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Feral Horses and Their Environmental Impacts in the Australian Alps: Policy and Management Priorities

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Feral horses (*Equus caballus*) are listed as a Key Threatening Process (KTP) under federal and state conservation policies, leading to active state government management programs aimed at reducing feral horse populations in ecologically sensitive regions (Tables 1 and 2). Program and expert reporting shows benefits for water, vegetation, soil, waterbirds and native fish from horse removal in these systems (Rowland, Moore, and Walsh 2023; Just et al. 2025). The NSW Government's Kosciuszko Wild Horse Heritage Act 2018 diverges from the policies of other States, and conflicts with the NSW KTP listing, by mandating retention of 3000 horses in one third of Kosciuszko National Park. This is despite extensive scientific evidence of the environmental harm caused by feral horses in Kosciuszko National Park, across other alpine, subalpine and riverine regions (Figure 1), and in other ecosystems (Nimmo and Miller 2007; Driscoll et al. 2019; Stobo-Wilson et al. 2020).

The key environmental impacts of feral horses in alpine and subalpine ecosystems are:

1. **Ecosystem Disturbance:** Feral horses degrade ecosystems and change landscape hydrology (Eldridge et al. 2019; Scanes et al. 2021; Ward-Jones et al. 2019; Wilson et al. 2022). Impacts accumulate in alpine and subalpine wetlands and peatlands even at low horse densities (<1/3 horse/km^2; Driscoll et al. 2019; Tolsma and Shannon 2018); higher densities have more severe impacts (Berman et al. 2023).
2. **Vegetation Changes**: High horse activity reduces vegetation height, lowers foliage density, increases weed diversity and cover, and creates bare ground (Hartley et al. 2022; Porfirio et al. 2017; Driscoll et al. 2019).
3. **Soil Changes:** Horse activity increases soil runoff and acidity, and disrupts soil nutrient accumulation (Rowland and Lovelock 2024). Soil temperature and compaction increase, and soil moisture decreases when feral horses are present (Treby and Grover 2023).
4. **Hydrological Degradation**: Horses frequently access waterways, eroding streambanks, impacting water flow, increasing stream turbidity and damaging riparian vegetation (Robertson et al. 2019; Scanes et al. 2021; Treby and Grover 2023). Turbidity levels sometimes exceed national guidelines by up to 50 times, impacting aquatic fauna including threatened galaxiid fish (Allan and Lintermans 2018).
5. **Carbon Cycle Damage:** Sensitive *Sphagnum* peatlands, crucial for carbon storage, are trampled and compacted by horses. This increases CO_2 emissions and reduces carbon-to-nitrogen soil ratios, contributing to climate change (Rowland and Lovelock 2024; Treby and Grover 2023, 2024; Treby and Carnell 2023).
6. **Threatened Species Declines**: Vegetation damage by feral horses was responsible for the extinction of local populations of the threatened broad-toothed rat (*Mastacomys*

Summary

- Feral horses cause extensive ecological harm, including damage to soil, waterways, vegetation, and the carbon cycle, leading to declines in threatened species.
- While most Australian states pursue population reduction or removal, NSW's Kosciuszko Wild Horse Heritage Act mandates retention of horses in parts of Kosciuszko National Park, contradicting scientific consensus and national conservation policies.
- Scientific evidence strongly supports complete removal of feral horses from sensitive alpine and subalpine ecosystems, as fencing and local exclusion are insufficient.
- Effective protection and restoration of damaged alpine ecosystems requires coordinated management of all invasive species, evidence-based public communication, and legislative support.

fuscus), and declines in the abundance and distribution of other threatened plants and animals (Cherubin et al. 2019; Foster and Scheele 2019; Schulz et al. 2019).

1 | Policy and Management Recommendations

Complete removal via culling of feral horses from threatened alpine and subalpine ecosystems, including peatlands and wetlands, is recommended (Beeton and Johnson 2019). Excluding horses from sensitive locations (e.g., through fencing), or using fertility control methods, is insufficient for preserving ecological function and connectivity of sensitive ecosystems such as alpine peatlands and wetlands (Driscoll et al. 2019; Hobbs and Hinds 2018).

Horse control must be coordinated with integrated fire and pest management strategies addressing other invasive herbivores and omnivores, weeds and invasive predators (Keith et al. 2022;

TABLE 1 | Evidence base for the effects of feral horses on Australian biodiversity, ecosystem services and society.

