Kaimanawa feral horses: recent environmental impacts in their northern range

Geoff Rogers

Manaaki Whenua - Landcare Research
Private Bag 3127
Hamilton

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PREPARED FOR:
Director, Science & Research Division, Conservation Sciences Centre, Department of Conservation, P.O. Box 10-420, Wellington, and Conservator, Wanganui Conservancy, Department of Conservation, Private Bag 3016, Wanganui

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1. Summary

1.1 Project and client

The impacts of Kaimanawa feral horses on tussock grasslands, wetlands, and rare plant habitats have been identified by the Department of Conservation as of major concern. This project, undertaken in May-June 1994 by Landcare Research New Zealand Ltd, Hamilton, assesses recent impacts of feral horses on representative tussock grasslands, wetlands, and rare plant habitats. The study follows an earlier study of the environmental impacts of horses (Rogers 1989, 1991).

1.2 Objectives

- Assess what deterioration or improvement has occurred in rare plant habitats and vulnerable tussock grasslands since management proposals for the Kaimanawa feral horses were formulated in 1990/91.
- Advise on the current level of impact on the abundance and habitat of rare plants, and on the condition of red tussock and hard tussock grassland.
- Comment on the likelihood of recovery of rare plant habitats and vulnerable tussock grasslands if horses were excluded from such areas, and the time scale of such a recovery.

1.3 Methods

The impact of feral horses on tussock grasslands is being monitored in exclosure plot pairs in their northern range. Information on the impacts of horses on mesotrophic wetlands is obtained from an exclosure plot in the Awapatu basin. Vegetation composition and stature in the exclosure plots is monitored using the Scott height frequency method (Scott 1965), giving estimates of plant biomass and stature. Estimates of tussock density and stature are obtained from randomly located 2 x 1 m subplots. Rare plant habitat is monitored along permanent photopoint transects and by field observations.

1.4 Results

Rare plant habitat: Permanent photopoints on highly fertile flush zones in the Ngawakaakauae showed increasing use by horses in 1989-94. Horse trampling and grazing fractured the saturated turf, causing downslope sedimentation, water ponding, and opportunities for the establishment of weeds. A large tarn in the Awapatu subject to seasonal water level fluctuations attracted heavy use by horses, pugging the tarn floor and littoral zone.

The habitats of other rare species on gravel levees and along stream banks appeared to be little modified, mainly because they are not preferred horse habitats.

Wetland exclosure plot

In the exclosure plot, total vegetation space or biomass increased nearly threefold between 1989 and 1994, and the mean height of the vegetation virtually trebled. The native sedge *Schoenus pauciflorus* accounted for much of this increase, along with red tussock and adventive grasses. The control plot showed a reduction in native sedges and an increase in weedy species.

Red tussock and hard tussock grasslands

An exclosure plot pair established in 1979 at Moturnatai (Fg. 11-14) monitored plateau red tussock-hard tussock grassland. Since 1989 exclusion of horses has resulted in a substantial loss of short tussocks, because of competition from adventive grasses, and a substantial increase in red tussock. The control plot showed further reductions in hard tussock and red tussock, and increases in native mat plants and weeds. Continuing use by horses of a basin tussock grassland in the Awapatu resulted in a reduction in the density (particularly of juveniles), biomass, and stature of hard tussock and red tussock. Early recovery of a partly degraded tussock grassland in a hillslope exclosure plot in the Awapatu was marked by an increase in hard tussock, blue tussock, red tussock, and adventive grasses.

1.5 Conclusions

Conclusions do not differ from an earlier environmental impact assessment (Rogers 1989, 1991), in that trends in rangeland condition indicate further deterioration of preferred horse habitats. Mesotrophic wetlands and plateau, basin, and hillslope red tussock-hard tussock grassland have continued to deteriorate. A release of horse grazing pressure in all these preferred habitats led to a proliferation of red tussock and native sedges, as well as exotic grasses. A return to a near natural vegetation condition is likely within two decades on the mesotrophic wetland and four decades on most semi-intact red tussock grasslands.

