The Northern Grazing Systems Project: Estimating safe stocking rate

Scanlan, J.C.[1], Whish, G.L. [1], Pahl, L. [1], Cowley, R.A.[2], MacLeod, N.D.[3]

1. DEEDI, PO Box 102, Toowoomba. Qld. 4350
2. NT Department of Resources, PO Box 1346, Katherine, NT 0851, Australia.
3. CSIRO Sustainable Ecosystems, 306 Carmody Rd, St Lucia Q 4067

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Abstract

The Northern Grazing Systems project aims to increase adoption of innovative best-practice grazing management by beef producers throughout northern Australia. Four key areas requiring research, development and extension have been identified: stocking rate management; pasture resting; use of fire; and infrastructure development. The three main project components are: synthesis of literature; bio-economic modelling at whole beef enterprise scale; and regional guideline development. Simulations with the GRASP model were used to identify the safe stocking rate for various land types and locations. Safe stocking rate was defined as the fixed stocking rate that produced a mean percentage of perennials in the pasture of 70%. The utilisation rate corresponding to these stocking rates for a fertile land type was 18% at Longreach to 35% at Calliope in simulations using the same parameters other than climate station. For an infertile land type, the differences in safe utilisation rate and the differences in mean pasture production led to a five-fold difference in the safe stocking rate from Longreach to Calliope.

Introduction

Good grazing management in the extensive grazing lands of northern Australia is necessary to maintain and improve pasture condition and ensure an adequate economic return to landholders. Meat and Livestock Australia recently undertook a review of the future research needs for the northern grazing lands (R. Dyer, pers. comm.) and identified four key areas requiring research, development and extension: stocking rate management; pasture resting; use of fire; and infrastructure development. This led to the initiation of the Northern Grazing Systems (NGS) project with the broad aim being to increase adoption of innovative best-practice grazing management by beef producers throughout northern Australia.

NGS has three main components: synthesis of literature; bio-economic modelling at whole beef enterprise scale; and regional guideline development. The first component comprised a review, analysis and synthesis of data and outputs from completed research studies (J. G. McIvor pers. comm.). In the bio-economic modelling (BEM) component, the GRASP pasture simulation model (Rickert et al. 2000) was linked to the ENTERPRISE herd economic model (MacLeod and McIvor 2006) to evaluate management practices at the property level. Information from these two components are then combined with information gathered at regional meetings of technical specialists and selected landholders to produce regional guidelines for grazing management in six regions across Queensland, NT and WA.

Setting stocking rates for land types/regions was a critical aspect of the BEM component. Combinations of field studies and modelling have previously been used to develop methodologies for assessing safe stocking rates within Queensland (e.g. Johnston 1996). The work reported here provides an alternative, modelling approach to determine a safe stocking rate for any particular land type (Whish 2010) and timeframe.

Materials and Methods

The GRASP model was used to simulate the impact of land type fertility and location (rainfall) on safe stocking rates. Specifically, two land types (one fertile and one infertile) were modelled over a period of 60 years at three locations with varying mean annual rainfall - Longreach 409 mm; Duaringa 616 mm; and Calliope 1027 mm. A wide range of fixed stocking rates was modelled and the relationships between % perennials in the pasture, pasture utilisation and stocking rates were investigated. The model included a negative feedback of high utilisation rate on pasture condition.

For this study, a safe stocking rate was defined as the fixed stocking rate that would ensure a pasture composition of at least 70% perennial grasses (on a dry weight basis) over the simulation period. The period 1950-2010 was chosen as the climatic window of interest; for one study this was further divided into three 20-year climate windows.

Results

The longer the climate window, the lower is the safe stocking rate. For the 60-year simulation (1950-2010), the safe fixed stocking rate for a fertile land type (where mean % perennials was >70%) at Longreach was 13 adult equivalents per 100 hectares (AE/100 ha); by contrast, for three consecutive 20-year windows covering the same period, safe stocking rates were 23 AE/100 ha, 17 AE/100 ha and 22.5 AE/100 ha. For the infertile land type, the corresponding safe stocking rates were 6.5 AE/100 ha, 7.0 AE/100 ha and 4.5 AE/100 ha for the three climate windows. A similar pattern exists at other locations (data not presented).

