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A NEW METHODOLOGY FOR THE CALCULATION OF PASTURE UTILISATION FOR GRAZING LANDS

G.S. Stone[1], G.W. Fraser[1], P.J. O'Reagain[2], P.K Timmers[1,3], J.J. Bushell[2]

[1]Queensland Climate Change Centre of Excellence, EPA, Brisbane Qld 4068

[2] Department of Primary Industries & Fisheries, Charters Towers, Qld 4820

[3]Current address: Fire & Rescue, Department of Emergency Services, Brisbane Qld 4001

Email: Grant.Stone@climatechange.qld.gov.au

ABSTRACT AND INTRODUCTION

Pasture utilisation is a term used to describe the estimation of animal intake of pasture dry matter expressed as a proportion of either pasture growth per season or nominated period. The calculation has been used for purposes of evaluating animal production and grazing pressure impacts on the pasture resource, including the flow-on effects to runoff and soil loss. Pasture utilisation is a unifying concept across grazing trials (McKeon and Rickert 1984) and hence there has been increasing interest from rangeland scientists, policy makers and the grazing industry to determine optimal pasture utilisation across a range of land types for the purpose of improving rangeland management.

Information from the Wambiana grazing trial at Charters Towers was used to model 'potential' pasture growth, and provide estimations of animal intake and pasture utilisation. This analysis was performed on a paddock-by-paddock basis for each draft of steers (annual grazing period) from 1997 to 2007. The GRASP model (McKeon and Rickert 1984) was used to produce daily pasture simulations from SWIFTSYNpD data (Day and Philp 1997) collected at the trial and the QuikIntake spreadsheet model (McLennan and Poppi 2004) was used to calculate feed intake. Liveweight of steers and pasture dry matter digestibility (DMD) were interpolated to daily values using a linear interpolation function in an MS EXCEL spreadsheet. The resultant time-series include accumulated pasture growth, feed intake, pasture digestibility and pasture utilisation. The information presented in the time-series provides a valuable summary of management outcomes and is used to compare differing grazing strategies across land types for both production and sustainability issues.

Key words: *pasture, pasture utilisation, grazing trial, feed intake, QuikIntake, GRASP*.

BACKGROUND AND METHOD

Location for Analysis

The Wambiana Grazing Trial located 70 km south-west of Charters Towers provided the necessary field data (e.g. pasture biomass, pasture digestibility, rainfall, animal liveweight) and general information (e.g. burning, land type) for this analysis. The trial has ten paddocks comprising five treatments with 2 replicates, which include: high stocking rate (HSR); low stocking rate (LSR); variable stocking rate (VAR); rotational wet season spell (Rspell); and variable stocking rate based on pasture total standing dry matter and Southern Oscillation Index (SOI) based predictions. The stocking treatments, soils and land types in the trial are well described in O'Reagain *et al.* (2008).

Pasture Growth Simulation and Generation of Daily Data

Pasture production data using SWIFTSYNpD methodology was gathered across land-types over the duration of the grazing trial. The GRASP model was parameterised with particular attention to the differences in soil fertility between land types. The parameter sets were then used to simulate pasture growth yields over the period of the grazing trial (1997 to 2007). The proportional area of each land-type (e.g. Box, Ironbark, and Brigalow) in each paddock was then used to calculate an overall daily paddock pasture growth. The simulated growth does not include the effects of grazing in terms of decline in resource condition that occurred during the trial.

An issue with making calculations of feed intake using animal liveweight data collected intermittently are the ‘jumps’ from one period to the next. For example, steers recorded as 250 kg at weighing may be consuming ≈5.4 kg DM head/day with a 54% DMD; when the steers are weighed 40 days later at 270 kg with a 60% DMD the intake could be 6.0 kg DM/head/day. Hence, uncertainty arises as to what intake values should be used for the interim period between weighings.

As steer liveweight and pasture digestibility data from the grazing trial was provided on a ≈monthly basis, an interpolation process was developed to convert periodic data to daily values. Lookup tables were constructed in an MS Excel spreadsheet, which returned an incremented value per day for steer liveweight (kg) and pasture digestibility (%DMD), to establish a daily time-series of values. These values were used to estimate a daily feed intake as part of the pasture utilisation calculation.

Feed Intake and Utilisation Calculation

Estimates of dry matter intake (DMI) are fundamental to the calculation of utilisation and have varied considerably between different extension and research reports. Different approaches were evaluated for estimating DMI, including: simple daily estimates based on metabolic body weight; the intake equation of Minson and McDonald (1987) using liveweight gain and liveweight; a spreadsheet model (QuikIntake, McLennan and Poppi 2004) using inputs of digestibility, liveweight gain and liveweight based on equations from SCA (1990); and intake estimates from GRASP based on converting animals to weaner equivalents based on the intake equation of Siebert and Hunter (1977).

