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SHORT COMMUNICATION

SHORT-TERM EFFECTS OF RABBIT GRAZING ON A DEGRADED SHORT-TUSSOCK GRASSLAND IN CENTRAL OTAGO

Summary: Rabbits are serious economic and environmental pests in New Zealand's semi arid lands, yet there is surprisingly little quantitative information about their grazing impacts. This paper describes the short-term gains in pasture yield following protection from rabbit grazing in a rabbit-prone, dry tussock grassland community in Central Otago. During the four most productive plant growing months of 1994 (September to December), a six-fold increase in pasture yield was observed after protection from rabbit grazing (139 kg dry weight ha^{-1} with rabbits cf. 853 kg DW ha^{-1} without rabbits). Rabbit counts were 30 to 42 rabbits per spotlight km. The following four months (January to April) were characterised by reduced pasture growth (3 kg DW/ha with rabbits cf. 337 kg DW ha^{-1} without rabbits) and higher rabbit numbers (42-76 rabbits per spotlight km), and was a critical period of herbage depletion. These substantial differences in pasture yield indicate the potential benefits for pastoral production and land conservation following protection from rabbits.

Keywords: rabbit; *Oryctolagus cuniculus*; vegetation; grazing impacts; tussock grassland; herbage yield.

Introduction

Despite 120 years of rabbit (*Oryctolagus cuniculus* L.) control in New Zealand, there is a surprising dearth of quantitative information on the damage rabbits cause to agricultural systems and the environment. Research and debate on rabbits have traditionally centred on the various technical options available for their control, and their cost efficiency. Little attention has been paid to the environmental and economic costs of rabbit grazing.

A clear understanding of the need for pest control is important because pest management concerns not only primary producers but also animal welfare groups, conservationists, commercial users of pest products, and Maori. Adopting more cost effective rabbit control technologies that some perceive to be more 'risky', such as biological control, clearly rests on a proper understanding of why there is a need to control rabbits.

This paper contributes to that process by reporting the results of a short-term study on the impacts of rabbit grazing on pasture production in a degraded, dry short-tussock grassland. The results should be seen in the light of our intention to obtain indicative data only for a precisely chosen part of the vegetation community.

Methods

Study site

The study was conducted on Earnscleugh Station, Central Otago (45° 9' 42" S/169° 16' 54" E) between September 1994 and April 1995. The dominant land-use is fine wool production from merino livestock grazing. A 1000 ha paddock was chosen for study because of high rabbit numbers (30-76 rabbits per spotlight km) and the absence of livestock since 1993.

The climate is semi-arid with a mean annual rainfall of 344 mm. There is a marked rainfall maximum in January, and March is the most reliable month for rainfall. Mean monthly temperatures vary between 2.5°C (June) and 18°C (January). The plant growing season generally occurs between early September and late April (Radcliffe and Cossens, 1974). Soils belong to the Arrow and Alexandra steepland soils sets (Soil Bureau 1968, sheet 10). These soils are pallic, formed on schist, generally quite shallow and stony, and weakly leached but with an adequate supply of most nutrients (Orbell, 1974).

Grazing impacts were measured in a degraded short-tussock grassland community of hard tussock

(*Festuca novae-zelandiae* Hark) and blue tussock (*Poa colensoi* Hook. f.), interspersed with exotic grasses (sweet vernal, *Anthoxanthum odoratum* L.; browntop, *Agrostis capillaris* L.; Yorkshire fog, *Holcus lanatus* L.; and chewings fescue, *Festuca rubra* L.) and herbs (e.g. tussock hawkweed, *Hieracium lepidulum* (Stenstroem) Omang; purging flax, *Linum catharticum* L.; Maori onion, *Bulbinella angustifolia* (Ckn. & Laing) L. B. Moore; St. Johns wort, *Hypericum perforatum* L.; *Geranium sessiliflorum* Cav.; *Carex sp*.; *Epilobium sp*.; and *Raoulia subsericea* Hook.f.).

Vegetation sampling

Ten 100 m^2 sites were selected along a 2.5 km track traversing the Molyneux Face block. Care was taken to minimise environmental variation between sites by selecting sites with similar aspect (north-easterly facing), altitude (range, 760-840 m), slope (range, 5-15 degrees) and slope shape (convex). Vegetation composition across the 10 sites was relatively uniform.

