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REPORTING CHANGE IN THE RANGELANDS
HOW WELL CAN WE INTEGRATE BIOPHYSICAL DRIVERS OF CHANGE?

Gary Bastin [1] and the ACRIS Management Committee

[1] CSIRO, PO Box 2111, Alice Springs NT 0871

INTRODUCTION

Extensive pastoralism, (that is, the grazing of sheep and cattle) occupied 3.67 million km^2 (59% of the rangelands) and contributed $1.8 billion (74% of rangeland agricultural production) in 2001 (Bastin *et al*. 2008). This production is important to the Australian economy, but at what environmental cost? There has been much debate in the rangelands literature and at past rangeland society conferences as to how sustainable current grazing practices are. Recent examples include Watson *et al.* (2007) (the density of longer-lived species important for livestock production are being maintained or increased at monitoring sites in the arid shrublands of WA) and Pringle *et al*. (2006) (acute degradation processes are still occurring in the same region, especially within and surrounding drainage lines).

Agency monitoring programs to report changes in the vegetation (and in some cases, soils) have operated in most rangeland jurisdictions for 15+ years (see Appendix 1 in Bastin *et al*. 2008 for brief descriptions and Watson *et al.* 2007 for an example of results). When available data are combined, how effective are these programs in reporting the sustainability of recent grazing management across all of the rangelands? Recent seasonal conditions often have the biggest influence on changes detected at monitoring sites while, in much of northern Australia, extensive fire is another important agent of change.

Can available monitoring data identify improving areas, assist with determining the management practices responsible for this improvement and provide land managers with due recognition of their positive management? Conversely, where adverse change appears to be occurring, how confident are we of the likely causes of change? Where we are certain that ameliorative action is required, do we have the capacity or willingness to implement required management, administrative or policy responses with sufficient speed to prevent significant degradation? In this paper we demonstrate how the Australian Collaborative Rangeland Information System (ACRIS) has reported change, between 1992 and 2005, in the longer term availability of stock forage (defined as 'critical stock forage') and identified the probable influences of recent seasonal conditions and fire on such change.

MONITORING DATA

Site-based monitoring data are available for the pastoral estate of four rangeland jurisdictions: WA, SA, NSW and the NT. In the southern rangelands, palatable 'decreaser' shrubs are the main indicator of critical stock forage. Elsewhere, and particularly in northern Australia, palatable perennial grasses provide the indicator. Queensland does not operate a monitoring program to specifically report change in critical stock forage. Rather, change is inferred from AussieGRASS simulation of estimated pasture utilisation as demonstrated by Hall *et al*. (1998).

Seasonal effects prior to each site reassessment were filtered using a 'seasonal quality' matrix used by Watson *et al*. (2007). Recent rainfall at each site, derived from the SILO database, was compared with the long-term (1900-2005) record to provide a tercile rank (i.e. seasonal quality below average, average or above average). The seasonal quality score and direction of change for all sites within a reporting region (e.g. bioregion) were then tabulated to summarise change (example results in Table 1). In reporting regional results (Fig. 1 below), ACRIS focuses on the two shaded cells of Table 1: i.e. (i) where decline occurred following above-average seasonal quality (increase expected at this time) and (ii) increase occurred following below-average seasonal quality (decline expected at this time).

Table 1. Seasonally interpreted change in the composition (by biomass) of palatable perennial (2P) grasses, as an example of the regional reporting of change in critical stock forage, for the NT part of the Mitchell Grass Downs bioregion.

Seasonal Quality	Number of sites	Percentage of re-assessed sites showing		
		>20% decrease	No change	>20% increase
Above average	210	10	71	19
Average	124	4	73	23
Below average	45	7	60	33

Change in critical stock forage

The percentage of reassessed sites in pastorally important bioregions in WA, SA, NSW and the NT showing a decrease in the indicator of critical stock forage following above-average seasonal quality is mapped in Fig. 1. Most bioregions had <20% of reassessed sites recording decline under better seasonal conditions. The most significant areas differing from this general trend were the Northern Kimberley sub-IBRA, Ord Victoria Plain bioregion and Eastern Goldfields sub-IBRA, all in WA. Note that the reported results apply to the local area of sites only, not the entire area of each bioregion.

