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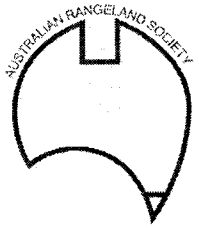

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PATCHINESS IN HERBACEOUS VEGETATION: RELATIONSHIPS WITH SOIL MICROBIAL BIOMASS

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ABSTRACT

This paper reports the preliminary results of studies on patch development in ground cover and its association with soil microbial biomass carbon (MB) at three sites near Charters Towers in north Queensland. At each site MB was significantly lower in bare patches compared with annual grass and perennial grass patches. Bare patch MB ranged from 17-42% of the MB of perennial grass patches with annual patches having 37-85% of the MB of perennial patches. Patch stability and the risk of transition from perennial grass to annual or bare patches is discussed in relation to grazing pressure and the biological capacity of soils to influence such transitions.

INTRODUCTION

Recent evidence suggests that few of Australia's tropical grazing systems are managed as sustainable agro-ecosystems (Williams and Chartres 1991) and that large areas are recognised as either deteriorating or degraded (Tothill and Gillies 1992). The state of a grazing system is usually assessed visually, often in terms of changes in herbage composition and cover and/or changes to soil surface characteristics (Tothill and Gillies 1992). Soil chemical properties are also useful indicators but, as with herbage and soil surface characteristics, provide information on the present state and not the potential for transitions between states. In contrast to most soil physical and chemical properties, soil microbial biomass carbon (MB) responds rapidly to changes in land use or management (Jenkinson 1988) and may therefore provide warning of a potential transition to another state. This paper reports the preliminary results of a study of the MB associated with three distinct herbage types at three sites near Charters Towers in tropical semi-arid north-eastern Australia.

METHODS

The three sites, Hillgrove/Eumara Springs, Cardigan and Lakeview/Allan Hills, are part of a long-term grazing experiment. Patches of bare ground, annual grasses or perennial grasses were sampled in three to six paddocks at each site. All patches were >1 metre diameter and soil samples (0-75 mm depth) were collected from approximately ten of each patch type in each of the paddocks. Grasses present in each of the patches were identified.

Microbial biomass was determined using the fumigation-extraction method of Amato and Ladd (1988).

RESULTS

Herbage biomass was generally much higher in the perennial grass patches than in the annual grass patches. Seventeen species of annual grasses and 13 species of perennial grasses were represented in the patches, with many common to at least two of the sites.

Microbial biomass was significantly different between the soils of each patch type, with bare patches being lowest, annual patches intermediate and perennial patches highest in MB for all paddocks at each of the three sites. Although the absolute values varied between sites, the trend of increasing biomass from bare to annual to perennial patch was consistent across all paddocks and sites. Mean values for each site are presented in Table 1.

Table 1. Soil microbial biomass (μg C/g soil) of herbage patches at three sites in north Queensland (standard error in parentheses).

Site	Patch Type		
	Bare	Annual grass	Perennial grass
Hillgrove/Eumara Springs	81 (22)	147 (53)	272 (23)
Cardigan	57 (5)	141 (22)	190 (33)
Lakeview/Allan Hills	49 (10)	101 (22)	161 (34)

DISCUSSION

Intra- and extra-cellular enzymes released into the soil by the MB are largely responsible for mineralisation of soil organic matter into plant available nutrients (Smith and Paul 1990). A change in the MB will affect the supply of nutrients in soils, thereby indirectly influencing the growth and survival of the herbage layer. The very low MB of soils in the bare patches and, to a lesser extent, in the annual patches will result in lower mineralisation rates, lower levels of plant available nutrients and, hence, lower potential herbage growth within these areas. These results are consistent with those of Holt (in press) who showed that the MB of heavily grazed pastures in the Charters Towers region was significantly lower than in lightly grazed pastures.

Microbial biomass is the active fraction of the soil organic matter, having turnover times measured in weeks (Parton *et al.* 1989). It responds very quickly to changes in system management and can be documented long before secondary effects such as changes in pasture composition and soil chemical and physical properties are manifested. Microbial biomass could therefore be an early indicator of a change in the ability of soil to maintain herbage production. Since patches of annuals are intermediate in MB between the bare and perennial patches, they might logically be viewed as a temporary phase during a transition from pastures dominated by large areas of perennial herbage to poor pastures with extensive areas of bare soil. Future studies will examine the hypothesis that the direction of transition can be predicted by analysing short-term changes in the MB, and that MB may allow the risk of pasture degradation under a range of management and environmental parameters to be assessed.

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