1.6 Recommendations

This study has reinforced the conclusions and guidelines for management outlined in previous reports on horse impacts (Rogers 1989, 1991).

Some rare plant ecosystems are more vulnerable to horse impacts than tussock grasslands. A density of 1 horse per 250 ha recommended for the Ngawakaakauae and Awapatu sectors is set more in terms of reducing the probability of deleterious impacts on vulnerable rare plant habitats than on compatibility with the long-term recovery of tussock grasslands from their

modified condition. Nevertheless, at the densities experienced between 1989 and May 1994 horses impacted negatively on grassland and rangeland condition in both northern sectors.

2. Introduction

The impacts of Kaimanawa feral horses on tussock grasslands, wetlands, and rare plant habitats have been identified by the Department of Conservation as of major concern. This project, undertaken in May-June 1994 by Landcare Research New Zealand Ltd, Rotorua, assesses recent horse impact on representative tussock grasslands, wetlands, and rare plant habitats.

The study is based on remeasurement of exclosure plots in tussock grasslands and a wetland, and on monitoring of photopoint transects in rare plant habitats. It also seeks to review the applicability of earlier recommendations for horse management (Rogers 1989, 1991) in view of an expanded monitoring network established in 1990 and a roundup and disposal of horses from the Argo / Auahitotara and Awapatu management sectors (Rogers 1991) in June 1993. This interim report provides an interpretation of the results in terms useful for management planning. More detailed technical information and implications for management will be presented, with Departmental support, in a final report during 1994/95.

Tussock grasslands of the horse range have been variously modified by burning and by grazing of farm stock, hares, rabbits, and feral horses. A retrogressive successional shift results from this modification, with tall red tussock replaced by the short tussocks (hard tussock and silver tussock), which are in turn replaced by adventive grasses, and finally *Hieracium pilosella*, patotara, and scabweeds. Horses and hares are considered to be the primary modifying influences in the northern area where the exclosure plots are located, because farm stock have been excluded since the 1950s and wild fire is rare.

3. Objectives

- Assess what deterioration or improvement has occurred in rare plant habitats and vulnerable tussock grasslands since management proposals for the Kaimanawa feral horses were formulated in 1990/91.
- Advise on the current level of impact on the abundance and habitat of rare plants, the habitat of those plants, and on the condition of red tussock and hard tussock grassland.
- Comment on the likelihood of recovery of rare plant habitats and vulnerable tussock grasslands if horses were excluded from such areas, and the time scale of such a recovery.

4. Methods

The impact of feral horses on tussock grasslands is being monitored in three 20 x 20 m exclosure plots, one on a plateau at Motumatai and two in the Awapatu basin. Information on the impacts of horses on mesotrophic wetlands is obtained from an exclosure plot in the Awapatu basin. Vegetation composition and stature in the four exclosure plots is monitored using the Scott height frequency method (Scott 1965). This detailed method records plant intercepts in a 2.5 x 2.5 cm square visual sampling column, graduated in height intervals of 5 cm, and placed vertically at intervals along a transect. Summation of the plant intercepts in the column provides indices of species occurrence and vegetation space, which are reliable estimates of plant biomass. Tussock population density, size-class distribution, and stature are estimated from randomly located 2 m^2 plots within each tussock exclosure plot pair. Rare plant habitat is monitored along permanent photopoint transects and by field observations.

5. Results

5.1 Rare plant habitat

Permanent photopoints on flush zones in the Ngawakaakauae showed increasing use by horses of these high-fertility sites over the period 1989-94 (Fig. 1-6). Horse trampling and grazing fractured the saturated turf (Fig. 2), causing downslope sedimentation, water ponding, and opportunities for the establishment of weeds. The prostrate turf supporting *Ranunculus recens* on the lower slopes suffered silt inundation (Fig. 3). *Carex berggrenii* was wrenched from wet turf in the upper reaches by horse grazing. These species,, are classed respectively as 'rare' and 'vulnerable' (Cameron et al. 1993).