The utilisation rate that maintained good pasture condition (70% perennials) for a fertile land type was 18% 22% and 35% for Longreach, Duaringa and Calliope, respectively (Fig.1). For this land type, a utilisation rate of 25% is commonly used in management guidelines as an indication of a sustainable rate. At that utilisation rate, simulations produced 30%, 52% and 88% perennials for Longreach, Duaringa and Calliope, respectively (Fig.1).

Mean pasture production for the infertile land type increased with increasing rainfall, with mean annual growth being 785 kg/ha, 1932 kg/ha and 2153 kg/ha at Longreach, Duaringa and Calliope, respectively. When this was combined with the higher safe utilisation rate as rainfall increased, the safe stocking rate simulated by GRASP was 3 AE/100 ha, 12 AE/100 ha, 23 AE/100 ha respectively (Fig. 2). Assessing stocking rate based on utilising a certain percentage (25% in this case) of mean growth in ungrazed pasture produced corresponding stocking rates of 5.4 AE/100 ha, 13.4 AE/100 ha and 14.9 AE/100 ha for the three locations. These are much higher stocking rates than those calculated using the new approach.

The same pattern was observed for the fertile site, with the corresponding safe stocking rates being 13 AE/100 ha, 26 AE/100 ha and 49 AE/100 ha for Longreach, Duaringa and Calliope, respectively using the new method.

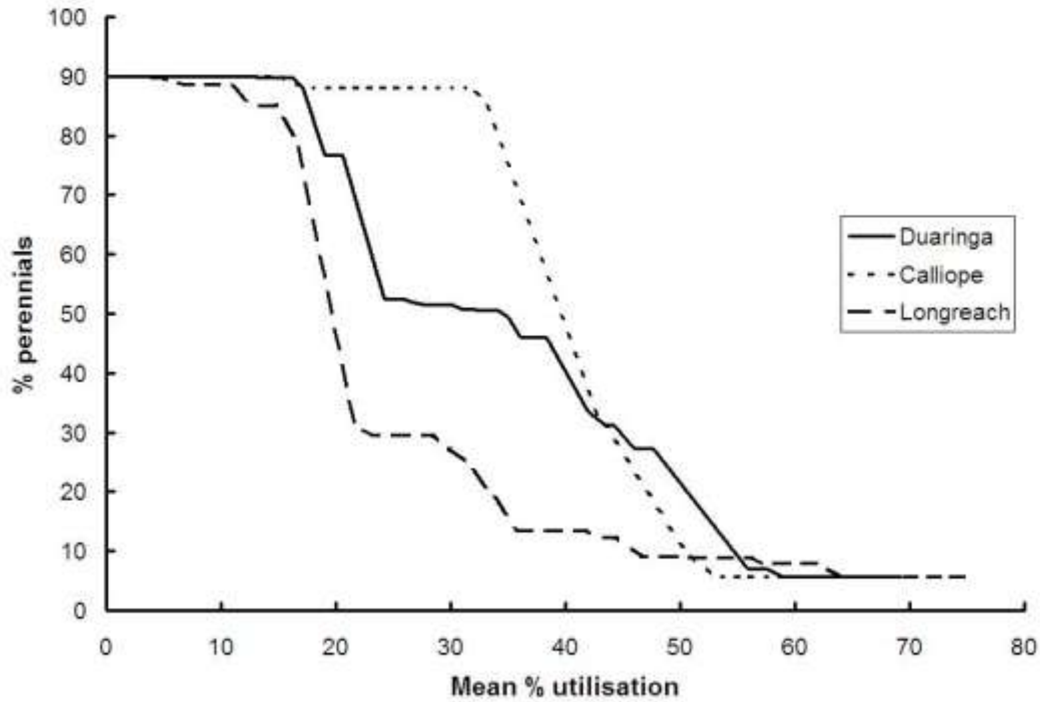

Fig. 1. Simulated percent perennials in pasture at a wide range of utilisation rates for a fertile land type at Longreach, Duaringa and Calliope. Note: same parameter set used for all simulations, with only the climate station changing.