Full reference	Key results
Hartley, R., Blanchard, W., Schroder, M., Lindenmayer, D. B., Sato, C., & Scheele, B. C. (2022). Exotic herbivores dominate Australian high-elevation grasslands. Conservation Science and Practice, 4(2), e601.	1. Greater horse (exotic) activity associated with lower vegetation height, lower foliage density, higher forb cover, higher weed cover, and higher soil compaction 2. Native herbivores (kangaroos and wallabies) had no effect on vegetation 3. Exotic herbivores detected at 94% of sites. Total herbivore activity was primarily attributed to exotic herbivores and was associated with elevation and grassland type. Rabbits & hares most prevalent (85% of sites), followed by horses (42% of sites) 4. Probability of horse presence increased as elevation decreased and as distance to water increased
Newsome, T., Spencer, E., Cairncross, R., Fust, C., Vandersteen, J., & Barton, P. (2024). A call to further understand the role of carrion in food webs: a case study of the Australian Alps. Australian Zoologist, 43(4), 574–587.	1. Vertebrate scavenging rates are relatively low in the Australian Alps compared to other bioregions in Australia, and carcasses in this system can become hotspots for introduced species like European wasps (*Vespula germanica*), red foxes (*Vulpes vulpes*), and feral pigs (*Sus scrofa*) 2. Horse carcass monitoring revealed that dead horses attract large apex scavengers (dingoes and wedge-tailed eagles), an invasive predator (red fox) and bird scavengers (corvids). Carcasses are rapidly removed
Pickering, C. M., & Norman, P. (2020). Assessing discourses about controversial environmental management issues on social media: Tweeting about wild horses in a national park. Journal of Environmental Management, 275, 111244.	1. Issue of horse management in Kosciuszko National Park was a common topic in 2085 Tweets mentioning the Park made between 2018 and 2019, with 56% of the Tweets referring either to horses (44.8%) and or brumbies (14.7%) 2. Public sentiments towards horses ranged from strongly positive to strongly negative. Public discourse on Twitter about Kosciuszko National Park mainly focused on a controversial issue common to many parks: how best to manage large mammals with often highly divergent attitudes within the community 3. Despite considerable polarisation in the broader debate, including in the traditional media and on other social media platforms, the discourse on Twitter focused mainly on the environmental impacts of horses, and ways to reduce their numbers, rather than wanting to keep horses in the Park

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TABLE 1 | (Continued)

Full reference	Key results
Rowland, J. A., Moore, J. L., & Walsh, J. C. (2023a). How expert insight into alpine peatland conservation complements global scientific evidence. Conservation Biology, 37(3), e14081.	1. Experts identified 15 interventions used to conserve Australian peatlands, most of which enhanced or restored peatland condition and effectively addressed diverse threats 2. Grazing control identified as very effective for reducing threats to the Australian alpine and subalpine peatland ecosystem, restoring hydrology and recovering vegetation: Permanently excluding introduced herbivores (via regulation, fencing, or both) identified as somewhat to very effective at reducing populations of horses, cattle, and deer on alpine peatland and allowing native vegetation and hydrology to recover. Ecosystem recovery rates vary with the level of damage and can be hindered by wildfire or if grazing pressure was replaced by other, nontargeted introduced herbivore species 3. Feral introduced herbivores have been successfully managed by reducing the population density through shooting, and trapping and removal, although trapping is very expensive. The effectiveness of population reduction programs varies depending on whether there is sustained control to keep populations low across all introduced species 4. Effectiveness of biosecurity protocols in ACT, Tasmania and NSW limited by horse movements—biosecurity actions may be mostly futile in areas where horses and deer move freely between peatlands and spread pathogens including amphibian chytrid fungus and the aquatic fish virus EHN (Epizootic haematopoietic necrosis) 5. Effectiveness of regulations to reduce populations of feral introduced herbivores depends on scope of the policy to reduce the size of the population. In the Australian Capital Territory, enough (effectively all) feral horses were removed resulting in a reduction in trampling damage, yet recovering peatlands had very low tolerance to new invasions. In New South Wales, where horse control is controversial, number of horses removed was insufficient to protect the ecosystem from degradation or to prevent increases in horse populations
Rowland, J. A., Walsh, J. C., Beitzel, M., Brawata, R., Brown, D., Chalmers, L., ... & Moore, J. L. (2023b). Setting research priorities for effective management of a threatened ecosystem: Australian alpine and subalpine peatland. Conservation Science and Practice, 5(3), e12891.	1. Experts agreed that feral ungulate (horses, deer) populations cannot easily be eliminated from alpine regions using fencing or regulations but require population control. Given extensive degradation caused by exotic herbivores, experts identified need to evaluate options to reduce abundance of species that are hard to eradicate or effectively control (horses, deer) as current approaches are insufficient 2. Social acceptability of culling horses is a challenge where jurisdictions have varied influence to reduce populations due to pressure from advocacy groups. Peatlands have multiple user groups with differing interests (e.g., Indigenous culture, conservation, recreation, water harvesting, livestock grazing), representing a significant management challenge to avoid conflicts 3. A roadblock for peatland conservation identified by experts was the limited public and political support for the management of important threats, particularly cattle grazing and feral horses (Williams, 2019)

