Grassland Landscape Design: Working with Land-Managers

C. J. Pearson
Bureau of Rural Sciences, Australia

R. K. Mann
Greenwich Group Pty Ltd., Australia

I. G. Mann
Greenwich Group Pty Ltd., Australia

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GRASSLAND LANDSCAPE DESIGN: WORKING WITH LAND-MANAGERS

C.J. Pearson[1,2], R.K. Mann[2] and I.G. Mann[2]

[1]Bureau of Rural Sciences, PO Box E11 Kingston ACT 2604

[2]Greenwich Group Pty Ltd, 89 Jansz Crescent, Griffith ACT 2603

Abstract

We are entering an era of landscape design in order to simultaneously tackle large-scale issues such as salinity and rising water tables, whole-farm profitability and the maintenance or enhancement of rural communities. In Australia, an important element of landscape design will be the reintroduction or broadening of the base of perennial grasses within farm systems. The goal of this project was to accelerate awareness and adoption of perennial grasses in a large but ecologically-specific area, namely the already-cleared steep uplands in the high rainfall recharge areas of the Murray-Darling Basin. We used a participatory model, in which land-managers made monthly observations of grassland composition and condition, and of livestock. This paper describes the project, some of the outcomes eg that stocking rate varied more within grassland types than between types, and could be relatively high, eg 10 adult sheep equivalents per hectare on indigenous grasslands. Land-managers' data eg height, were coupled to correlations with other variates such as dry matter and leaf area, to derive seasonal estimates of digestible dry matter-on-offer, and environmentally-important variates such as seasonal evaporation. Collection of these data by land-managers creates opportunities for local awareness and the development of regional data sets which are not possible through traditional small-plot research. In our view, land-manager

participation, leading to awareness and in some cases enthusiasm, will be a prerequisite for regional landscape design.

Introduction

For more than a decade there has been widespread recognition of the value of deep-rooted perennial grasslands for control of water tables and, less directly, salinity. However, attempts to establish and maintain perennial grasses have often been disappointing, in part because the historical emphasis has been on introduced grasses such as phalaris (*Phalaris aquatica)* and cocksfoot (*Dactylis glomerata),* while there is little understanding of the value or biology of indigenous grasses such as *Themeda*, *Danthonia*, *Microlaena,* and *Bothriochloa* species. We believed that community-based participatory research would be the only method available to collect information on widespread indigenous grass communities to achieve a level of awareness of the biology of these grasses, beginning with issues as rudimentary as their identification. This awareness would be essential for local communities to undertake "landscape design" whereby they would make decisions as to long-term alienation of different classes of land to crops, perennial grasslands and woody perennials, to address sustainability in biological, economic and social terms.

Material and Methods

Following a period of consultation, which included 22 community meetings, a Steering Committee, the majority of which were land-managers, first met on 2 March 1994. The Committee developed a methodology for monitoring grasslands on rural properties across a wide geographical area, from Boorowa, New South Wales (lat 34^{o}S long 148^{o}) to Avoca, south-west of Bendigo, Victoria (lat 37^{o}S long 144^{o}). Properties were selected as being representative of low input, already-cleared steep rural uplands in the high rainfall and recharge areas of the Murray-Darling Basin. The area was defined as having between 600 mm annual rainfall and the high-rainfall boundary of the Murray-Darling Basin watershed. This includes about 1.04 million hectares of native or indigenous pasture and 1.56 million hectares of sown pasture. Properties which were monitored had acid soil of low fertility and upper slopes commonly >10^o. Soil pH using 1:5 soil/0.01M $CaCl_2$ extraction, ranged from 4.0 to 4.7 in 22 of 23 sites, and pH 5.1 at one site. Topsoil P using an Olsen extraction ranged from 3.0 to 8.5 ug per g in 21 of 23 sites and 10.5 and 18.0 ug per g in the other two. Twenty-three land-managers monitored their grasslands for periods of up to about 800 days: 15 fields were monitored for between 630 and 784 days, four fields for between 470 and 560 days and four fields from 226 to 288 days. The main species in each field were *Danthonia* (in 6 fields), *Microlaena* (6), *Bothriocloa* (3), *Themeda* (3), or sown *Phalaris* and *Dactylis* (5)

On each property, the project team built twelve exclosures within one representative field; each was 3 x 3 square metres, fenced and netted to exclude large wildlife. Land-managers made estimates such as the percentage of particular species, percentage of greenleaf area, scores for the extent to which the main species was grazed, and scores for grass phenology, both within the exclosures and at a paired site, five metres into the grazed grassland. Livestock movements were also recorded as a basis of calculating grazing pressure, as adult sheep equivalents (ASE) per hectare.