After review it was decided to use ‘QuikIntake’, the MLA funded spreadsheet model produced by McLennan and Poppi (2004), to calculate DMI. QuikIntake had the advantage of including pasture digestibility algorithms in the model to account for changes in observed feed quality and liveweight which, in turn, influence estimates of DMI. Relevant information (age, current liveweight, liveweight change per day, dry matter digestibility and distance walked) was entered into the QuikIntake model to estimate DMI for each day and by paddock (i.e. ≈3500 days x 10 paddocks). Other inputs such as gender, breed, terrain and distance walked were kept constant. A ‘macro’ was generated in MS Excel to automate the process. Supplementation of steers has not been included in this analysis, but could be estimated in further studies to improve estimates of feed intake.

Pasture utilisation (i.e. the ratio of animal intake to pasture growth) was then calculated for each steer draft by paddock for the duration of the trial. Feed intake per steer was summed to give total feed intake per paddock using the number of steers that were present on a given day. Daily pasture growth was summed for each land type in a paddock. At the end of an annual grazing period (usually the end of May), utilisation for each draft was calculated as the sum of daily feed intake values (kg DM/paddock) divided by the sum of daily pasture growth values (kg DM/paddock) expressed in percentage terms.

RESULTS AND DISCUSSION

A time series of annual pasture utilisation for the ten paddocks of the Wambiana Grazing Trial for drafts of steers from December 1997 to June 2007 (10 draft periods) is shown in Figure 1. Draft periods varied from 180 days (1997/98) to 377 days (1999/2000) with an average duration of 346 days. Pasture utilisation across all paddocks was light for the first few drafts of the trial (e.g. 1997-2000) due to wet conditions and, in turn, high pasture growth. However, from 2000 onwards, utilisation levels were much higher due to drier conditions and lower pasture growth. The years from 2001-2005 (the millennium drought) showed a series of peaks and troughs where pasture growth was severely reduced, while steer numbers were maintained at earlier rates. The utilisation rates during this period were particularly high for the High and Variable stocking rates (HSR, VAR). With an overall reduction in stocking rates and more moderate seasons, the rates of utilisation were reduced in 2006 and 2007. A full analysis will be undertaken to relate paddock pasture utilisation rates of the various treatments to pasture condition.

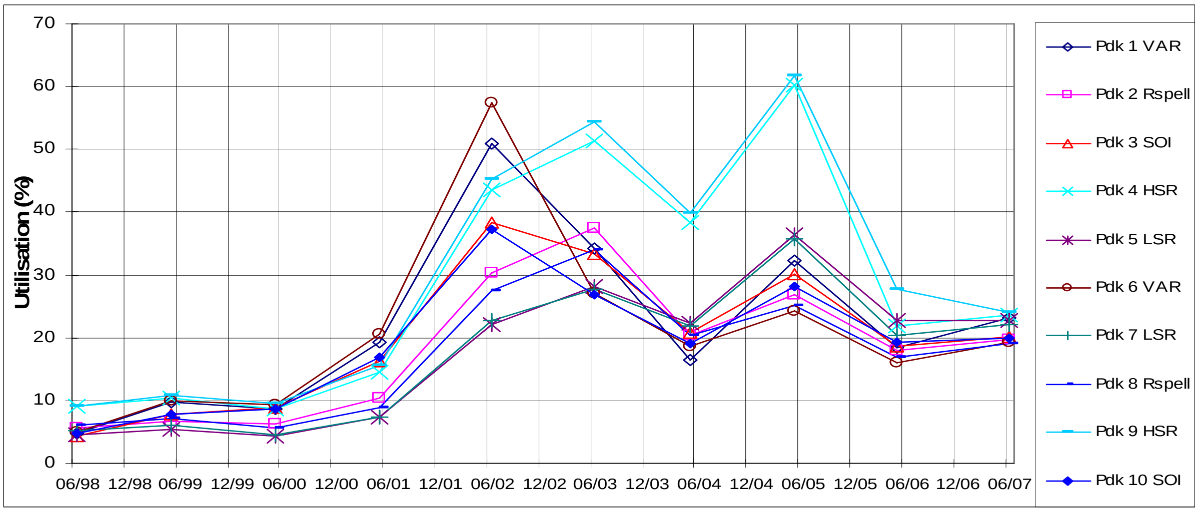

Figure 1. Time series of annual pasture utilisation for the 10 paddocks in the Wambiana grazing trial. There were 10 draft periods for the duration of the trial (December 1997 to June 2007).