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Full reference	Key results
Rowland, P. I., & Lovelock, C. E. (2024). Global impacts of introduced ungulates on wetland carbon and biodiversity: A review. Biological Conservation, 290, 110432.	1. Highest numbers of global impacts on carbon storage and biodiversity in wetlands were from cattle (29%), followed by pigs (19%), and horses (13%) 2. Over 50% of global studies reported impacts from ungulate species on freshwater wetlands. Within Australia, the most reported ungulate impacts on the carbon storage and biodiversity of wetlands were from unmanaged introduced pigs (21%), followed by cattle (20%), buffalo (14%), and horses (12%) 3. Global riparian environments were most frequently affected by cattle, horses, and pigs respectively. Australian riparian habitats were most frequently impacted by cattle (52%), pigs (15%), horses (12%), and sheep (12%) 4. Reported impacts from introduced horses were similar to negative impacts of cattle, though horses are generally more active and graze more intensively. Impacts include: Soil compaction and erosion (increased runoff, increased acidity, disruption of vertical accretion processes that accumulate soil carbon; decreased resilience to climate change and storm damage); habitat and population declines for native birds, amphibians, reptiles and mammals; Altered vegetation community composition (weed dispersal, reduced species richness); Trampling and overgrazing of vegetation (including reduced aboveground biomass); Altered water systems (Widening and shallowing of water channels; increased turbidity, increased nutrient load + eutrophication, bacterial contamination of waterway, reduction in dissolved oxygen, accelerated drying of pools, degradation of downstream environments) 5. More studies reported soil damage, weed dispersal, decreased vegetation cover, and woody vegetation suppression than neutral or positive changes in these metrics. Decreases in richness and abundance of native flora and fauna were more frequently reported than increases. Of 33 studies reporting wetland carbon impacts, 24 reported increased CO_2 emissions due to loss of soil carbon or vegetation biomass
Scanes, P. R., McSorley, A., & Dickson, A. (2021). Feral horses (*Equus caballus*) increase suspended sediment in subalpine streams. Marine and Freshwater Research, 72(9), 1290–1302.	1. Feral horses preferentially utilise aquatic landscape elements. Over a 10-week period in summer, horses were responsible for 99.9% of large grazer interactions with streams. Results provide no support for the idea that other herbivores such as deer and pigs cause riparian damage or suspended sediment 2. Horse interactions with streams led directly to increased turbidity. Turbidity and damage to riparian vegetation and bank and stream morphology proportional to horse activity. Main forms of damage: close grazing of riparian grasses, crushing and pugging of banks and erosion at crossing points. Horse activity not evenly distributed within riparian strips. Horses tend to follow defined tracks and when these lead to established stream crossing points, it concentrates impacts. In heavily used areas, crossings and access points can occur every 5–10 m for extended lengths of stream bank 3. Long-term turbidity in horse-affected streams peaked at up to 50 times the national guideline value, and in summer months average turbidity was eight times greater than the guideline value. Horse interactions (as indicated by turbidity) most intense in summer and autumn and least intense in winter 4. The risk of ecological harm from horse-related stream turbidity and associated deposited sediments is very high. Re-suspension by intense or prolonged horse activity can result in high (0.90 NTU) and prolonged (up to 6 h) turbidity that can affect long distances downstream. These events were common in the logged turbidity at horse-affected sites and contributed to the significantly greater seasonal elevation of turbidity

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TABLE 1 | (Continued)

Full reference	Key results
Treby, S., & Grover, S. P. (2023). Carbon emissions from Australian Sphagnum peatlands increase with feral horse (*Equus caballus*) presence. Journal of Environmental Management, 347, 119034.	1. Average site condition significantly lower at sites with feral horses present than at sites without horses. Differences in peatland condition between horse-present and horse-absent sites cannot be attributed to the presence of deer and/or pigs (equal evidence of pig and deer presence between sites with and without feral horses) 2. Carbon dioxide emissions significantly higher at sites with feral horses than at sites without horses. No significant difference in methane emissions between sites with or without feral horses. Daytime 20-year sustained global warming potential of peatlands ($CO_2 + CH_4$) significantly higher at sites with feral horses present. Horse presence/absence stronger driver of CO_2 fluxes than any other environmental variables (i.e., site condition, elevation, soil water content, soil temperature, pH) 3. Soil bulk density, electrical conductivity and soil temperature significantly higher at sites with feral horses present. Soil water content significantly lower at sites with feral horses present. No effect of feral horses on peat depth 4. Water temperature, EC, pH, and turbidity significantly higher at sites with horses present. Water depth and dissolved oxygen (DO) did not differ significantly between sites where feral horses present or absent
Treby, S., & Grover, S. P. (2024). Carbon and nitrogen storage in Australian Sphagnum peatlands: The influence of feral horse degradation. Journal of Environmental Management, 359, 121049.	1. Soil carbon (C) significantly higher at sites without horses. Impacts of horses higher in bare soil sites compared to Sphagnum-dominated sites. Soil nitrogen (N) significantly lower at sites without horses. Soil C:N ratios significantly higher at sites without horses than at sites with horses 2. Significant positive relationship between site condition and peat carbon concentrations. Suggests that degradation of peatlands by feral horses significantly impacts long-term carbon storage in these ecosystems, dependent upon the level of grazing and trampling damage
Wilson, B. R., Tulau, M., Kuginis, L., McInnes-Clarke, S., Grover, S., Milford, H., & Jenkins, B. R. (2022). Distribution, nature and threats to soils of the Australian Alps: a review. Austral Ecology, 47(2), 166–188.	1. Negative impacts of feral horses have been well documented in both the NSW and Victorian Alps, and include erosion and pollution from trampling, pugging, grazing, track creation, collapsing stream banks and incision of wetlands and streams 2. Peat soils are particularly susceptible to damage by horses, causing channelised flow, degrading water-storing capacity and redistributing nutrients. Extensively damaged bog communities could take millennia to recover 3. Alpine humus soils and transitional alpine humus soils are susceptible to damage by horses due to loss of surface litter and cryptogams, increased compaction and reduced aeration, water infiltration, pore space and soil water 4. Horse faeces and urine contain high concentrations of N and P and the addition of manure can lead to local nutrient hotspots along tracks and trails. In areas of high horse densities, nutrients can affect vegetation, favouring species adapted to higher nutrients leading to the potential proliferation of weed species 5. Soil disturbance by hooved animals can create conditions suitable for pathogen invasion, and soil movement has been implicated in transferring *Phytophthora cinnamomi* and associated root pathogens from infected to non-infected areas