Sampling was also undertaken by researchers, to allow us to calculate correlations between the land-managers' estimates, eg of percentage composition, versus the researchers' estimates. Correlation r^2 values ranged from 0.19 to 1.0. At ten of the sites the majority of correlations had r^2 values in excess of 0.60. At one site, the manager's observations correlated with those of the researcher with seasonal r^2 values of 0.90, 0.95, 0.95 and 0.92; at another, r^2 were consistently about 0.89.

Results

From discussions with land managers and the correlations between land-managers' and researchers' observations, we concluded that approximately 60% of the sites produced "scientifically useful" data; this is necessarily, a subjective judgement. Additionally, in a high percentage of sites the activity of monitoring caused the land managers to substantially increase their knowledge of grass identification and biology and their awareness of pasture dynamics; this led to far higher levels of reflectiveness and sophistication in their management. In two sites, land managers did not maintain their early enthusiasm and gained little or no benefit from involvement with the project. Table 1 illustrates some of the data which the land-managers collected (first column) and reflects on its usefulness.

An outcome arising from this research deals with the stocking rates (SR) that were maintained throughout the observation periods. Observed SR, in adult sheep equivalent per hectare, varied from 3.1 to 4.9 for Themeda; 1.9 to 10.8 Danthonia; 3.8 to 10.0 for Microlaena and 3.9 to 6.0 for Bothriochloa as compared to 8.5 to 15.9 for Phalaris and Cockfoot. These illustrate wide variation within grasslands dominated by any particular species, and also that the indigenous species were in many cases maintaining stock at grazing pressures as high as those in the introduced phalaris (*Phalaris aquatica*) or cocksfoot (*Dactylis glomerata*) grasslands. There was no correlation between stocking rate and either soil phosphorus or soil pH. The two sites which had atypically high soil phosphorus (10.5 and 18 ug per g soil), which were dominated by *Microlaena* and *Themeda*, supported intermediate stocking rates of 6.8 and 4.9 ASE per ha.

Considering now the seasonal dynamics of the grasslands, Figure 1a illustrates this for a *Microlaena* grassland near Albury, on the border of New South Wales and Victoria. Understandably, the height of the grazed grassland was always lower or the same as that in the fenced exclosures. For 6-8 months each year the height was 4 cms or less, rising to approximately 20 cms (or up to 40 cms in the exclosure) when the main species became reproductive, in early summer. Coupling the land-managers' grazing scores with their observations of height indicated that, for the three species of indigenous grasses which were measured, preferential grazing falls-off above heights of about 4 cms.

The land-managers' estimates of grass height were coupled with linear correlations of height and leaf area, and height and dry matter digestibility, from samples taken on the same properties. Using these correlations and estimates of the percentage of ground covered by green herbage, as well as meteorological office evaporation data for nearby towns, allowed the land-managers' data to be used to estimate seasonal dry matter-on-offer, digestible dry matter, and water use. Figure 1b illustrates seasonal patterns in digestible dry matter, while estimated daily evaporation from the grassland is shown in Figure 1c.

Discussion

The project demonstrated that land-managers can define research opportunities and then effectively take responsibility for collecting data within their grasslands. We believe that this type of participatory research - the involvement of land managers in both the problem identification and their taking responsibility for implementing the project - should lead to increased awareness of the complex biology of grassland systems as well as rapid dissemination of their observations to their neighbours. There was substantial adult learning within the project, with most land-managers now able to identify at least six indigenous and introduced grasses. Some, through their involvement in the project, became enthusiasts for management of indigenous perennial grasses. These grasses were largely ignored prior to this project. A minority of participants also developed adaptive seasonal grazing strategies which would benefit the perennial grasses, as well as a new level of understanding of issues such as seasonal palatability and animal intake. This project, covering a wide arc (approximately

2000 kilometres) of south-east Australia, satisfied criteria such as those identified by Pearson (1994) and Pinhero *et al* (1994) that action should be socially constructed and based on power sharing: the "experts" acted as facilitators for the learning community. It is difficult to imagine more effective ways of increasing local knowledge and enthusiasm for "landscape design".

