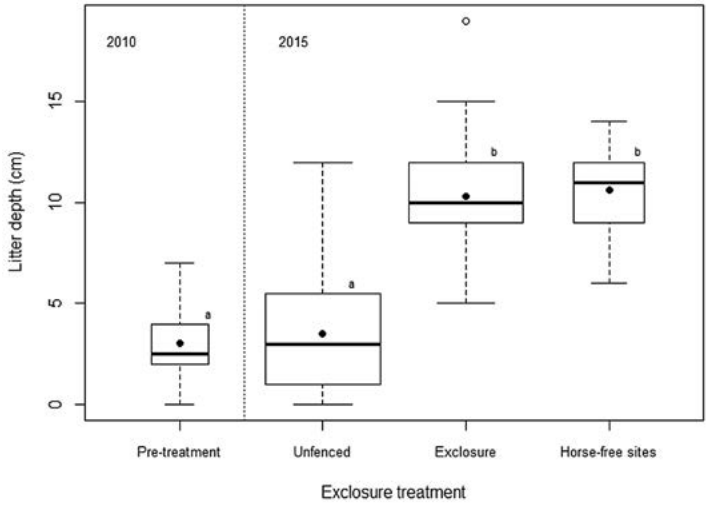


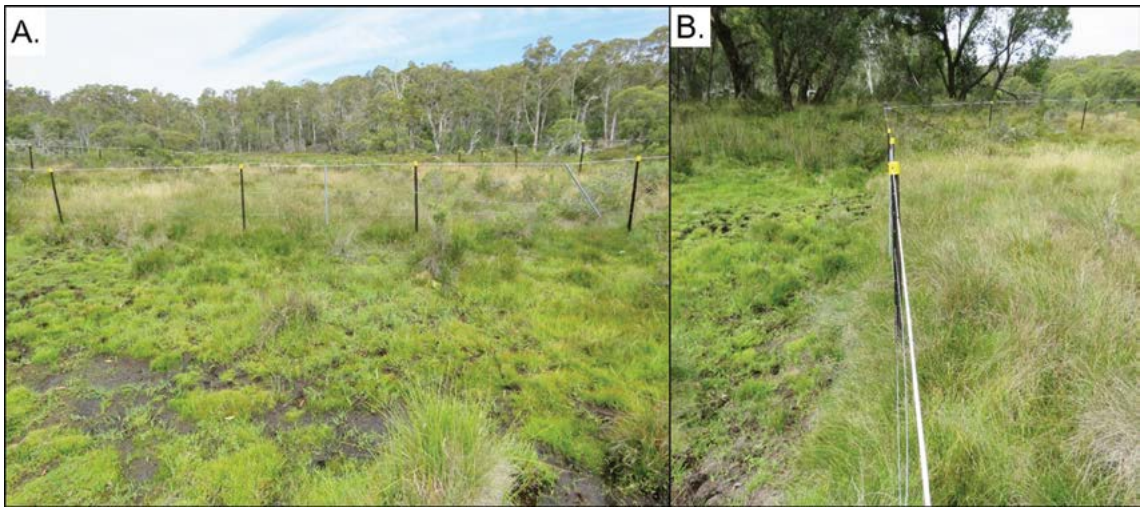
Figure 6. Difference in litter matrix depth among the horse exclosure treatments.

Boxplot widths are proportional to sample size. Boxplots show median, 25th and 75th quantiles, and range (whiskers). Solid points show group mean. Different letters indicate significant differences in mean depth using Tukey post-hoc tests at $p<0.05$.

Male Northern Corroboree Frog (*Pseudophryne pengilleyi*) in breeding habitat.

Corroboree Frogs breed in terrestrial nests that they construct in the litter matrix found above the mineral soil.

Source: Rohan Bilney.



Horse exclosure fence constructed at a Northern Corroboree Frog (*Pseudophryne pengilleyi*) breeding site, 2018.

Photo B shows the same fence line featured in photo A. Both photos show damage to wetland habitat associated with horse presence, including trampling, pugging and substantial reductions in the depth of the litter matrix.

Source: Ben Scheele.