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Full reference	Key results
Keith, D. A., Allen, S. P., Gallagher, R. V., Mackenzie, B. D., Auld, T. D., Barrett, S., ... & Tozer, M. G. (2022). Fire-related threats and transformational change in Australian ecosystems. Global Ecology and Biogeography, 31(10), 2070–2084.	1. Herbivores may concentrate in post-fire regrowth to exploit foraging resources, limiting survival and growth of post-fire seedlings and resprouts. They may also degrade ecosystem function by reducing plant biomass and litter and disrupting soil structure and these effects are likely exacerbated by fire 2. The most pervasive introduced herbivores in locations burnt by the 2019/2020 Australian wildfires were rabbits and deer, although horses and pigs were locally important
Just, K., Bennetts, K., & Wright, T. (2025). The Living Murray Barmah-Millewa Wetland Vegetation Condition Monitoring 2024 Annual Report. Consultant report to Goulburn Broken Catchment Management Authority, Shepparton. Murray-Darling Basin Authority (2025). Barmah–Millewa Forest Report Card 2023–24. Report by the Australian Government Murray-Darling Basin Authority.	1. Barmah Forest is a Ramsar listed wetland complex in the Murray–Darling Basin of Australia, indicating it has global significance. Declines in the cover and condition of Moira grass (Pseudoraphis spinescens) plains in the Murray-Darling Basin have been significant and were attributed to a combination of horse grazing and inadequate environment water management. In recent years, these declines threatened to impact the forest's Ramsar listing 2. There has been substantial grazing pressure in the past from feral horses in the forest. Flooding and active management of horses (largely through ground shooting) throughout the region in 2022 and 2023 has reduced the feral horse population 3. Increase in Pseudoraphis spinescens (Moira Grass) cover at the Steamer Plain monitoring sites over the two years from <0.01 to $10.01\,m^2$ reflects the reduction of feral horses
Treby, S., & Carnell, P. (2023). Impacts of feral grazers and unseasonal summer flooding on floodplain carbon dynamics: A case study. Ecohydrology & Hydrobiology, 23(2), 186–197.	1. Feral herbivore exclusion did not result in any significant changes in soil bulk density, nitrogen concentration or carbon concentration 2. There was a reversal trend in the top 1 cm of soil following feral herbivore exclusion, indicating a shift in soil condition in recent history 3. In the surface horizon, soil nitrogen and carbon concentrations were slightly higher in the fenced zone than in the unfenced zone, while bulk density was slightly lower 4. Effectiveness of grazing removal for enhancing the carbon sink potential of wetlands was not evident. Higher CO_2 emissions corresponding to feral herbivore exclusion at Little Rushy Swamp are most likely the result of increased plant respiration where Pseudoraphis spinescens biomass has increased following the reduction of grazing and trampling
Stobo-Wilson, A. M., Stokeld, D., Einoder, L. D., Davies, H. F., Fisher, A., Hill, B. M., ... & Gillespie, G. R. (2020). Bottom-up and top-down processes influence contemporary patterns of mammal species richness in Australia's monsoonal tropics. Biological Conservation, 247, 108638.	1. A broad suite of large feral herbivores (including swamp buffalo [*Bubalus bubalis*], banteng [*Bos javanicus*], horse [*Equus caballus*], cattle [*Bos indicus*], donkey [*Equus asinus*] and rusa deer [*Cervus timorensis*], ordered from most- to least-frequently detected), at a landscape-scale, are negatively affecting populations of small native mammals in monsoonal northern Australia, with such impacts more substantial than previously recognised. The impact of feral herbivores is particularly important considering the uncontrolled, and relatively high abundance of these species in a number of regions, including conservation reserves 2. As feral herbivore abundance increased, species richness of small mammals decreased. Feral herbivore abundance and feral cat occupancy had the strongest influence on site-based species richness from all possible predictors, with all but two species (common brushtail possum and *Sminthopsis* spp.) declined with increasing herbivore abundance

