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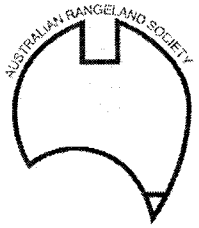

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PRECISION MANAGEMENT SYSTEMS FOR PASTORAL LIVESTOCK PRODUCERS

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ABSTRACT
Available technology now allows individual animals to be identified and weighed whenever they access water, data to be telemetered to a remote computer, and animals to be automatically drafted on the basis of weight or other individualistic criteria. The application of spatial pasture growth models to seasonal risk assessment (eg PaddockGRASP) allows current and future stocking rates to be assessed in an explicit risk management framework, providing a new capacity to assist with the matching of forage demand and forage supply. The combination of these technologies potentially provides rangeland pastoralists with an unprecedented capacity to manage for both economic and environmental outcomes. The capacity to produce frequent and reliable estimates of live weight also provides a new tool for the development of models linking pasture growth and animal production.

INTRODUCTION
New and increasingly available technologies are today providing pastoralists with opportunities to improve profitability and enhance sustainability not previously feasible in extensive management systems. These technologies relate to both the animal and pasture components of the system and together constitute what may be described as 'precision pastoralism'.

Central to 'precision pastoralism' are the capacities to manage individual animals, or animal groups, according to their specific requirements, and to address more effectively the central issue of matching forage supply and demand to achieve both optimum animal production and sustainable resource use.

THE ANIMAL MANAGEMENT SYSTEM
The capacity to record the weight of individually identified animals, telemeter this information to a remote office and subsequently activate an automatic drafting race on the basis of specified criteria is now a reality. Physically, this system involves:

- Spear gates and a race that allow animals access to water in 'single file', while passing over a weighing platform;
- RFID (Radio Frequency Identification) tags applied to each animal;
- A tag reader installed in the race in parallel with the weighing platform;
- A scales indicator/computer that accepts input from both the tag reader and the weighing platform;
- A CDMA connection that allows downloading of tag number-weight pairs to an office computer via a modem and dial-up connection; and
- An automatic (two-way) drafting race that can be programmed, via the indicator, to separate the mob into two groups based on weight or tag number.

The system now operational at Prattenville is as shown in Figure 1. The system is portable and the objective is to use it, or its component parts, as required throughout the property.

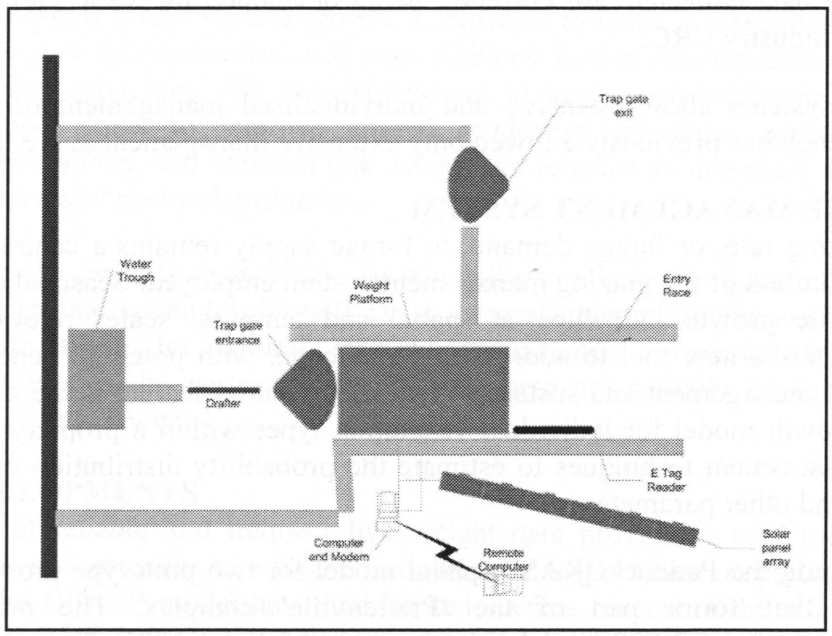

Figure 1: The 'walk through' weighing and drafting system established at Prattenville showing various components. Power is supplied by batteries charged by solar panels. The total cost of this installation is about $15,000

In addition to the physical infrastructure, soft ware is required on the office computer to 'clean up' the downloaded data stream by removing anomalous readings, such as occur when two animals are simultaneously on the weighing platform or an animal is in an agitated state. Only about 60-70% of readings are useful but when 'clean up' software is developed, about 5-7 useable body weight measurements per sheep per week can be expected (J. Rowe, pers. comm.). The final product will be in Excel format and software development is currently in progress within NSW DPI.

