The effect of grazing management on the hydrological balance of natural pastures on the North-West Slopes of New South Wales

Sean Robert Murphy

Bachelor of Natural Resources (Hons) – University of New England

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Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged.

Sean Robert Murphy

Abstract

Natural pastures, which are dominated by native plant species, occupy an extensive proportion of Australia (432 M ha, or 56% of the continental landmass). Traditional grazing methods (continuous set-stocking) can lead to low levels of herbage mass, litter mass and ground cover, which in turn leads to high surface runoff, high soil evaporation, and poor pasture growth. A key component of designing a sustainable grazing system for these pastures includes a sound knowledge of the impact of that system on the hydrological balance.

A grazing management experiment was established at Springmount near Barraba on the North-West Slopes to study the effect of five grazing treatments on pasture characteristics while monitoring the associated impact on selected components of the hydrological balance. The grazing treatments included: continuous grazing (4 and 6 sheep/ha), continuous grazing with subterranean clover and fertiliser applied (8 sheep/ha), and rotational grazing (4 sheep/ha) with pastures grazed for four weeks and rested for four weeks (two paddock rotation) or rested for 12 weeks (four paddock rotation). The continuous grazing treatments had significantly lower mean levels of herbage mass (1500-1800 kg DM/ha), litter mass (100-110 kg DM/ha) and ground cover (70-73%) compared with either rotational grazing or over-sowing with subterranean clover (3000-3500 kg DM/ha, 210-260 kg DM/ha, and 83-90% for herbage mass, litter mass and ground cover, respectively).

The frequency and magnitude of surface runoff events increased with rainfall amount and intensity and as ground cover declined. Runoff was higher on plots that were continuously grazed (142 mm, or 6% of rainfall) compared with those that were grazed rotationally (8 mm, or 0.3% of rainfall).

Daily actual evapotranspiration values ranged from 0.2 to 7.6 mm/d, in winter and summer, respectively, and the maximum bare soil evaporation rate was 3.9 mm/d. Analysis of the data indicated that when soils were wet, high litter mass (3000 kg DM/ha) may reduce evaporation by up to 1.04 mm/d compared with no litter, although at Springmount, the maximum litter was only 780 kg DM/ha.

A neutron moisture meter indicated that profile wetting events were rare and mean plant available water was low (35-56 mm). There were few significant differences between grazing treatments and these were restricted to the surface soil layer (0-30 cm) where root density and evaporation effects were greatest and deeper in the profile (150-170 cm) where soil physical characteristics were different.

Simulation modelling indicated that deep drainage events were episodic with a frequency of 12 events in 31 years, and that grazing management had little effect on the magnitude of these events. However, modelling indicated that canopy interception of rainfall was an important and substantial component of the hydrological balance, particularly for those pastures that had higher herbage mass. Rotational grazing treatments intercepted up to 131 mm of rainfall (or 20% of annual rainfall) compared with just 14 mm for those grazed continuously.

Grazing management may be used to maintain herbage mass between 2000 and 3000 kg DM/ha with litter mass > 1000 kg DM/ha and ground cover > 70%, and so offer the greatest productive and sustainable use of annual rainfall. For such a pasture, loss of water through surface runoff, soil evaporation, and deep drainage may be minimised, while transpiration and canopy interception may be high. Such a pasture may also provide ideal conditions for soil biological activity and so soil health and sustainability.

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