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Full reference	Key results
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, 2023: e01107.	1. Evidence of feral horse grazing or trampling detected at all sites where horse faeces detected 2. Impacts concentrated in particular locations rather than spread throughout entire region: proportion of all sampled areas with actual horse impact low (< 1%) on BHP and low (< 18%) in EVA. E.g., horse paths, which compact soil and damage or remove vegetation. Paths running along drainage lines can disturb stream banks and streamflow. Observed examples of what appears to be severe impact where paths crossed streams (gully erosion and churned-up mud)-impacts were very localised 3. Impacts from feral horses related to densities: higher densities lead to more severe impacts on vegetation and soil disturbance 4. Threshold of horse impact at ~250 horse faecal piles per ha. Above this threshold, a slight increase in horse density results in a disproportionately large increase in impacts (grazing and trampling of vegetation, stream bank and soil disturbance)
Allan H., & Lintermans M. (2018). The threat from feral horses to a critically endangered fish. In: G. L. Worboys, D. A. Driscoll, and P. Crabb (eds.), Feral Horse Impacts: The Kosciuszko Science Conference (pp. 88–89). Australian Academy of Science; The Australian National University; Fenner School of Environment and Society; and Deakin University, Canberra.	1. "Wild horses are abundant in the Tantangara area and establish/use well-worn trails throughout the Tantangara Creek catchment. These trails commonly cross Tantangara Creek where Stocky Galaxias is found. At such crossings, bankside vegetation is largely absent, bank structure is damaged, the stream is wide and shallow, and fine gravels and silt have filled an otherwise boulder- and cobble-dominated substrate." 2. "Observations downstream of horse crossings show accumulations of fine sediment, almost certainly mobilised by horse damage (pugging, trampling, bank slumping, runoff from trails). These sediment accumulations are generally less severe or absent in areas further downstream, or immediately upstream of crossings. The extremely small current distribution of Stocky Galaxias magnifies the importance of instream and riparian habitat degradation from feral horses." 3. "rocky substrates and clean spaces between stones appear important for Stocky Galaxias spawning. Sedimentation reduces available spawning habitat and can smother and kill fish eggs. The long incubation time of Stocky Galaxias eggs means the species is particularly vulnerable to sedimentation. Direct damage by horse trampling could also impact egg and larvae survival."
Bates, H., 2018. Indirect impacts of the feral horse on the mountain pygmy-possum. In: G. L. Worboys, D. Driscoll, and P. Crabb (eds.), Feral Horse Impacts: The Kosciuszko Science Conference—Conference Abstracts. 2018. Australian Academy of Science, The Australian National University and Deakin University Canberra, pp. p76–p78.	Feral horses are currently not abundant around areas of Mountain Pygmy-possum habitat. However, they have been seen grazing among boulder-fields and feeding on sedges in lakes on the western fall of Mt. Kosciuszko, on the Summit Road habitat site 2 km from Charlotte Pass and at Dead Horse Gap. Horse presence (dung heaps) is evident around the Rough Creek habitat site in Northern Kosciuszko National Park. Expansion of horse numbers throughout the alpine area and parts of the Jagungal Wilderness Area (e.g., Gungartan) can be expected without effective control, particularly with continuing climate change–induced droughts. Resulting impacts include trampling of alpine shrubs and sedimentation of streams, evident where horses are currently abundant. This is likely to cause loss of food resources and enhancement of feral predator impacts through reduced cover and creation of trails in summer and disruption of the subnivean space in winter

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Full reference	Key results
Beeton, N. J., & Johnson, C. N. (2019). Modelling horse management in the Australian Alps. Ecological Management and Restoration, 20(1), 57–62.	1. Mustering is always less cost-effective and more expensive per animal than aerial culling 2. Aerial culling always produces the best outcomes in terms of reducing final population numbers and cost-effectiveness of management. In all simulation scenarios, "no management" results in the highest final population of feral horses, followed by trapping and mustering, then aerial culling in Victoria, then VIC & NSW aerial culling with the lowest final populations of feral horses
Cairns, S. (2019). Feral Horses in the Australian Alps: the Analysis of Aerial Surveys Conducted in April–May, 2014 and April–May 2019.	1. The number of horses in the North Kosciusko block increased significantly from 3255 in 2014 to 15 687 in 2019. Overall annual finite rate of population increase was 1.370, or 37%. 2. Across all survey sites (North Kosciusko, Byado-Victoria and Bago-Maragle blocks, 2860 km^2), the total number of feral horses was 9187 in 2014 and 25 318 in 2019. Overall annual finite rate of population increase was 1.225, or 23%. 3. Feral horse density to between 6.84 and 13.88 horses km^2 (average 10.13) in North Kosciusko grasslands and open woodlands, and between 0.98 and 3.31 horses km^2 in medium terrain woodlands across all study blocks. Feral horse population in the North Kosciuszko block has a doubling time of 2.20 years.
Cherubin, R. C., Venn, S. E., Driscoll, D. A., Doherty, T. S., & Ritchie, E. G. (2019). Feral horse impacts on threatened plants and animals in subalpine and montane environments in Victoria, Australia. Ecological Management and Restoration, 20(1), 47–56.	Feral horses associated with vegetation types and characteristics that negatively influence the presence or abundance of Alpine Water Skink and Broad-toothed Rat. Sites with high horse activity had more low-growing forbs, and the abundance of Alpine Water Skink was negatively related to this vegetation type. Grasses, sedges, rushes and shrubs were also less dense and lower in height in high horse activity sites, and Broad-toothed Rat was less likely to be present in areas with these habitat attributes
de Bie K., & Vesk P. A. (2014). Ecological indicators for assessing management effectiveness: a case study of horse riding in an Alpine National Park. Ecological Management and Restoration 15, 215–221.	There were significant differences in the amount of bare ground, the height of shrubs and ground layer vegetation, and shrub cover between track and control plots in 2001. Ten years later, track plots were recovering with reductions in bare ground and changes in vegetation, with improved ground layer vegetation height. Results show that vegetation condition has improved with restrictions of horse numbers
Driscoll, D. A., Worboys, G. L., Allan, H., Banks, S. C., Beeton, N. J., Cherubin, R. C., Doherty, T. S., Finlayson, C. M., Green, K., Hartley, R., Hope, G., Johnson, C. N., Lintermans, M., Mackey, B., Paull, D. J., Pittock, J., Porfirio, L. L., Ritchie, E. G., Sato, C. F., Scheele, B. C., Slattery, D. A., Venn, S., Watson, D., Watson, M., & Williams, R. M. (2019). Impacts of feral horses in the Australian Alps and evidence-based solutions. Ecological Management and Restoration, 20: 63–72. doi:10.1111/emr.12357	New evidence indicates that feral horses in Australia's alpine parks systems endanger threatened species and damage critically endangered bog communities that could take millennia to recover. These impacts are not confounded by effects of deer and accumulate over time, even when only a small number of feral horses (~100) are present. Trapping alone does not control feral horse numbers. Aerial culling is needed to cost-effectively and humanely control feral horses. The relatively small amount of suffering feral horses experience during a cull is outweighed by (i) avoiding suffering and death of horses from starvation and thirst, (ii) avoiding the suffering of native animals displaced by horses and (iii) avoiding the ethical concerns of driving threatened species towards extinction. As a result of ineffective management, horse populations are now expanding and causing well-documented damage to Australia's alpine parks, placing at risk almost $10 M spent on restoration after livestock grazing ended

