PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE

Official publication of The Australian Rangeland Society

Form of Reference

The reference for this article should be in this general form;
Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).
For example:
Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite (*Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15th Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

ESTIMATION OF PADDOCK LEVEL PASTURE PRODUCTION USING PADDOCKGRASP IN WESTERN NEW SOUTH WALES

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ABSTRACT

Matching livestock numbers with seasonal variation in forage supply is a major challenge for rangeland graziers. This paper describes the use of a spatial pasture growth model (Paddock GRASP) to assist stocking rate decisions at either paddock or property levels. The spatial framework allows the estimation of pasture growth on a paddock by paddock basis, when sub-models are parameterised for specific soil types and vegetation communities within individual properties. Forward projection from current conditions for up to 12 months, based on historical climate data, allows the risk associated with alternative stocking options to be readily appreciated. Output from the model includes estimates of the long term carrying capacity of each paddock and pasture type, estimates of the grazing month-stocking rate options available at the 20th, 50th and 80th percentile levels of future pasture growth, and expected ground cover at the end of the planning period if the current stocking rate is maintained, again at the 20th, 50th and 80th percentile levels. Understanding of the likely environmental consequences of the current stocking policy and the prospects for future forage availability should provide useful input to stocking rate decisions in a risk management context.

INTRODUCTION

Matching livestock numbers with seasonal variation in forage supply is a major challenge for rangeland graziers. Particularly where rainfall is not distinctly seasonal, as in western NSW, this task involves consideration of likely future seasonal conditions. Probabilistic estimates of future pasture growth have considerable potential to assist stocking rate decisions in these circumstances, enabling graziers to capitalise on good seasons while minimising the economic and environmental costs of drought.

To this end, we are working to develop stocking rate decision tools using the PaddockGRASP model at either paddock or property level. PaddockGRASP is a spatial framework within which the GRASP pasture growth model (Littleboy and McKeon 1997) can be run for polygons that represent pasture types within paddocks. The framework allows the estimation of pasture growth and related variables (e.g. total standing dry matter, stocking rate) from environmental and metrological data on a paddock by paddock basis, as well as for pasture types within paddocks. The model accounts for factors such as soil type, existing pasture type and condition, and tree cover. When combined with seasonal climate risk assessment techniques it has the capacity to estimate future pasture production and ground cover at defined level of probability.

PROPERTY SET UP IN PaddockGRASP

Incorporation of a particular property into the Paddock GRASP framework requires appropriate mapping of infrastructure and land resources as well as the parameterisation of the GRASP model for each of the vegetation communities on the property. The first step is to accurately map the physical features of the property.

In our development of PaddockGRASP for two prototype properties in the Western Division, boundary fences, internal fences, rivers, dams and roads were first mapped using a GPS flashcard. Satellite imagery was then used to map land units corresponding to variations in soil and vegetation attributes, particularly soil water holding capacity and tree basal area (TBA), which are important for parameterisation of the GRASP model.

From each land unit, soil samples from several locations were collected from depths of 0-10 cm, 10-50 cm and 50-100 cm using a hand auger. Particle size analysis was then used to determine the soil texture class of each sample and to estimate its water holding capacity. Permanent Wilting Point and Field Capacity were determined by matching the particle size distribution (% clay, % silt and % sand) to a standard soil hydraulic property chart.

Approximate TBA for each unit was estimated using the Bitterlich method. A Bitterlich gauge 50 cm long with a cross arm defined by pins 10mm apart was used to count trees with apparent diameter equal to or wider than the cross-arm at approximately 1.3m above the ground. Several sites were sampled within each unit, and counts made from several points at each site. A gauge of these dimensions has a Basal Area Factor of 1.0 so that the count from any point is equal to the TBA in m^2/ha.

MODEL OUTPUT

The model provides both a carrying capacity assessment and a seasonal risk assessment.

Carrying capacity based on long term average pasture growth is provided for both paddocks and pasture types (Table 1, a and b). The lower carrying capacity of the riverine corridor in this example may be attributed at least in part to the high tree basal area, and perhaps also the high clay content that may limit the effectiveness of small rainfall events.