A large tarn in the Awapatu (Fig. 7) subject to seasonal water level fluctuations attracted heavy use by horses, pugging the tarn floor and littoral zone (Fig. 8); the former supports *Amphibromus fluitans*, the latter *Gnaphalium ensifer*.

The habitats of other rare species such as *Acaena inermis*, *Myosotis* sp. (*M. pygmaea* var. *glauca*), *Nertera* sp. (aff. *N. balfouriana*), and *Luzula* sp. (*L. rufa* var. *albicomans*) (Rogers 1991) appeared to be little modified, mainly because they are not preferred horse habitats. This study did not survey the habitat of *Agrostis imbecilla* or *Koelaria* sp. (*K novozelandica* agg.).

5.2 Wetland exclosure plot

The exclosure plot was installed on 9 April 1989 on a poorly drained sloping terrace above a creek feeding the Awapatu Stream (Fig. 9). In May 1989 the dominant vegetation was closely cropped *Schoenus pauciflorus*, with a diverse mix of low-growing sedges and herbs and scattered tall red tussock. Remeasurement of the exclosure plot 5 years later (Fig. 10), on 7 April 1994 showed:

- total vegetation space or biomass increased nearly threefold, from 224 intercepts to 576 intercepts;
- the mean height of the vegetation virtually trebled, from a low 0.12 m to 0.3 m;
- substantial increases in the dominant native species *Schoenus pauciflorus, Eleocharis gracilis, Gonocarpus micranthus, Galium perpusillum, Hydrocotyle microphylla, Plantago raoulii,* red tussock, R*ytidosperma gracile,* and *Viola cunninghamii;*
- a substantial increase in the weeds Yorkshire fog, *Hieracium pilosella,* and sweet vernal;
- substantial reductions in the weeds *Juncus articulatus* and *Linum catharticurn.*

The control plot showed:

- a substantial reduction in the previously dominant natives *Schoenus pauciflorus, Carex echinata,* and *Eleocharis gracilis;*
- a substantial increase in weeds such as *Juncus articulatus,* sweet vernal, Yorkshire fog, dandelion, and *Hieracium pilosella.*

Hares appeared to have a small dampening effect upon the recovery of native and exotic sedges, exotic grasses, and native herbs in half of the exclosure plot available to them.

5.3 Plateau red tussock and hard tussock grassland

An exclosure plot pair established in 1979 at Motumatai (Fig. 11-14) monitored plateau red tussock-hard tussock grassland adjacent to an isolated stand of mountain beech. Since 1989 exclusion of horses has resulted in:

- a substantial loss from all diameter classes and in total biomass of hard tussock because of competition from exotic grasses;
- no recruitment of silver tussock, and a progressive reduction in its biomass;
- a doubling of biomass, increasing stature, and substantial recruitment of red tussock, despite competition from a dense exotic grass sward;
- no change in exotic grass biomass;
- virtual elimination of short-statured blue tussock (*Poa colensoi*);
- a reduction in the cover of prostrate herbs and woody species.

The control plot exposed to continuing horse use has shown:

- a moderate reduction in density of hard tussock and red tussock;
- a moderate loss of 'seedling' and 'juvenile' hard tussocks and red tussocks;
- a substantial reduction in the mean height of hard tussock and red tussock;
- a substantial reduction in total vegetation biomass, most of it accounted for by hard tussock;
- an increase in indigenous species diversity, particularly among shade-intolerant prostrate species;
- a substantial increase in *Hieracium pilosella,* patotara, and moss, all mat species indicative of severely degraded tussock grassland.

Exclusion of hazes from one half of the exclosure plot has not differentially affected the biomass, stature, or recruitment of either hard tussock or red tussock. There is evidence that hares feed mainly on exotic grasses.