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TABLE 1 | (Continued)

Full reference	Key results
Eldridge, D. J., Ding, J., & Travers, S. K. (2020). Feral horse activity reduces environmental quality in ecosystems globally. Biological Conservation, 241, 108367.	Across all countries around the globe that have researched feral horse impacts: 1. Feral horse activity leads to substantial, non-trivial reductions in ecosystem functions and biomass—on average, 19% reduction in ecosystem function, 31% decline in litter levels, 25% decline in plant biomass, highly variable declines in composition (5%) and structure (8%). Reductions in plant biomass, height and structure resulting from increasing horse activity could lead to a number of potential outcomes such as: (1) alteration to plant cover, richness and composition (Lopez et al., 2017); (2) reduced vegetation structure and therefore habitat quality, which has been shown to alter ant community composition, (3) reduced capacity for production of litter and organic matter, and thus increased soil erosion risk, and (4) reduced organic matter inputs into the soil, with feedback effects on soil biota, microbially-mediated decomposition and therefore soil nutrient pools 2. Feral horse activity increases erosion risk—on average, 31% increase in soil erosion. Feral horses increased erosion by pugging and streambed widening in riparian areas. Impacts highly variable and vary with factors such as vegetation type, density, soil properties, slope and level of utilisation 3. Possible positive effects of low grazing activity (as found elsewhere for cattle and African systems where ungulates have co-evolved with ecosystems) are unlikely in continents that lack native hard-hoofed ungulates such as Australia
Eldridge, D. J., Travers, S. K., Val, J., Zaja, A., & Veblen, K. E. (2019). Horse activity is associated with degraded subalpine grassland structure and reduced habitat for a threatened rodent. Rangeland Ecology & Management, 72(3), 467–473.	1. Quadrats showing no evidence of horse activity had longer broad-toothed rat runways, taller but fewer grasses, double the shrub cover, and lower plant richness than quadrats showing evidence of horse activity 2. Structural equation modelling showed no significant direct associations between horse activity and rat activity 3. Horses have an indirect negative effect on broad-toothed rat habitat by reducing grass height and altering plant species richness 4. Other herbivores (rabbits, kangaroos) are not responsible for differences in broad-toothed rats across grazed and ungrazed habitats. There were no significant effects of rabbits on any environmental variables, and kangaroo grazing was associated with an increase in shrub cover only
Foster, C. N., & Scheele, B. C. (2019). Feral-horse impacts on corroboree frog habitat in the Australian Alps. Wildlife Research, 46(2), 184–190.	1. Depth of leaf litter in wetlands significantly affected by the presence of feral horses 2. Pool-edge litter 1.9 times deeper in areas without horses (inside horse-exclosure plots and horse-free sites) than in areas accessible to horses (unfenced areas in horse-occupied sites)
Good, R., & Johnston, S. (2019). Rehabilitation and revegetation of the Kosciuszko summit area, following the removal of grazing–An historic review. Ecological Management and Restoration, 20(1), 13–20.	"... the landscape was once degraded and severely eroded, devoid of many of the natural catchment values so important to the discharge of water to the rivers and to the Snowy Mountains Hydro-electric Scheme. The rehabilitation of the alpine zone has contributed to and seen the recovery of many native species and communities, some nearing extinction during the grazing years, such that their conservation will be forever ensured."

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TABLE 1 | (Continued)

