Mortality Model for a Perennial Grass in Australian Semi-Arid Wooded Grasslands Grazed by Sheep

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Introduction Grazing of sheep in marginal semi-arid environments is risky because grazing appears to predispose grass plants, especially palatable species, to sudden death (Hodgkinson, 1994; 1995). These early observations were based on a preliminary analysis of perennial grass survival in a single drought and supported the concept of tactical grazing proposed by Westoby *et al.* (1989) as a preferred management. Later this idea was developed by suggesting the existence of critical thresholds for perennial grass survival, which when crossed, collapses grass populations (Hodgkinson, 1994). Here we examine the relationship between mortality of a palatable perennial grass, *Thyridolepis mitchelliana,* and a number of variables measured during a 10-year period.

Materials and methods Seven paddocks, 4 to 15 ha in area, were each continuously grazed by six Merino wether sheep from 1986 to 1996. The landscapes within each paddock have been described by Tongway and Ludwig (1990) and are typical of banded mulga (*Acacia aneura*) woodland. In each of 5 zones within the 7 paddocks at least fifteen 1m^2 quadrats were randomly located. At 3- or 4-monthly intervals each grass plant was examined to see if it were alive and a number of plant and climate variables were measured. Logistic step-wise regression was used to develop the model.

Results On those occasions when plants died, the variables given in Table 1 accounted for a significant amount of the variation considered in a step-wise model. The height of plants (reflecting degree of grazing) accounted for most variation in mortality and then rain/evaporation variables were the next fitted. The only significant interaction term was zone x plant height. All variables had negative coefficients indicating that mortality decreased as variables increased. The relationships derived from the model are shown in Figure 1.

Table 1 Deviance of measured variables (P<0.001, %) in a step-wise regression accounting for mortality of *T. mitchelliana* over a 10-year period. Other variables, NS

Variable	Deviance
plant height	124
rain/evap. 3-6 mo	64
rain/evap. 0-3 mo	39
zone x plant height	25
zone	20
basal diameter	5

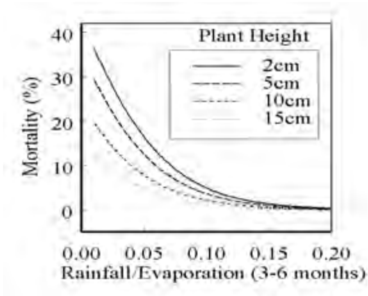

Figure 1 Modelled mortality for different heights and rain/evaporation in the preceding 3-6 months

Conclusions In this wooded grassland, the co-occurrence of drought and heavy grazing predisposes the palatable grasses to higher mortality than if the plants were not grazed. Grazing intensity, as indicated by the average height of grazed plants, had a significant negative effect on plant mortality and the effect increases with the severity of the drought period. This model supports the concept of "death traps" for perennial grasses; the trap is set by grazing and sprung by drought. The relationships can inform managers about when to consider reducing stock numbers on the basis of an approaching drought.

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