5.4 Basin floor hard tussock grassland

An exclosure plot pair installed in May 1989 monitors degraded hard tussock grassland on the Awapatu basin floor. Unfortunately, the exclosure fence was damaged in 1993 and horses entered the plot. Comparisons between the control and exclosure plot could, therefore, not be made. Nevertheless, a comparison of the vegetation condition of the open control plot between 1989 and 1994 showed that:

- the density of hard tussock and red tussock had reduced by 16% and 23% respectively;
- the vegetation space or biomass of red tussock had declined from 51 intercepts to 42;
- there was a loss of hard tussock and red tussock from all diameter and height classes, indicating that horses graze the entire populations, but with a proportionately greater loss of small-diameter tussocks of both species, probably reflecting lower resilience of seedling and juvenile plants to horse grazing;
- despite the loss of tussocks, total vegetation biomass had not changed substantially in five years, with prostrate species such as *Hieracium pilosella, Wahlenbergia albomarginata,* lichens, mosses, patotara, and exotic grasses dominating the closely cropped intertussock space and, except for exotic grasses, mostly escaping horse grazing because of their low stature;

- the heavily grazed intertussock turf had increased species diversity and a proliferation of very low, shade-intolerant species such as *Stackhousia minima., Pentachrondra pumila, Hieracium pilosella,* and *Racomitrium lanuginosum*.

5.5 Hillslope red tussock and hard tussock grassland

An exclosure plot pair in the Awapatu basin established in May 1989 monitored partly degraded red tussock-hard tussock grassland on a lower valley slope. In the last five years the exclosure plot has shown:

- the density of both hard tussock and red tussock increased by approximately 20%;
- a substantial increase in the biomass of red tussock, blue tussock, and exotic grasses;
- total vegetation biomass increased from 311 to 387 intercepts;
- a substantial increase in species diversity, particularly among native herbs.

The control plot showed:

- a moderate reduction in hard tussock biomass, from 130 intercepts to 96.
- a reduction in the density and recruitment of red tussock, but an increase in the mean diameter and height of mature plants.

Hares and rabbits have had a substantial dampening effect upon the rates of recovery of red tussock, hard tussock, and exotic grasses in one half of the subdivided exclosure plot.

6. Conclusions

6.1 Rare plant habitat

Horses target not only mesotrophic-eutrophic wetlands as preferred habitat, but also the periodically inundated Awapatu tarn and flush zones within the Ngawakaakauae basins. Horse damage to the tarn littoral zone and flushes increases with water table height and soil wetness. Saturated substrates are easily quagmired by trampling, whereas dry turfs are more resistant to fracturing. Vulnerability of these turf communities lower down the slope results more from sedimentation than from hoof fracturing of the tightly intertwined mat vegetation. Hydrological changes on both systems result from water ponding in hoof imprints (Fig. 6) and increased downslope sedimentation (Fig. 3). Furthermore, invasive weeds benefit from additional establishment sites.

Both ecosystems have deteriorated substantially in the last five years. However, recent intensified horse damage to these habitats appears to be correlated with increases in the

regional density of horses (W. Fleury pers. comm. 1994). The onset of damage can also result from just one additional local band establishing a home range containing rare plant habitat.

If horses were totally removed, restoration of the saturated substrates on the upper slopes of the flushes to their previously smooth profile would probably require one to two decades of natural siltation (Fig. 8). Profile restoration of the tarn bottom and littoral zone is governed by the frequency and intensity of flooding events.

6.2 Mesotrophic-eutrophic wetlands

The vegetation response within the exclosure plot pair on the Awapatu wetland indicates that horses have a deleterious impact on mesotrophic wetlands. Virtually all erect species are heavily browsed, and weedy rushes and grasses are encouraged. Trampling and grazing appear to be equally destructive. Field observations suggest that evidence of wetland deterioration from the exclosure plot over the last five years applies to other wetlands throughout the Awapatu, and elsewhere in the northern sectors. Most eutrophic wetlands have lost virtually all their natural values, and would respond to horse removal by transition to rank exotic grass swards. Removal of horses from lightly to moderately modified wetlands should lead to structural recovery within 15-20 years. Compositional recovery to an entirely indigenous system is unlikely, because exotic grasses and rushes are highly competitive on mesotrophic to eutrophic wetlands. Virtually all wetlands in the study area are now at best semi-natural systems.