For the seasonal risk assessment, current climate data are downloaded from either SILO or CLIMARC data files. The model is then run from the beginning of the climate record to the present, and current conditions, including estimated soil moisture, are saved. Field estimates of current pasture biomass are then used, together with the historical rainfall record, to project pasture growth forward for a nominated period (3-12 months) and provide estimates of the grazing months available, for a range of stocking rates, at the 20^{th}, 50^{th} and 80^{th} percentile levels (Figure 1). The output is provided for each paddock and for land units within paddocks. In the example given in Figure 1, the grazing months available for the whole paddock at a stocking rate of 1ha/DSE range from about 1 month under poor seasonal conditions to about 4 months under good seasonal conditions. The available grazing could be extended to about 8 months, assuming good seasonal conditions, by halving the stocking rate (2ha/DSE). The model also provides the expected ground cover at the end of the period if the current stocking rate is maintained, again at the 20^{th} 50^{th} and 80^{th} percentile levels (Figure 2).

Table 1: Long term carrying capacity of each paddock (a) and land type (b) on a prototype property in the Western Division

a

Paddocks	Carrying Capacity (DSE)	Carrying Capacity (Ha/DSE)	Average Growth	Available Growth	Accessible (%)	Safe Utilisation %	Un-palatable %	Area Ha
Corbins	1570	2.2	1700	230	100	15	10	3,077
Harts	460	2.2	1610	220	100	15	10	965
Holding	50	1.8	2000	270	100	15	10	89
Hut	20	1.9	1900	260	100	15	10	43
Irrigation	90	2.5	1420	190	100	15	10	218
Little River	400	2.9	1350	180	100	15	10	994
River Gum	230	4.2	1,040	140	100	15	10	734
Road	900	2.1	1720	230	100	15	10	1,745
Strip	120	2.1	1680	230	100	15	10	243
Whitewood	470	2.6	1490	200	100	15	10	1,062
Totals	**4320**	**2.5**	**1570**	**210**	**100**	**15**	**10**	**9,170**

b

Land Types	Carrying Capacity (DSE)	Carrying Capacity (Ha/DSE)	Average Growth	Available Growth	Accessible (%)	Safe Utilisation %	Un-palatable %	Area Ha
Bare red ridges	1950	1.5	2280	310	100	15	10	2,849
Coloured cracking clays adjacent to drainages with trees	1080	3.0	1120	150	100	15	10	3,208
Grey cracking clay soils in drainages	1180	2.1	1610	220	100	15	10	2,439
The riverine corridor	120	5.5	600	80	100	15	10	675
Totals	**4320**	**2.5**	**1570**	**210**	**100**	**15**	**10**	**9,170**

Available Pasture = (Annual Growth) x %Accessible x (1-%Unpalatable) x %Safe Utilisation
Growth, Available Pasture, %Accessible, Safe Utilisation%, and %Unpalatable are averaged, weighted by area, over all areas within paddocks and land types
Safe Utilisation is set by the user and not calculated by PaddockGRASP