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Table 1 - Some of the Observations made by land-managers, with comments

Data	End-use	Comments
Botanical composition	Develops farmer recognition of various grasses first step to awareness of their value in terms of biodiversity and desirability of having mixed grassland ground cover and to provide alternative feed sources at various times of the year	Farmer recognition developed within project (to the extent that some collaborators are hosting field-days); stimulated interest and demand for a reference /key to grass identification. Project assisted in addressing this need by crossing State borders and re-printing/publicising Mitchell's grass booklet (Mitchell 1994)
Percentage ground cover	Allows gross estimation of water residence times and surface run-off and erosion	Can be used as input into computer based models eg SWIM. Addresses one of the crucial "multiple ecological uses" of perennial grasses
Percentage green	Allows grass estimate of likely water use	Gross water use or catchment evaporation may be calculated from % green x height (as a surrogate for dry weight or leaf area) after taking account of ground cover. Referred to pan evaporation from nearby meteorological office site.
Percentage composition and height	Allows estimate of dry matter on offer to livestock and wild life	When coupled with digestibility and protein contents of the target grass this allows estimate of standing crop and value for livestock; and hence informs stock management
Grazing (score)	Develops farmer awareness of palatability and seasonal value of various species	An input, with estimates of digestible feed-on-offer, into seasonal grazing management

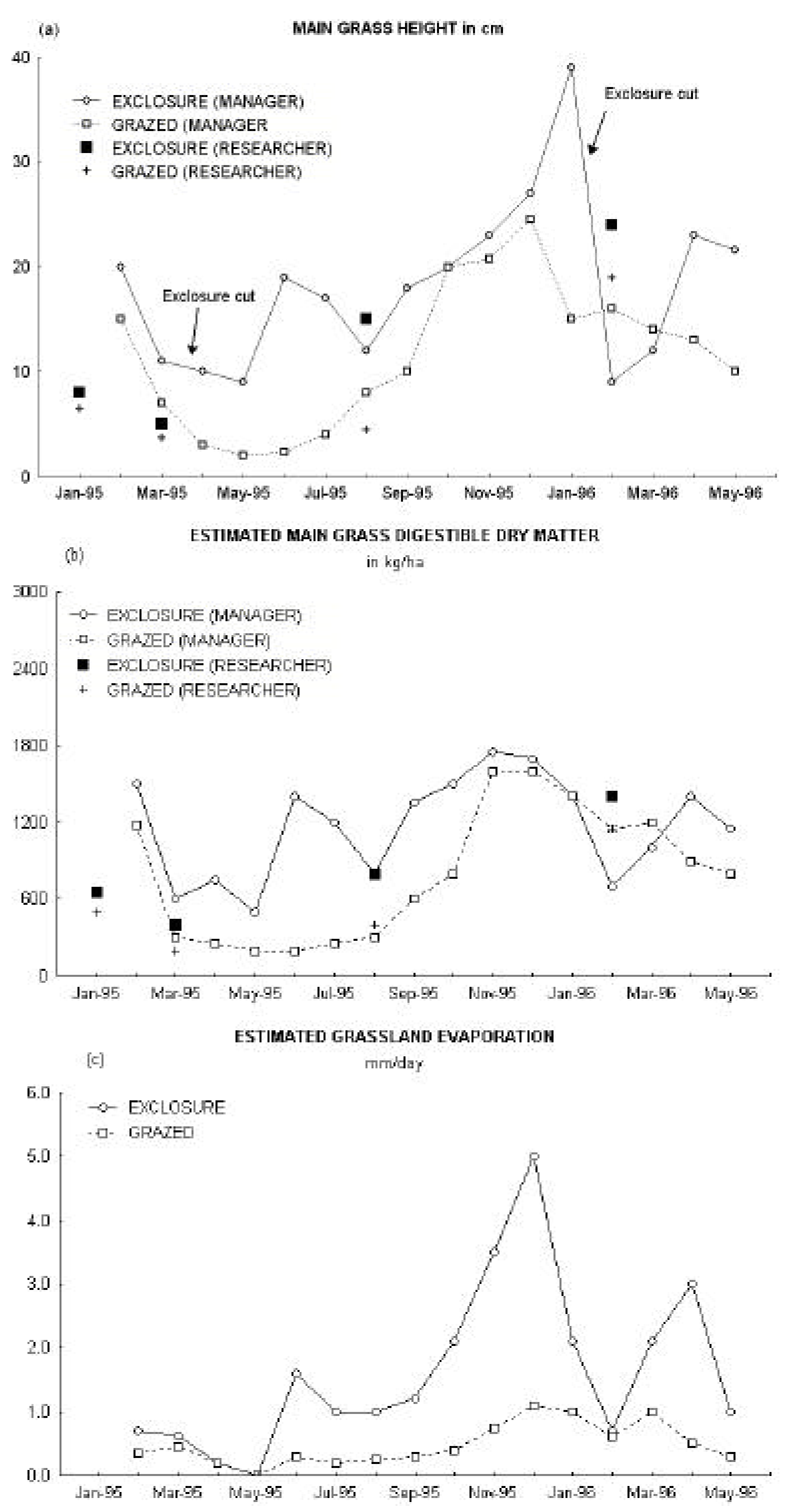

Figure 1 - Average height and estimated digestible dry matter on offer (B) and grassland evaporation (C), in a Microlaena grassland at Albury.