6.3 Tussock grasslands in general

Red tussock and hard tussock dominate a wide range of horse habitat from oligotrophic-mesotophic depressions on basin floors (Fig. 15) to dry, rounded ridge tops and frosty basins (Fig. 16). Red tussock grasslands on hillslopes are the most intact, with plateau grasslands generally showing increased cover of hard tussock, and basin floors often dominated by hard tussock. Use by horses of these diverse grasslands varies considerably in response to their nutritional differences, local variations in weather, and differences in horse population density (Fig. 15-18). All tussock grasslands are modified to varying degrees by such influences as pastoral use, military manoeuvres, and grazing by feral animals. Impacts of horses must be assessed against this background, as well as the intactness and naturalness of each community type. Exclosure plots can provide information on the impacts of both horses and hares.

The three exclosure plots - on a hillslope, a plateau, and a basin floor - apply not only to different topographies but to grassland spanning the degradational shift from red tussock to hard tussock dominance. The exclosure plots provide information on the short to medium-term exclusion of horses from parts of this red tussock-hard tussock continuum Interpretation of results therefore applies to modified tussock grassland in a 5-15-year time frame.

The short-term (5 year) response of modified tussock grasslands to exclusion of horses is:

- a proliferation of exotic grasses;
- increased biomass and limited recuitment of both red tussock and hard tussock;
- a small increase in native species diversity.

The medium-term (15 year) response is:

- biomass dominated by exotic grasses and red tussock;
- continuing recruitment and canopy dominance of red tussock;
- loss of hard tussock from all diameter classes because of competition from choking exotic grasses;
- loss of prostrate native herbs, probably from intertussock dominance by exotic grasses.

Beyond 15 years the cover and stature of red tussock are expected to increase further. Native shrubs may also appear, depending on local seed sources, topography, and humidity (Rogers & Leathwick 1994).

The Motumatai plot indicates that even substantially modified red tussock-hard tussock grassland has sufficient resilience to return to red tussock dominance with hares present but horses removed. The process would span at least four decades. Progressive loss of hard tussock would be an inevitable consequence of a return to taller red tussock in mixed grassland, even in the absence of exotic grasses. With or without exotic grasses, the process would see greater loss of hard tussock on sites optimal for red tussock, such as damp basins, than on more marginal sites such as dry rolling hill country.

The three control plots demonstrate continuing tussock depletion from all three topographical and modification stages of tussock grassland in the presence of moderate numbers of horses. Aerial counts show that horse population densities did not substantially change at Motumatai and Awapatu between 1990 and May 1994 (W. Fleury, pers. coma. 1994).

7. Recommendations

This study has reinforced the conclusions and guidelines for management outlined in previous reports on horse impacts (Rogers 1989, 1991).

Some rare plant ecosystems are more vulnerable to horse impacts than tussock grasslands. A density of 1 horse per 250 ha recommended for the Ngawakaakauae and Awapatu sectors is set more in terms of reducing the probability of deleterious impacts on vulnerable rare plant

habitats than on compatibility with the long-term recover- of tussock grasslands from their modified condition. Nevertheless, at the densities experienced between 1989 and May 1994 horses impacted negatively on grassland and rangeland condition in both northern sectors.

