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The role of grass tussocks in maintaining soil condition in north east Australia

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Introduction Soils of the grazing lands of north eastern Australia are inherently nutrient-poor. Heterogeneously distributed plants are important to the conservation of the limited amounts of nutrients, through storage in plant tissues or in soil sinks close to plants (Ludwig *et al*., 1997). Loss of perennial vegetation through disturbance reduces conservation of these resources, to the detriment of feedback mechanisms, and ultimately causes loss of soil condition. Large areas of north east Australia have been degraded, or threatened by degradation, through combinations of variability in precipitation and heavy grazing (Gardener *et al*., 1990). This study examined the inter-related responses of plants, soil microbes and soil nutrients to management-related disturbance.

Methods During the dry and wet seasons of 1998, replicate (n=4) soil samples from the upper 15 cm of the profile were collected in two sets of paddocks (n=2) in different condition (intact State 1 and degraded State 2), following 15 years (1983-1998) of grazing management [application of no and heavy (75% use of herbage produced each year) grazing, respectively]. Samples were collected at different locations (± 30 cm upslope-downslope) from the centre of tussocks of the two dominant perennial grass species (*Bothriochloa ewartiana* and *Chrysopogon fallax*). Total soil C and N were determined colorimetrically, and total microbial C was estimated from N values following ninhydrin fumigation of samples. A second set of samples was collected along similar transects to a depth of 50 cm, sectioned into 10 cm depth increments, roots were separated from soil, and surface area was defined by root scanner.

Results Microbial C, total soil C and N concentrations were present at higher levels in close proximity to grass tussocks on intact (State 1) condition paddocks (Figure 1). Concentrations on the degraded (State 2) paddocks were at or below the more distant locations of the intact paddocks. Microbial C was highest within ± 8 cm of centres of tussocks on both paddocks, compared with the remaining locations. Soil C and N declined with distance from tussock centres on the intact paddocks, while concentrations on the degraded paddocks were similar across locations. Root surface area was not widely distributed in either paddock, with the majority located within 20 cm of tussocks and at depths above 40 cm. Root surface areas in degraded paddocks were not recorded below 30 cm, nor in large amounts > 15 cm from tussock centres.

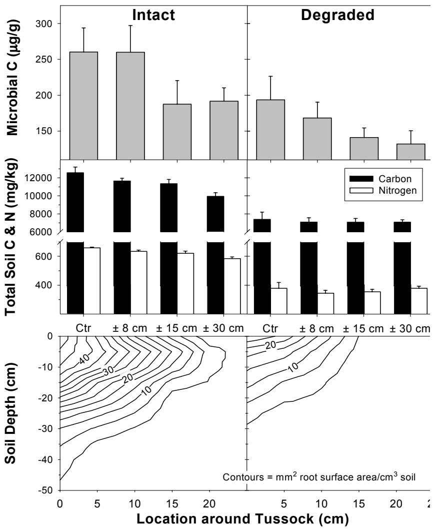

Figure 1 Microbial C, total C and N, (±1 s.e.) and root surface area distributions around grass tussocks

Conclusions The enrichment of soil by tussock grasses was highly localised, and highlights the inter-relatedness and tight coupling that exists between plants, nutrient pools, and microbial activity in north eastern Australia. Responses also underscore the importance of the biological component to landscape condition. Disturbance of the herbaceous community had carry-over effects on components related to nutrient cycling and pools. Also, differences between the intact and degraded paddocks were not large [2150 (±520) mg/kg C, 65 (±10) mg/kg N, and 66 (±11) µg/g microbial C], indicating that reserves available to resist or recover from disturbance were limited. The differences noted here represent the effects of management over relatively short periods (15 years), and underscore the importance of balancing grazing pressure against productive capacity of the landscape.

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