Full reference	Key results
Hobbs R. J., & Hinds L. A. (2018). Could current fertility control methods be effective for landscape-scale management of populations of wild horses (*Equus caballus*) in Australia? Wildlife Research 45, 195–207.	"Throughout Australia, populations of wild horses are dispersed over large areas, in varied and difficult-to-access terrain and vegetation. Moreover, horse herds are open to immigration and introductions from neighbouring populations, making them poor choices for the successful application of currently available fertility-control agents. Applied alone, fertility control will not reduce horse numbers within 10 years and will not effectively halt population growth unless enough mares within those populations are treated concurrently and every 2–4 years in relation to the contraceptive used and to the duration of infertility induced by the specific contraceptives."
Hope G. (2018). Feral horse damage to soft terrain: bogs and fens in the Snowy Mountains. In: G. L. Worboys, D. A. Driscoll, and P. Crabb (eds.), Feral Horse Impacts: The Kosciuszko Science Conference (pp. 54–56). Australian Academy of Science; The Australian National University; Fenner School of Environment and Society; and Deakin University, Canberra.	"Examples of stream widening, incision of peatlands, pugged peat and drying peat at risk from fire have been described in all areas of horse occurrence in Kosciuszko National Park. Soft moss hummocks that are key to raised water tables are readily destroyed by trampling, thus losing the mosaic of small pools that are essential to frog breeding success. During drier periods, the soft sedges of fens are grazed and horse trackways become drainage lines that concentrate flows."
Nimmo, D. G., & Miller, K. K. (2007). Ecological and human dimensions of management of feral horses in Australia: a review. Wildlife Research, 34(5), 408–417.	The review found that documented environmental effects of feral horses include: • soil loss, compaction and erosion • trampling of vegetation • reducing plant species richness • inducing mortality of native trees through bark chewing • damage to bog habitat • damage to water bodies • facilitation of weed invasion • altering community composition of birds, fish, crabs, small mammals, reptiles and ants
Porfirio, L. L., Lefroy, T., Hugh, S., & Mackey, B. (2017). Monitoring the impact of feral horses on vegetation condition using remotely sensed fPAR: A case study in Australia's Alpine Parks. Parks, 27.	1. Presence of feral horses is correlated with reduced condition of natural treeless drainage systems (riparian areas and wetlands) in the Australian Alps 2. Significant differences in field-monitored Landscape Function Analysis (LFA- uses indicators to assess the status of biotic and abiotic processes that retain water and nutrients) index between sites where horses were present or absent. Vegetation condition was lower in sites with feral horses 3. Significant differences in remotely-sensed fraction of photosynthetic active radiation (fPAR—a measure of vegetation cover and productivity) between sites where horses were present or absent. Sites with presence of horses have 10% lower fPAR than sites with absence of horses 4. Significant correlation between field-based and remotely-sensed condition assessments
Prober, S. M., & Thiele, K. R. (2007). Assessment of Impacts of Feral Horses (*Equus caballus*) in the Australian Alps: An experimental monitoring program in the Cobberas-Tingaringy Unit of the Alpine National Park: Progress 1999 to 2005. Unpublished report to Parks Victoria.	The differences between exclosures were significant for vegetation height, stream depth and stream pugging, with feral-horses excluded plots having increased vegetation height, stream depth, and pugging. At a fine-scale, unfenced plots had higher overall plant species richness. Exclusion of horses had no effect on weed cover or richness

(Continues)

TABLE 1 | (Continued)

Full reference	Key results
Robertson, G., Wright, J., Brown, D., Yuen, K., & Tongway, D. (2019). An assessment of feral horse impacts on treeless drainage lines in the Australian Alps. Ecological Management and Restoration, 20: 21–30.	1. Significant differences among horse-occupied and horse-free sites for all nine indicators of soil and stream stability assessed 2. For all soil and stream stability indicators assessed (including nutrient pollution, streambank stability, stream depth, siltation, and pugging), the average score and environmental condition was worse in horse-occupied areas. Sites in poorest condition were occupied by horses 3. No significant differences among horse-occupied and horse-free sites in projected foliage cover 4. Horses predominant cause of differences between sites—other mammalian herbivores species (wombats, macropods, and feral goats, rabbits, pigs and deer) had only minor impacts on alpine ecosystems
Schulz, M., Schroder, M., & Green, K. (2019). The occurrence of the Broad? toothed Rat *Mastacomys fuscus* in relation to feral Horse impacts. Ecological Management and Restoration, 20(1), 31–36.	1. Significant negative relationship between feral horse impacts and both Broad-toothed Rat presence and abundance 2. No rat scats were identified at localities where feral horse impacts were severe, and 34% of moderate horse impact sites had no rat scats 3. Sites with low horse impacts had little impact on Broadtoothed Rat occurrence 4. The decline in occupancy with increasing horse impacts suggests that feral horse impacts drive local population extinctions of Broad-toothed Rats 5. Declines in Broad-tooted Rat come about because Rat depends on dense vegetation cover in winter for insulation and to form subnivean space beneath the snow pack to allow for foraging. Loss of cover through grazing and trampling damages vegetation and the ability of the Rat to survive over winter months
Ward-Jones, J., Pulsford, I., Thackway, R., Bishwokarma, D., & Freudenberger, D. (2019). Impacts of feral horses and deer on an endangered woodland of Kosciuszko National Park. Ecological Management and Restoration, 20(1), 37–46.	1. Total herbivore dung density increased fourfold since the 1987, mostly attributed to horses—no evidence of horses or deer from 1987 dung surveys. In 2018, 84% of the dung was from horses, 13% from deer, 1% from rabbits and 2% from macropods 2. Greater cover of understorey plants and denser, taller midstorey inside the exclosures 3. Sparser vegetation cover and more extensive soil erosion outside exclosures 4. Total number of invertebrates captured in small pitfall traps was nearly twice as many within the exclosures compared to horse-grazed plots 5. Neglible change in density of overstorey (White Cypress Pine) over 34 years
Williams, P. R. J. (2019). Science as an antidote to horse trading in the Australian Alps. Ecological Management and Restoration, 20(1), 4–6.	Studies show deleterious impacts of livestock grazing on alpine ecosystems and their conservation values. Grazing resulted in very high levels of damage to vegetation and soils, requiring $10 M taxpayer investment in rehabilitation in the Australian Alps There is no evidence to support previous claim that horses "can roam without causing significant environmental harm" as they are free ranging and cannot be kept in one place away from sensitive ecosystems, they graze selectively often in rare and endangered grasslands and herbfields, travel long distances that results in soil and water degradation, and damage wetlands when they visit them to drink
Tolsma A. D., & Shannon J. (2018). Assessing the Impacts of Feral Horses on the Bogong High Plains, Victoria. Arthur Rylah Institute for Environmental Research. Unpublished client report for Parks Victoria, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.	In 2017 resurveyed 56 sites that were originally surveyed in 2006–2008. Less than 4% of bogs had feral horse impacts in 2006–2008, but 32% had been impacted in 2017. This damage accumulated with only around 100 feral horses on the Bogong High Plains. "There is unlikely to be an acceptable, minimum population size that would avoid incremental, on-going degradation."