8. References

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Fig 1
A flush zone fed by spring-derived water on the lower toeslope of the Ngawakaakauae intermontane basin. The turf of *Selliera microphylla* and *Juncus novae-zelandiae* supports the rare sedge in the North Island *Carex berggrenii* on the wetter mid reaches and the vulnerable buttercup *Ranunculus recess* var. on the drier lower fan. A photopoint transect established in 1989 monitors horse impact. (Photograph 11 Jan 86)

Fig 2
The upper reaches of the flush immediately to the left of the left-most botanist in Fig 1. Recent intensified use of the flush as a horse thoroughfare and fodder source have severely modified this rare ecosystem. (Photograph 3 May 94)

Fig 3
Horse-induced erosion of the upper flush leads to accelerated siltation lower down and inundation of the <1 -cm-high turf's that support the vulnerable *Ranunculus recess* var. (Photograph 3 May 94)

Fig 4
Turf communities < 1 cm high on mesic middle reaches of the flush show fragmentation of these seasonally-dry surfaces from horse hooves. (Photograph 11 Nov 90)

Fig 5
Transect 1, Photopoint 3, on a flush zone of Fig 1. The rare sedge *Carex berggrenii* appears as red tufts above mat *Selliera microphylla* and *Juncus novae-zelandiae*. (Baseline photograph, 7 May 89)

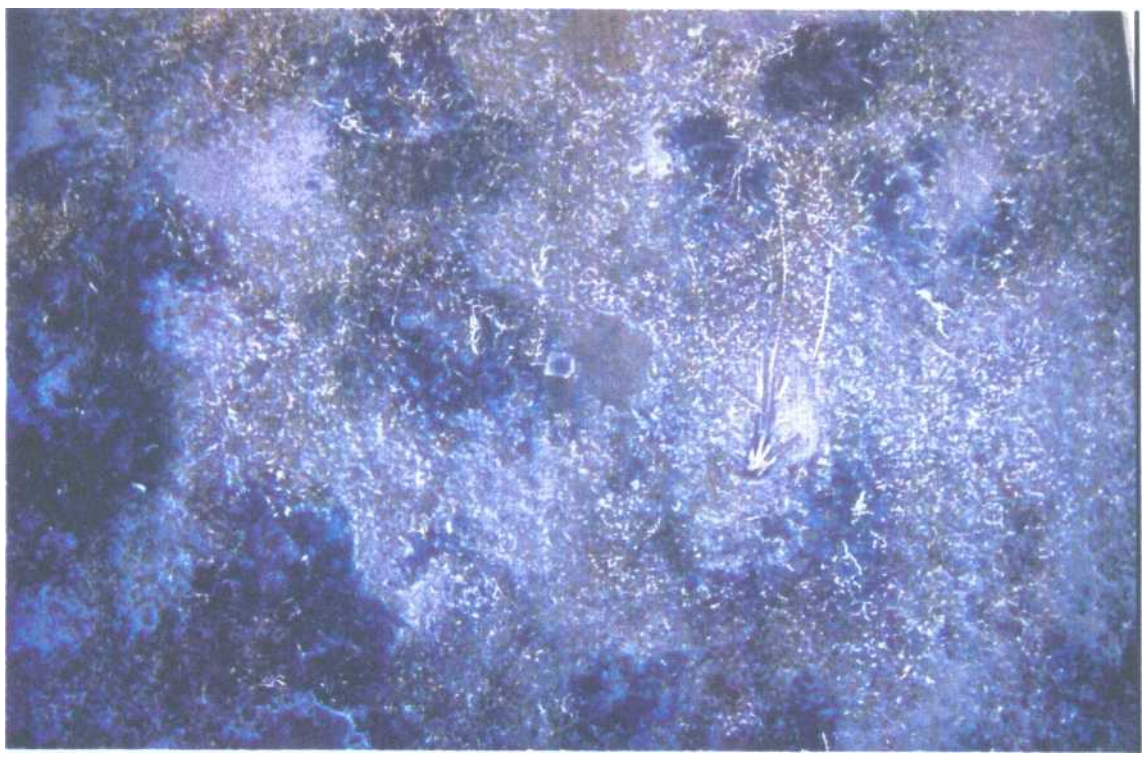

Fig 6
Transect 1, Photopoint 3. Surface pugging from horse tramping has fractured mat vegetation, caused water ponding and flooding, mobilised silt, and created weed establishment sites. (Re Photograph, 11 Nov 90)

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