Pasture utilisation – a key driver for profitable grazing

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Abstract: *The SGS Pasture Model was used to predict pasture growth and Merino wether intake of a native perennial grass pasture at Glen Innes, New South Wales for a 101-year period (1908–2008) for continuously grazed and variable stocking rates. With continuous grazing mean annual predicted pasture utilisation was 29% for 3 wethers/ha and 49% for 10 wethers/ha. At the low stocking rate no supplementation was required, while at the high rate about 20% of the total predicted intake came from supplementary feed. While variable stocking rates in which stock density was adjusted daily according to feed availability had the highest predicted pasture utilisation (89%), such adjustments could be difficult to implement. However, a 20% increase in predicted pasture utilisation for a native perennial grass pasture could be achieved by combining it with a system where lambs were opportunistically traded in summer and autumn.*

Key words: stocking rate, stock density, continuous grazing, variable stocking, model

Introduction

Pasture utilisation (i.e. the ratio of animal intake to pasture growth, Stone *et al.* 2008) is widely regarded as a key driver of profitability for the red meat (MLA 2011*a*) and wool (Hyder *et al.* 2004) grazing industries in southern Australia. Utilisation of pasture in southern Australia is typically 25–30% and an increase of up to 20% could double farm profit (Hyder *et al.* 2004). However, despite its importance pasture utilisation is not commonly used by producers as a factor in their business management, since the measurement of pasture growth is time consuming and costly and animal intake is rarely measured in the field. Therefore other means such as estimation of pasture growth and animal intake or their prediction using biophysical models are often used when calculating pasture utilisation.

On-farm, increasing pasture utilisation involves increasing the animal intake of green pasture growth. While intake is influenced by pasture height, density, total herbage mass and digestibility the aim is to maximise the stock density that a pasture can sustain without restricting its regrowth and long-term sustainability (MLA 2011*b*). Within the limits of pasture growth the main way to increase pasture utilisation is to increase stocking density by increasing stocking rate, buying and selling stock (trading), or taking advantage of the natural fluctuations in feed demand that normally occur as part of the reproductive cycle, with intake being least for dry animals and highest in early lactation. However, within a grazing system if intake exceeds pasture growth then different animal enterprises may need to be considered, or alternative higher growth rate pastures/fodders may need to be used. In continuously grazed systems, constant stocking rates imply little attempt to increase intake in response to increased pasture growth (both inter- and intra-annually) and so pasture utilisation is traditionally low, particularly at low stock densities. This situation often occurs in northern New South Wales (NSW), where native perennial grass-based pastures are dominant and tend to be stocked by producers year-round at about their winter carrying capacity (e.g. Lodge *et al.* 2003).

In this paper, we describe the use of the Sustainable Grazing Systems (SGS) Pasture Model (Johnson *et al.* 2003) to simulate pasture growth and animal intake for a native perennial grass-based pasture over a 101-year period of variable climate in northern NSW. These analyses highlight the substantial variation that can occur over time in predicted pasture utilisation at different stocking rates. We also document the marked effect that varying stock density according to pasture availability assessed at different time intervals can have on predicted pasture utilisation. This information was used to devise tactics that could be used on-farm to achieve a modest 20% increase in predicted pasture utilisation.

Methods

The SGS Pasture Model was used to simulate a C_3/C_4 native perennial grass pasture growing at Glen Innes (29 42'S; 151 42'E) on the northern Tablelands of NSW. Parameterised values for this pasture are available within the model and have been widely tested (e.g. Cullen *et al.* 2009; Lodge and Johnson 2008*a*, *b*; Lodge *et al.* 2009) and the soil type was a generic clay-loam. Long-term (1908–2008) daily interpolated weather data for the above latitude/longitude coordinates were abstracted from the SILO Data Drill (Jeffery *et al.* 2001). For all simulations, fertiliser was applied to maintain soil nitrogen above a growth limiting factor (Johnson *et al.* 2003) of 0.75. Simulations were run for; (i) a cutting study to predicted daily pasture growth rate (kg dry matter (DM)/ha/day), (ii) continuously grazed stocking rates of 1–10 wethers/ha, and (iii) four variable stocking rates (stock density adjusted daily, monthly, every two months or every three months according to feed availability). In the model, the pastures in (ii) and (iii) were grazed with Merino wethers (60 kg liveweight) that were supplementary fed to maintain metabolisable energy intake at >60% of daily requirement. All simulations were for a 100 ha area.

