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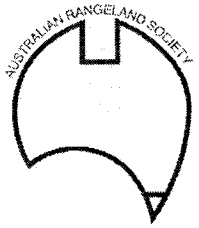

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IMPACT OF GRAZING ON SPECIES DENSITY AT SMALL SCALES IN RANGELANDS

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ABSTRACT

The impact of stocking rate (ranging from below- to above-commercial rates) on species density was assessed at sites near Charters Towers and Mundubbera. At both locations there was a 25-30% increase in species density as stocking rate increased. These changes in species density with grazing pressure were quite different to published information on temperate grasslands. This may reflect a wider range of past grazing histories in the temperate data set, and the prior loss of grazing-sensitive species from the tropical sites.

INTRODUCTION

Most Australian rangelands have been grazed by domestic livestock for more than a century. The grazing industries have been important for the development and use of the rangelands and for the economic growth of Australia. Grazing has wrought substantial changes to the vegetation in some areas: these changes have had considerable publicity and broad descriptions have been published, such as that of Tothill and Gillies (1992) for northern Australia. There is increasing interest in the impacts grazing has had, and is having, on rangeland vegetation both for the sustainability of the grazing industries and for alternative uses, including conservation. There is little detailed information on grazing impacts on biodiversity in rangelands. This paper provides such data for species density (number of species per unit area) at sites near Charters Towers (tropical savanna) and Mundubbera (subtropical savanna) in Queensland.

METHODS

At Charters Towers data were collected from two sites, Hillgrove and Cardigan. At each site all herbaceous species occurring in approximately 400 quadrats (1 m^2) on a 40 × 40 m grid were counted prior to experimentation. A large experiment involving factorial combinations of stocking rate (five levels from 0.1 to 1.0 an/ha), superphosphate application, sowing introduced species and tree killing was then established at each site (McIvor and Gardener 1995). Each year from 1982 to 1992 during the late wet season the presence/absence of all herbaceous species was recorded in 50 randomly located quadrats (0.25 m^2) in each experimental plot.

At Mundubberra, species density (in 1 m^2 quadrats) was recorded in sixteen paddocks before (in March 1989) and six years after (in March 1995) the imposition of four stocking rates. The site had a history of commercial stock grazing and all the paddocks had been band seeded with 5 exotic legume species (Cook *et al.* 1993). There were four stocking rates, which fluctuated over the experimental period but remained relative to each other: very low (75% of time at 0.15 steers/ha, 25% of time at 0.3 steers/ha), low (75% at 0.3 and 25% at 0.6), medium (36% at 0.3 and 64% at 0.6) and high (36% at 0.45 and 64% at 0.9). Paddock size varied with stocking rate: very low = 6.6 ha; low and medium = 3.3 ha and high = 2.2 ha. Presence/absence of all species rooted within the quadrats was recorded in 495 quadrats located on a 25 × 50 m grid (averaging 31 quadrats per paddock).

RESULTS AND DISCUSSION

Species densities (1 m^2 scale) at the tropical and subtropical sites were similar at the commencement of the experiments (Hillgrove 10.4, Cardigan 9.2, Mundubbera 10.8) so there is no evidence of differences relating to climatic region. Species-rich temperate natural grasslands (not pastures) have recorded densities of 42 at the same scale (Lunt 1990), and at the 0.25 m^2 scale Trémont and McIntyre

(1994) have recorded densities of 16 in grazed temperate natural pastures. These results suggest that temperate grasslands may be more diverse at small scales.

At all sites there was a trend to higher species density at higher stocking rates, although the effect was significant only at Cardigan. Average densities at the lowest and highest stocking rates were 11.1 and 13.9/m^2 at Mundubbera, 3.6 and 4.6/0.25 m^2 at Hillgrove, and 4.1 and 5.4/0.25 m^2 at Cardigan, respectively. At the higher stocking rates the matrix of dominant caespitose perennial grasses (e.g. *Heteropogon contortus*) was grazed down and partially eliminated. The reduction in competition from the matrix is likely to have encouraged smaller interstitial species, permitting species density to increase. These smaller species include forbs, annual grasses and short perennial grasses and sedges. Similar mechanisms for changes in species density have been described for temperate grassy vegetation in the New England region (Trémont and McIntyre 1994).

The gradual increases in density with higher levels of grazing were different to the pattern observed in New England, where highest densities were found in lightly grazed habitats (e.g. stock routes) and lowest densities in commercially stocked pastures (McIntyre and Lavorel 1994). The different patterns are attributed to the different range of grazing regimes sampled and the fact that most of the grazing sensitive component (which was encountered in the temperate study) would have already been eliminated from the tropical sites, which had been commercially grazed for more than a century. This emphasizes the importance of understanding site context and management history in studies of biodiversity. High species density at small spatial scales is only one measure of diversity. The representation of the regional grassland flora at pasture sites is also needed to understand the significance of pastures to the conservation of biodiversity.

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