At each site, four 0.5 m^2 quadrats ('plots') were randomly chosen. A further four plots were selected to match each of the first four plots on the basis of similar vegetation biomass and composition. For each plot, a species list was compiled and the living erect vegetation was clipped to ground level, hand separated into species where possible and stored in paper bags. A 1 x 1 x 0.5 m (width x length x height) wire mesh cage (4 x 4 cm mesh) was placed over one randomly chosen plot of each pair in the four paired plots to exclude rabbit grazing. The matching plot of each pair remained open to rabbit grazing.

Four months later the plots were harvested to ground level, separated into species where possible and bagged. Cages were then moved to protect the previously grazed plots, and new plots selected which were similar in plant biomass and species composition. All new plots were clipped to ground level and exposed to rabbit grazing. The original 'caged' plots were then discarded. A further four months later the plots were harvested, separated into species and bagged. All bagged plant samples were oven dried at 35°C for 48 hours and weighed.

Data analysis

Data from each site were averaged to give one independent replicate. The distribution of the data was normalised by transforming them into natural logs. Differences in accumulated pasture biomass between grazed and ungrazed plots were tested using a randomised block, 2-way analysis of variance. Sites were treated as blocks, and the factorial structure consisted of season and grazing.

Of the 60 plant species recorded during the study, only nine contributed significantly to the total harvest (Fig. 1). The remaining erect phytomass was collectively referred to as 'miscellaneous'. The species composition of the miscellaneous portion varied between plots, and in some cases included one or more of the nine species mentioned above if their individual biomass was so small as to preclude separation during harvest. Because it was not always possible to normalise the distribution of the biomass data for individual species, species differences were tested using a Wilcoxon Signed Rank Test.

Rabbit counts

Rabbits were counted on four separate occasions during the study, twice between September and December (spring), and twice between January and April (summer). On each occasion, rabbits were counted on three consecutive nights under spotlight from the back of a slow moving vehicle (10-15 km per hr) that travelled past the vegetation plots. Counting began about 30 minutes after sunset and was conducted on each occasion by the same observer. The terrain allowed counting within an approximately 100 m wide strip. The number of rabbits seen per km was used as an index of rabbit abundance.

Results

Impacts on total pasture

There were significant grazing, season and 'grazing x season' interaction effects (all $P<0.0001$). More biomass accumulated where rabbits were absent, more biomass accumulated in spring, and the proportional increase in biomass where rabbits were absent was greatest in summer, although less in quantity compared with spring (Table 1). Protection from grazing during the most productive plant growing months in spring resulted in a six-fold increase in pasture yield.

Table 1: *Mean phytomass (kg DW ha^{-1}) $\pm$ 1 S.D. of the mean (n=10) accumulated over four months in the presence and absence of rabbit grazing.*

	Sept. - Dec.	Jan. - April
Caged (No rabbit grazing)	853 $\pm$ 225	337 $\pm$ 161
Uncaged (Rabbit grazing)	139 $\pm$ 43	3 $\pm$ 5