Applications of this system may include:

- monitoring stock remotely to minimise need for physical checking, particularly when used in conjunction with level sensors at watering points;
- monitoring animal performance in relation to forward contracted specifications
- drafting of animals based on weight, or weight gain, criteria - either for sale, supplementation or other husbandry practices;
- drafting of animals on the basis of other individualistic information e.g. reproductive status (empty, single lamb, twin lamb), age or classer assessment;
- drafting out animals without tags (e.g. ferals); and
- in the future, possible individual application of preventative veterinary treatments.

Although not of immediate application to pastoral enterprises another benefit of this technology may be in the establishment of female pedigree in stud breeding flocks, based on the observation that lambs tend to follow dams over the weigh bridge (R. Mortimer, pers comm.). Development of acceptably accurate female pedigree data without the cost of physically 'mothering up', or of DNA fingerprinting, could allow a substantial improvement in the estimation of breeding values for both ewe and ram selection.

Systems similar to that shown in Figure 1 will soon be available from a number of commercial manufacturers. Protocols for certification of these systems, in terms of the accuracy of the data collected, are currently being developed by NSW DPI in cooperation with the Sheep Industry CRC.

Overall, such systems allow intensive and individualised management of animals in an environment which has previously allowed only extensive management at the flock level.

THE PASTURE MANAGEMENT SYSTEM

Matching stocking rate, or forage demand, to forage supply remains a central challenge for pastoralists regardless of the grazing management system employed. Seasonal risk assessment based on pasture growth modelling at spatial and temporal scales relevant to pastoral management offers a new tool to address this challenge, with potential benefits for animal production, risk management and sustainability. The essential feature is the parameterisation of a pasture growth model for individual vegetation types within a property and the use of seasonal risk assessment techniques to estimate the probability distribution of medium term forage supply and other parameters.

We are developing the PaddockGRASP spatial model for two prototype properties in NSW, including one that forms part of the 'Prattenville' complex. The process involves parameterisation of the GRASP model (Littleboy and McKeon 1997) for specific vegetation types mapped within each property. A number of parameter sets for GRASP are already available for western NSW and translation to the community-within-property level involves, in the first instance, the derivation of the major parameters that are thought to drive pasture production – plant available water and tree basal area. Both of these can be estimated using rapid techniques once vegetation communities have been mapped (Alemseged *et al.* 2006).

Output from the PaddockGRASP model provides:

- pasture growth estimates (for paddocks and vegetation types within paddocks) for the next 3-12 months at the 20^{th}, 50^{th} and 80^{th} percentile levels;
- corresponding estimates of stocking rate based on sustainable levels of pasture utilisation; and
- ground cover at the end of the planning period, at 20^{th}, 50^{th} and 80^{th} percentile levels, if the current stocking rate is maintained.

This output places the resource management implications of the current stocking regime in clear perspective, given the widely accepted figure of 40% as the minimum desirable cover level for semi arid rangelands in western NSW, and provides valuable input to tactical management decisions concerning the sale, agistment or purchase of stock.

A number of other systems to assist such decisions are currently available or under development based on satellite imagery (eg Basin *et al.* 2006). However, we would argue that the capacity to project forward, and to provide information that assists decision making in a risk management context, is an important advantage of simulation based approaches.

SYNERGIES

Technologies of the type described above are no substitute for the practiced eye of an experienced manager. There is no possibility of 'remote management'. However, the capacity to monitor animal performance remotely, and to assess seasonal risk with greater confidence, does provide powerful information to assist the tactical responses required to realise the productive potential of animals in a variable environment.

At 'Prattenville', the livestock enterprise is aimed at trading operations under favourable seasonal conditions, with the property otherwise destocked. The capacity to monitor animal performance and assess future pasture growth is expected to make a substantial contribution to the management of this enterprise, and may facilitate further developments of this kind. However, the same capacities will also be relevant to more traditional enterprises where considerable scope exists to improve animal production by more precisely targeted management interventions, and seasonal risk assessment remains an important and inevitable component of successful pastoral businesses.

At the same time, the capacity to assess the sustainability implications of current management (eg likely future ground cover levels) will assist pastoralists combine the goals of business management with those for natural resource management expressed by Catchment Management Authorities. In western NSW at least, these are partially framed in terms of desired levels of ground cover.

FUTURE DEVELOPMENTS

The availability of reliable and frequent live weight data provides a new tool for model development. Previous attempts to estimate live weight changes based on pasture production estimated with the GRASP model have had limited success, except at the relatively coarse annual level (Hall, 1996). We are hopeful that the availability of this new data source will facilitate a considerable refinement of this capacity and provide even more powerful information for rangeland livestock producers.

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