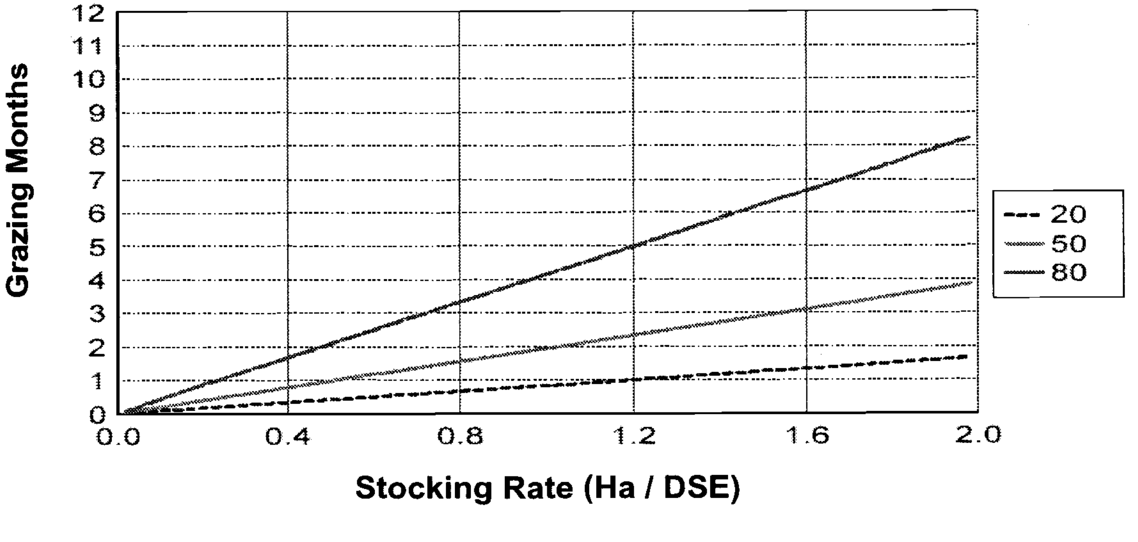

Figure 1: The estimated grazing months available for Corbins paddock at a range of stocking rates for the six month period from the 9 March 2006 to 9 September 2006 (assuming no further growth after 9 September 2006). Lines correspond to the 20tH, 50tH and 80tH percentiles of pasture growth over the period

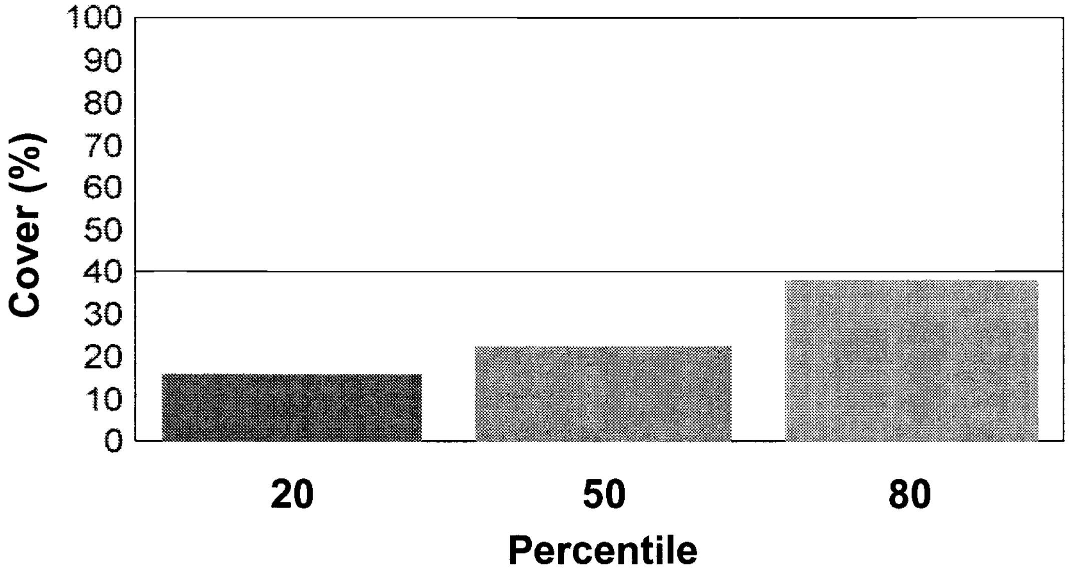

Figure 2: The 20th, 50th and 80th percentile levels of % ground cover (pasture and grass litter) at the end of the model period (9th September 2006), assuming the current stocking rate of 1ha/DSE is maintained

CONCLUSIONS

Understanding of the likely environmental consequences of the current stocking policy (in terms of ground cover) and the prospects for future forage availability should provide useful input to stocking rate decisions in a risk management context. Livestock trading enterprises, in particular, should benefit from such information. Graziers utilising software of this type, which should be readily accessible in coming years, should be better able to match stocking rate and forage supply and achieve improvements in both profitability and sustainability of pastoral enterprises.

ACKNOWLEDGEMENTS

Land & Water Australia and Australian Wool Innovation Limited have supported the development of the PaddockGRASP prototypes, through the Managing Climate Variability and Land Water and Wool Programs. The cooperation of Mr Tony Thompson and Jonathon and Naomi Vagg, whose properties have served as prototypes for Paddock GRASP, is gratefully acknowledged.

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