While Figure 1 enables comparison between paddocks, further information is required to fully interpret the results. For example, for Paddock 1 (VAR), we have graphed other information including daily values of pasture digestibility, animal numbers, pasture intake (accumulated per draft) and accumulated pasture growth (accumulated per draft). It can be seen from Figure 2 that high pasture growth in the period from 1997 to 2000 combined with low steers numbers resulted in a low rate of utilisation (i.e. 5-10). Increased grazing pressure from 2000 coincided with reduced pasture growth and resulted in high utilisation. When numbers were reduced (from mid 2002), the utilisation rates remained high for year 2003 and 2005 respectively (e.g. 40 and 38%).

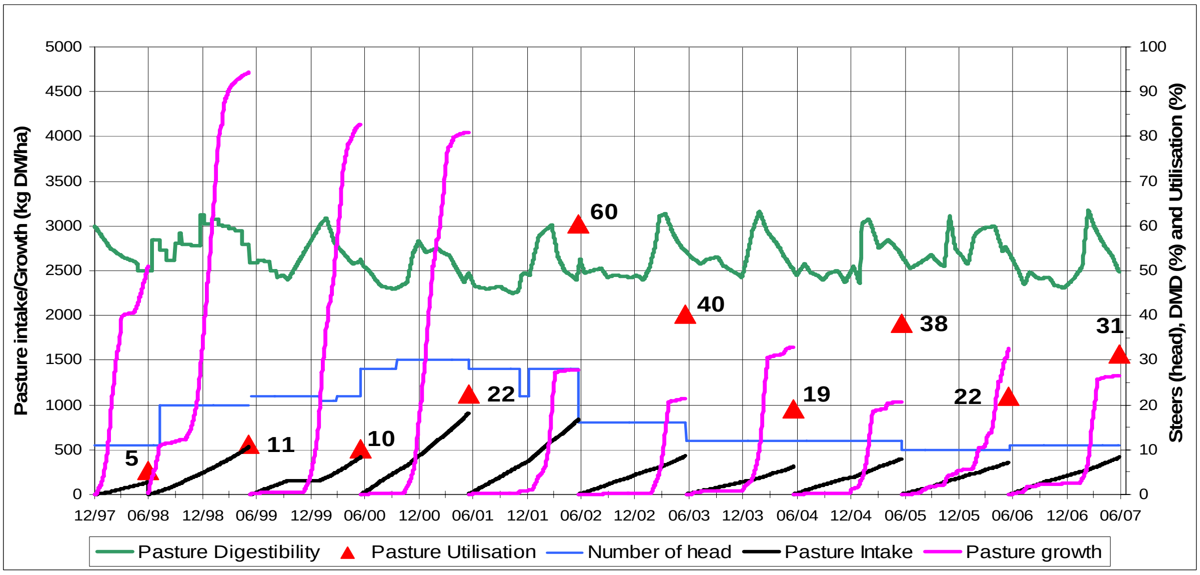

Figure 2. Grazing summary for Paddock 1 (variable stocking rate) of the Wambiana grazing trial from December 1997 to June 2007.

If the effects of grazing pressure were used as a feedback on pasture growth simulations, the rate of utilisation would be higher, particularly in the low growth years from 2001. Above average years (e.g. 1997-2000) can set unrealistic expectations of annual stocking rate and result in loss of desirable perennial grasses and pasture run-down. In the ensuing lower pasture growth years, grazing pressure needs to be managed carefully to avoid degradation of the pasture base. This was apparent in years such as 2003 and 2005, where steer numbers were low, but still too high (i.e. <30% utilisation) for long term sustainability. Where the gradient of feed intake (Figure 2, black line) is greater than pasture growth (purple line), it shows that the steers are consuming pasture faster than it is growing, implying that the previous year's growth would be utilised. Consumption of standover feed is also an issue for pasture sustainability as it provides protective groundcover against erosion in early summer storms.

CONCLUSION

Further analysis of utilisation would involve the simulation of pasture growth including the feedback effects of grazing on the pasture resource. These effects include changes in grass basal area, species composition and infiltration attributes of the soil surface. Calculation of pasture growth using this approach would use actual paddock measurements, including measured pasture yields and pasture basal area data. Animal effects would include the use of supplementation and variation in distance walked per day to reflect variation in seasonal pasture variability, as both of these factors influence feed intake. Wet season spelling can also be incorporated to calculate the pasture utilisation on individual spelled cells. This analysis will be carried out once the pasture data have been collated and each paddock calibrated with the GRASP model.

For grazing trials that are current (e.g. Wambiana), the analysis can be added to with each year's data for calculation. The calculation of pasture utilisation outlined in this paper has also been carried out on the Keilambete Grazing Trial (e.g. Jones *et al.* 2008). It could be repeated for all grazing trials (e.g. Galloway Plains) where information (as described above) can be provided. In this way, there will be a standardised approach applied to past, current and future grazing trials. For the first time the outputs from all trials can thus be assimilated and meaningfully compared using a standard process.

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