For the simulations described, predicted pasture utilisation (predicted net daily pasture growth (kg DM/ha/day)/predicted daily animal intake (kg DM/ha/day)*100) and stock densities (wethers/ha) were compiled to monthly and annual summaries.

Results and discussion

Average annual rainfall at Glen Innes was 831 mm/year and as reported for other centres in northern NSW (Lodge and McCormick 2010) was much lower in the first-half of last century compared with the second-half (Figure 1*a*). In the continuously grazed simulations, mean annual predicted pasture utilisation was 29% for 3 wether/ha (Figure 1*b*) and 49% for 10 wethers/ha (Figure 1*c*), but there was considerable inter-annual variation, ranging from 15–48% for the lower stocking rate (Figure 1*b*) and 33–69% for the higher rate (Figure 1*c*). While predicted pasture utilisation was 100% in the driest years for both stocking rates (Figure 1*b*, *c*) it tended to be higher in the drier years and lower in the wetter years at the low stocking rate (Figure 1*b*) and the opposite at the high stocking rate (Figure 1*c*), reflecting differences in the ratio of intake and pasture growth for both markedly different stocking rates and seasonal conditions.

Mean monthly predicted pasture growth ranged from 2.6 kg DM/ha/day in winter to 36.2 kg DM/ha/day in summer (Figure 2*a*), reflecting both the frost-sensitive nature of the dominant C_4 native perennial grasses and their ability to respond to summer rainfall and higher temperatures. In terms of being able to rapidly change stock densities, these large seasonal differences in growth rates are a challenge and indicate short time-frames for increasing stocking rates or buying and selling options, and at the whole-farm level the need to fill the winter-early spring 'feed gap' if spring lambing/

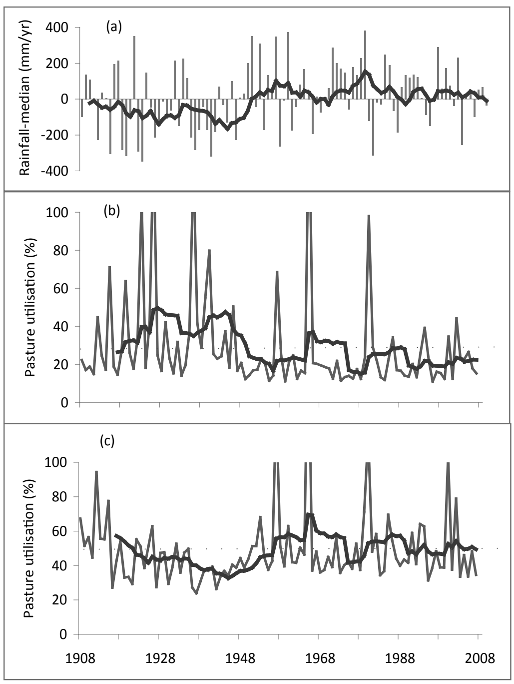

Figure 1. (*a*) Interpolated annual rainfall (mm) minus median annual rainfall for Glen Innes, NSW from 1908–2008, and predicted pasture utilisation (%) under continuous grazing at stocking rates of (*b*) 3 wethers/ha and (*c*) 10 wethers/ha. The smoothed line is the 10-year trailing mean.

calving enterprises are being considered. Available options would therefore be limited to trading in young sheep for red meat production and the use of sown pastures, winter fodder crops, oversown legumes and supplements for alternative livestock enterprises.

Under continuous grazing, increasing stock density from 1 to 10 wethers/ha increased mean annual predicted pasture intake from 0.5 to 2.9 tonnes (t) DM/ha/year (Figure 2*b*) and increased predicted pasture utilisation from 10 to 49%. However, at stock densities above 5 wethers/ha the intake of supplements as a proportion of total intake rapidly increased (Figure 2*b*) indicating that total intake exceeded pasture growth in some years. Clearly, increasing stock density is a simple way to increase pasture utilisation, but as stock density increases pasture intake as a proportion of total feed intake may decline.