TABLE 2 | Legal status of feral horses in different Australian jurisdictions as of August 2025.

Jurisdiction	Legislation & status of feral horses	Key management & notes
New South Wales	Habitat degradation and loss by Feral Horses (brumbies, wild horses), *Equus caballus* Linnaeus 1758, listed as a Key Threatening Process in Schedule 4 of Biodiversity Conservation Act 2016. Kosciuszko Wild Horse Heritage Act 2018 (protects a nominated "heritage" herd)	• Listed as Category 4 non-indigenous animal under Non-Indigenous Animals Regulation 2006 • Kosciuszko Wild Horse Heritage Act requires maintenance of a "heritage" population despite ecological impact • Feral horses cause major habitat degradation in Kosciuszko National Park • Recent government aerial shooting programs to reduce impact • Ongoing conflict with federal EPBC Act obligations
Victoria	Recognised as feral animal & threat to native species—degradation and loss of habitats caused by feral Horses (*Equus caballus*) listed as a Potentially Threatening Process under Victorian Flora and Fauna Guarantee Act 1988 Not classified as pests under Catchment and Land Protection Act 1994	• Managed to protect biodiversity and natural resources under Flora and Fauna Guarantee Act 1988, Parks Victoria Act 2018 and National Parks Act 1975 • Feral Horse Strategic Action Plan 2018–2021 implemented • Humane control via trapping, rehoming and professional shooting • Cross-border cooperation with NSW and ACT through the Australian Alps MOU
Australian Capital Territory (ACT)	Determined to be an Established Species of National Significance Not declared as pest to agriculture or biosecurity threat under Pest Plants and Animals Act 2005 or Biosecurity (Pests) Declaration 2025	• ACT Pest Animal Management Strategy 2021 designates horses as Established Species of National Significance • Maintains zero-tolerance and actively eradicates Feral horses in conservation areas • Feral horses restricted to Namadgi National Park with management plan (ACT Parks Management and Lands 2007) in place: ACT Parks staff authorised to trap, muster, remove and lethally control feral horses • Policy to remove horses crossing from NSW
Queensland	Not listed as prohibited or restricted invasive species under Biosecurity Act 2014	• Assessed as an "extreme threat" to environment • General biosecurity obligation to minimise feral horse risks • Local governments may undertake control as long as Animal Care and Protection Act 2001 welfare requirements are met
South Australia	Declared pest species under Natural Resources Management Act 2004	• No statutory requirement for control by Land managers • Limited formal control programs documented
Western Australia	Declared pest animals under Agriculture and Related Resources Protection Act 1976	• Listed as "Category A5" animals requiring landholders to reduce/control numbers in agricultural/pastoral zones • In cooperation with landholders, installation of strategic fencing, mustering and aerial culls undertaken to protect native fauna and flora in parks and reserves under Biodiversity Conservation Act 2016 (BC Act) • Control methods include mustering and aerial culling
Northern Territory	Listed as "feral animals" under Territory Parks and Wildlife Conservation Act 2001	• Recognised feral species with management focus on minimising environmental harm in pastoral and protected areas • Feral horse management part of a broader integrated pest animal management framework without specific stand-alone legislation • NT government encourages landholders to participate in control programs to reduce feral horse numbers • Management involves population control measures that emphasise humane treatment, consistent with National Code of Practice for Humane Control of Feral Horses. Methods include trapping, mustering, fertility control where feasible, and targeted culling operations

(Continues)

TABLE 2 | (Continued)

Jurisdiction	Legislation & status of feral horses	Key management & notes
Commonwealth (Federal)	Listed as Key Threatening Process under Environment Protection and Biodiversity Conservation Act 1999 ("Novel biota and their impact on biodiversity")	• Partners with states on management obligations • Federal Policy promotes humane and effective Feral Horse management practices • Supports National codes of practice for humane control • Australian Government's Australian Pest Management Strategy 2017–2027 sets out best practice management of pest animals (including feral horses) as one which "balances efficacy, target specificity, safety, humaneness, community perceptions, efficiency, logistics and emergency needs"

FIGURE 1 | Vegetation loss, pugging and erosion caused by horses along an alpine stream (Photo by Zac Walker).

Rowland, Walsh, et al. 2023). Restoration, including moss layer transfers and hydrological repair in peatlands, may reverse some damage and recover lost carbon storage capacity once horses are removed (Treby and Grover 2023).

Uncensored evidence-based communication of feral horse impacts by State agency staff, independent scientists and political leaders is essential to make the cost of inaction clear (Nimmo and Miller 2007). The evidence is unequivocal: feral horses present a significant ecological threat to Australia's alpine and subalpine environments. Legislation that supports effective feral horse control throughout national parks and other public land designated for conservation purposes must be in place.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that supports the findings of this study are available in the Supporting Information of this article.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** aec70117-sup-0001-DataS1.xlsx.