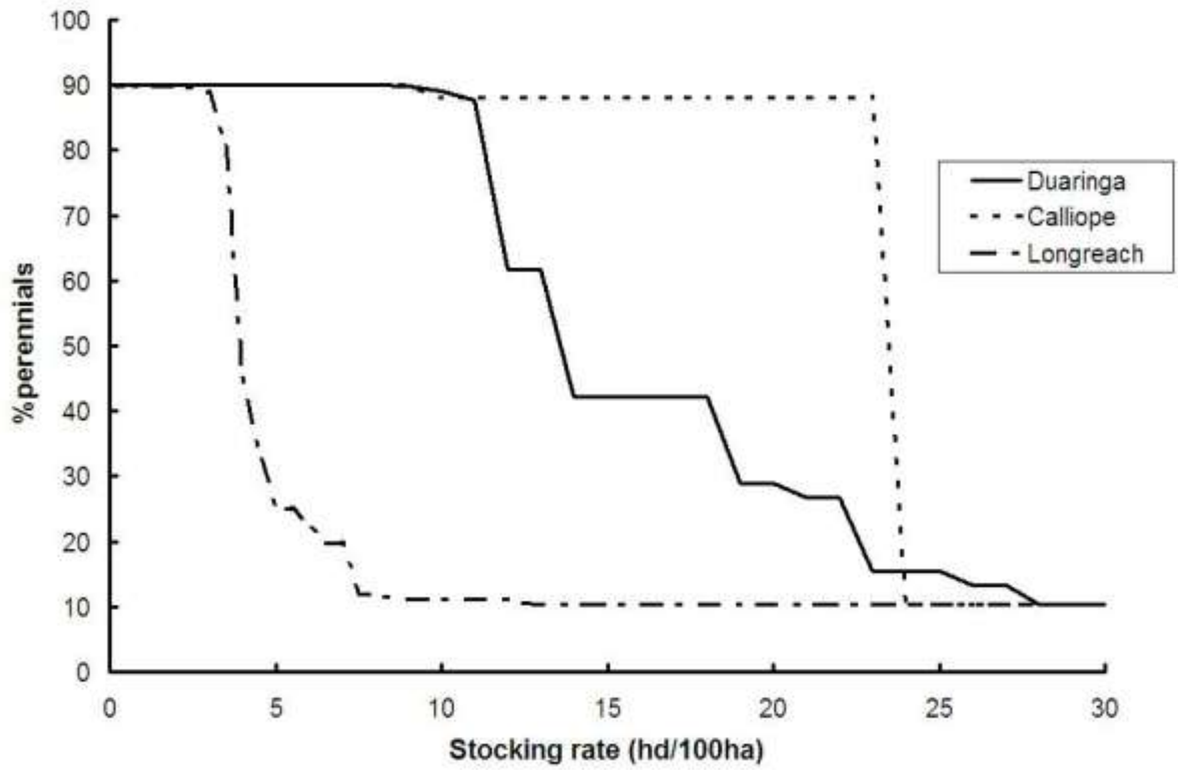

Fig. 2. Simulated percent perennials in pasture for an infertile land type at a range of stocking rates for three different climate locations. Note: same parameter set used for all simulations, with only the climate station changing.

Discussion

While it is well known that climate has a large impact on safe stocking rates, it is less well known that climate also influences safe utilisation levels. For a fertile land type, there was a doubling in the utilisation rate that simulated a pasture with an average of greater than 70% perennials grasses (18% for Longreach cf 35% for Calliope). This is consistent with the work of Hall et al. (1998) who derived a linear relationship between safe utilisation rate and an index of seasonal growing conditions. A key factor leading to this relationship is the variability in rainfall (G.M. McKeon pers. comm.). When this is combined with the influence of rainfall amount on production, safe stocking rates for an infertile land type can span an even wider range (3 to 23 AE/100 ha).

The method described here provides a clear methodology to derive safe stocking rates. The estimates of safe stocking rates are lower than those using a percentage of mean growth in ungrazed pasture. This is because the new method includes consideration of the negative impacts of high utilisation rates on pasture condition (and therefore pasture growth). While other simple methods may give similar answers to the new methodology in some circumstances, they ignore known feedbacks of pasture condition on pasture production and are likely to be less robust.

Safe stocking rates can be derived for any period of interest and for any land type. This is important information for all research and extension activities in the extensive grazing lands of northern Australia. A number of enhancements to the GRASP model are under development to enable other aspects of interest in the NGS project to be modelled, particularly pasture resting, and more flexible or variable stocking strategies.

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