Varying stock density either daily, monthly or every two or three months according to feed availability had a marked effect on the maximum predicted mean monthly stock density, but little effect on the minimum predicted mean monthly stock density (Figure 2*c*), highlighting the temperature restrictions on pasture growth in the winter months. Maximum predicted monthly stock densities were highest in summer, ranging from 30 wethers/ha when stock density was adjusted daily to 22 wethers/ha when it was adjusted monthly and 17 wethers/ha for both the two and three month adjustments (Figure 2*c*). Predicted monthly stock densities were lowest in July (~3 wethers/ha for all variable stocking rates, Figure 2*c*). Shortening the time-frame for making decisions about stock density based on a simple measure such as feed availability markedly affected predicted pasture utilisation, increasing it from 54 to 62% as the time decreased from three to two months, and from 76 to 89% as it decreased from one month to one day. No supplementation was required for any of the variable stocking rates, although mean predicted stocking rates varied from 16 wethers/ha for those adjusted every day to 9 wethers/ha for adjustments made every three months. While a short time interval of one-day may not be practical for adjusting stock densities, our results indicated that continuous adjustment gave the best match between pasture growth and intake over time.

Using the current simulations, a 20% increase (as suggested by Hyder *et al.* 2004) in the predicted pasture utilisation of a native pasture stocked at 3 wethers/ha (the winter carrying capacity) could be achieved in two main ways. Firstly, by increasing the continuous stocking rate to 10 wethers/ha (predicted pasture utilisation increased from 29 to 49%). However, at the low stocking rate no supplementation was required, but at the higher rate about 20% of the total predicted intake came from supplementary feed (mean predicted intake of 0.7 t DM/ha/year), mostly in the drier years. Secondly, by maintaining a stocking rate of 3 wethers/ha and also opportunistically trading lambs in the summer–autumn period to utilise the extra feed grown in most years and adjusting overall

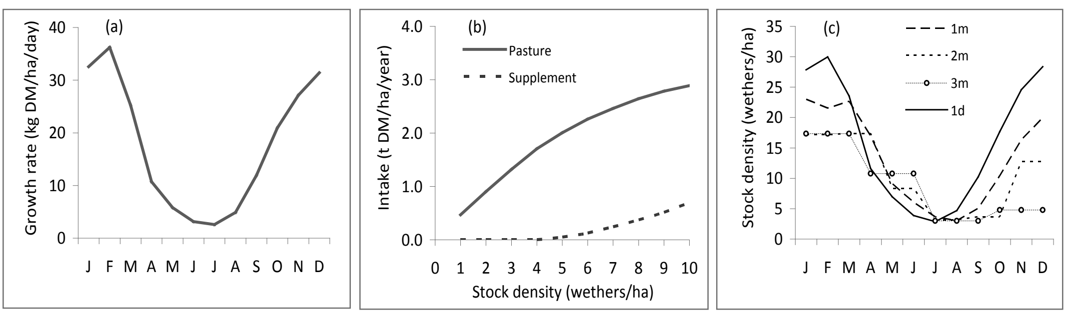

Figure 2. (*a*) Predicted mean monthly pasture growth (kg DM/ha/day), (*b*) predicted mean annual animal intake (t DM/ha/year) for stocking densities of 1–10 wethers/ha and (*c*) mean monthly stock densities (wethers/ha) for variable stocking rates with stock density adjusted monthly (1m), every two months (2m) or every three months (3m) and daily (1d), according to feed availability.

stock density every three months based on feed availability. More complex changes could be made to increase pasture utilisation, but these would require adjustments to the feedbase to increase pasture growth at those times of the year when it was limited (i.e. growing different pastures and forages) and increasing intake by changing from wethers to breeding enterprises.

Other general strategies that could assist in achieving a better balance between pasture growth and intake and so increasing pasture utilisation include; using stocking rates that are at or above the annual carrying capacity of the pasture; avoiding long-term supplementation (when the pasture to total intake ratio is low); matching feed grown to animal demand; using buying/selling to provide flexible stock densities, and using grazing plans, forage budgeting and monitoring of pastures, animals and land condition.

Conclusions

Simulations using the SGS Pasture Model indicated that an increase of 20% in the predicted pasture utilisation of a native perennial grass-based pasture continuously grazed by Merino wethers at a rate of 3/ha could be achieved by either (i) increasing stocking rate to 10 wethers/ha, or (ii) also opportunistically trading in lambs in the summer–autumn period and making adjustments to stocking density every three months based on feed availability. For over 100 years of variable climate the first approach increased the need for supplementation, particularly in the drier years, while the second approach would depend on feed quality being adequate to produce trade quality lambs. This study highlighted that modelling could have a role in both demystifying the concept of pasture utilisation for producers and in providing benchmark values for different pastures and livestock enterprises.

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