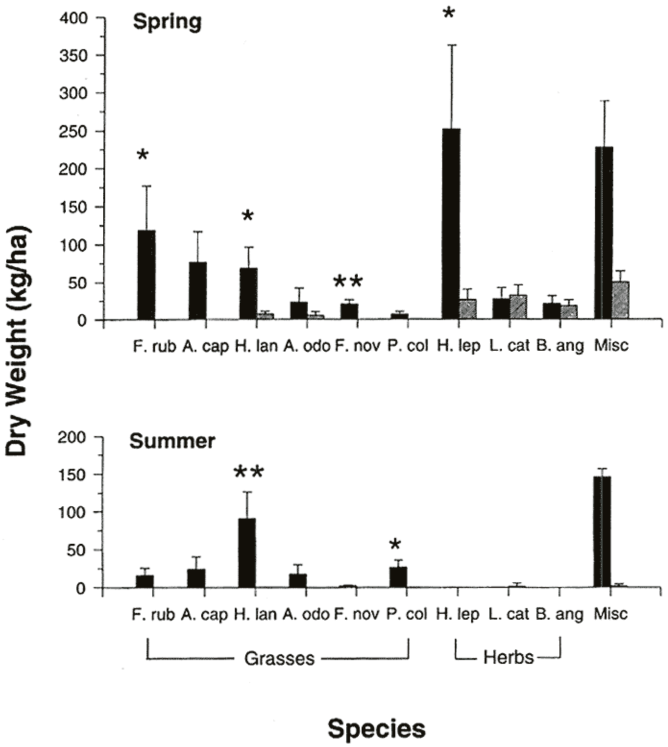

Figure 1: *Mean phytomass (kg DW ha*$^{-1}$*) + 1 S.D. of the mean (n =10) of harvestable species accumulated over four months during spring and summer in the presence (shaded bars) and absence (solid bars) of high rabbit numbers. Codes for plant species are: 'F. rub'* = Festuca rubra*; 'A. cap'* = Agrostis capillaris*; 'H. lan'* = Holcus lanatus*; ' A. odo'* = Anthoxanthum odoratum*; 'F. nov'* = Festuca novae-zelandiae*; 'P. col'* = Poa colensoi*; 'H. lep'* = Hieracium lepidulum*; 'L. cat'* = Linum catharticum*; 'B. ang'* = Bulbinella angustifolia*; 'Misc' = miscellaneous.* * = P*<0.05,* ** = P*<0.01. No comparisons were made for 'Misc'.*

Impacts on species

There were significant grazing effects during both seasons for *H. lanatus* (*P*=0.0313 in spring; *P*=0.0078 in summer) (Fig. 1). For spring only, significant effects were found for *F. rubra* (*P*=0.0355), *F. novae-zelandiae* (*P*=0.002), and *H. lepidulum* (*P*=0.0156). For summer, despite the fact that there was no harvestable biomass for most species in the grazed plots, there were significant grazing effects for only *H. lanatus* (see above) and *P. colensoi* (*P*=0.0313). All species (apart from *F. novae-zelandiae*) flowered profusely in the absence of rabbits.

Rabbit numbers

The mean values for the two rabbit counts in spring were 30 ± 7 (± 1 S.D.) and 42 ± 9 rabbits per spotlight km. Summer counts increased to 42 ± 9 and 76 ± 8 rabbits per spotlight km.

Discussion

A total absence of rabbit grazing during four months resulted in an extra 714 kg ha^{-1} of phytomass during spring, and an extra 334 kg ha^{-1} during summer. Although this result is confined to one habitat type during one spring/summer growing season, it demonstrates the potential gains in pasture yield in the absence of rabbits. The coincidence of relatively low pasture yields in summer (see also Radcliffe and Cossens, 1974), and seasonal peaks in rabbit numbers following recruitment from the breeding season in spring, indicates that summer may be a critical period of herbage depletion.

H. lepidulum, one of a number of hawkweeds currently spreading in the high country, grew prolifically in the absence of rabbit grazing during spring. Flowering was also profuse under these protected conditions, unlike that in the grazed plots where flowers were never observed. This species is therefore likely to spread following the cessation of stock and rabbit grazing. Without rabbit grazing, prolific flowering of grasses was also observed, as reported by Wood, Leigh and Foran (1987) in Australia, again leading to grass recruitment in the longer term.

There is limited information available on the impact of rabbits on New Zealand vegetation. Allen, Wilson and Mason (1995) found that rabbit grazing had an important influence on vegetation dynamics on four of the five sites studied in the semi arid grasslands. This effect varied with climate and land condition. Gibb, Ward and Ward (1978) observed a deterioration of pasture quantity and quality over a ten year period within an 8.5 ha rabbit enclosure in the Wairarapa district, but the results were confounded by seasonal effects and by an artificially enclosed rabbit population.

Foran (1986) found that high rabbit densities no longer degrade severely overgrazed pastures of arid Australia, but restrict their development in response to improving seasonal conditions. In such cases, seed beds have been destroyed and hence no change in species composition occurs when vegetation is protected from rabbit grazing (Leigh *et al.*, 1989). The short duration of our study precluded analysis of species compositional change arising from removal of rabbits.

While this study demonstrates some of the potential gains in herbage growth following protection from rabbits, the data are indicative only for part of the semi arid lands. Clearly, further replication over a range of vegetation communities of varying condition, soil types, altitudes, rainfall, and rabbit densities is needed to better understand the impact of rabbit grazing.

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