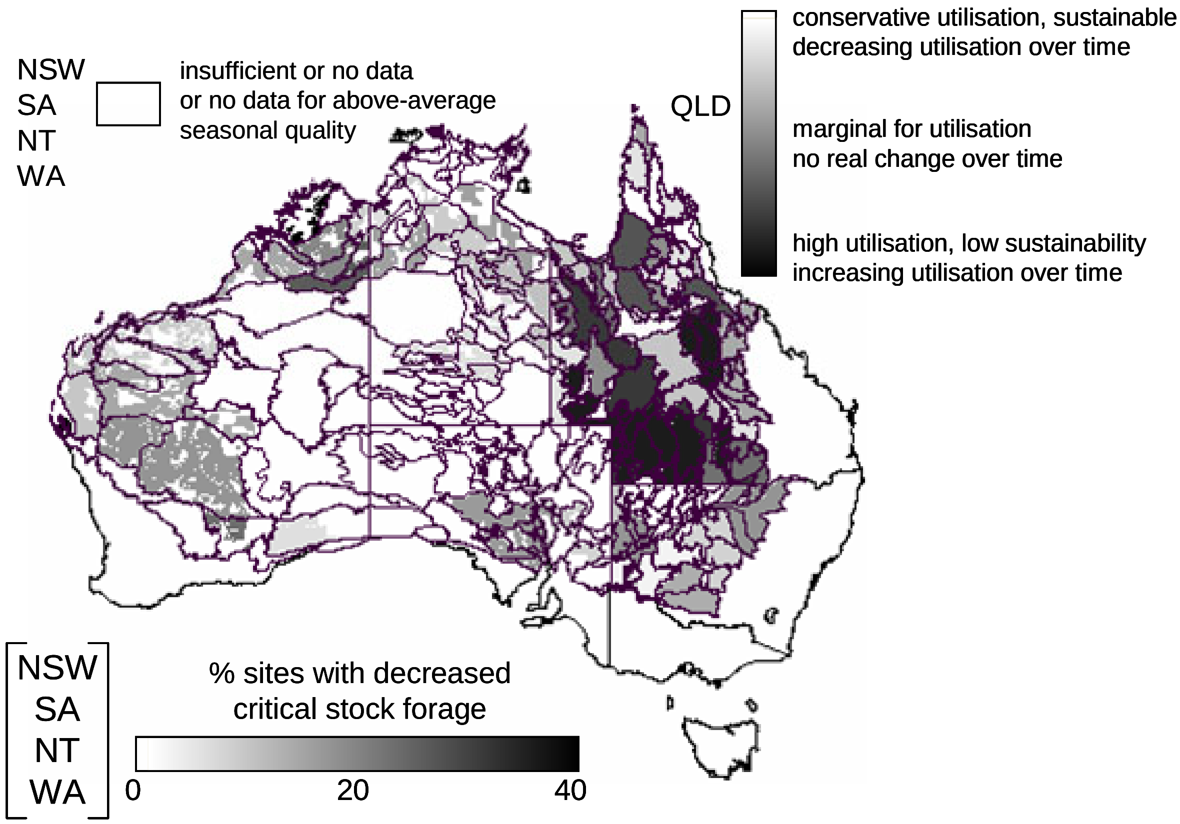

Figure 1. WA, SA, NSW and NT: the percentage of reassessed monitoring sites showing a decrease in critical stock forage following above-average seasonal quality (increase expected at this time). Queensland: indicated sustainability of stock forage based on AussieGRASS simulation of pasture utilisation. Line work shows the rangelands and bioregion boundaries.

The results for Queensland, based on AussieGRASS simulation of levels of pasture utilisation, are obviously different and it is not possible to compare results with neighbouring jurisdictions (Fig. 1). Most of the Brigalow Belt North and South, Cape York Peninsula and Einasleigh Uplands bioregions had utilisation levels during the 1991-2005 period that were less than the specified safe threshold which suggests that levels of stock forage were being sustained. Parts of the Mitchell Grass Downs and Simpson Strzelecki Dunefields bioregions also fitted this category. Simulated levels of pasture utilisation were considerably above specified safe thresholds, indicating they were not sustainable, throughout much of the 1991-2005 period in the Desert Uplands and Mulga Lands bioregions and in most of the Channel Country sub-IBRAs. Utilisation levels in parts of other bioregions (mainly the Darling Riverine Plains and Mitchell Grass Downs bioregions) were also considered non sustainable. Levels of pasture utilisation were close to the threshold safe level, hence marginally sustainable, for much of the Gulf Plains and remaining parts of the Mitchell Grass Downs bioregions. Pest animals, and particularly feral goats and kangaroos, contributed substantially to total grazing pressure and high (unsustainable) levels of pasture utilisation in some bioregions, particularly the Mulga Lands.

Spatial averaging of utilisation levels across sub-regions conceals local variability. Within reporting units (i.e. sub-IBRAs) there were undoubtedly areas (paddocks and properties) with lower (more conservative) and higher (less sustainable) levels of pasture utilisation than that reported as the average for each sub-IBRA.

Livestock density

The Australian Bureau of Statistics (ABS) conducts an agricultural census every five years and surveys a smaller number of primary producers in other years. ABS data were concorded from Statistical Local Area to bioregion and reported, for 1992-2004, as relative change in livestock density compared with the 1983-91 average (as a base) for pastorally important bioregions.

Some south eastern bioregions showed a consistent trend in reduced livestock density over the 1992-2004 reporting period (e.g. the Riverina) and some northern bioregions displayed a continuous increase for the same period (e.g. Pilbara bioregion). Seasonal conditions and the relative profitability of enterprise options no doubt influenced these trends. South-eastern Australia has experienced several very dry years, profitability of wool growing has declined and there has been a shift to dryland cropping and irrigated agriculture, where possible, in the rangeland margins of this region. In contrast, seasonal quality in much of northern Australia was well above average for much of the 1992-2005 period and cattle prices were buoyed by the live-shipper trade into south-east Asian markets. The consistent growth in cattle numbers for several northern bioregions raises concerns for the ACRIS Management Committee as to producers' capacity to adequately (and rapidly) reduce grazing pressure with the inevitable return of poorer wet seasons.

The ACRIS Management Committee compared relative changes in livestock density with seasonal quality for pastorally important bioregions. Our measure of seasonal quality is based on annual (or wet season) spatially averaged rainfall for the 1992-2005 reporting period ranked as deciles against the long-term (1890-2005) record. The seasonally interpreted trend in livestock density for the Desert Uplands bioregion is illustrated in Fig. 2.

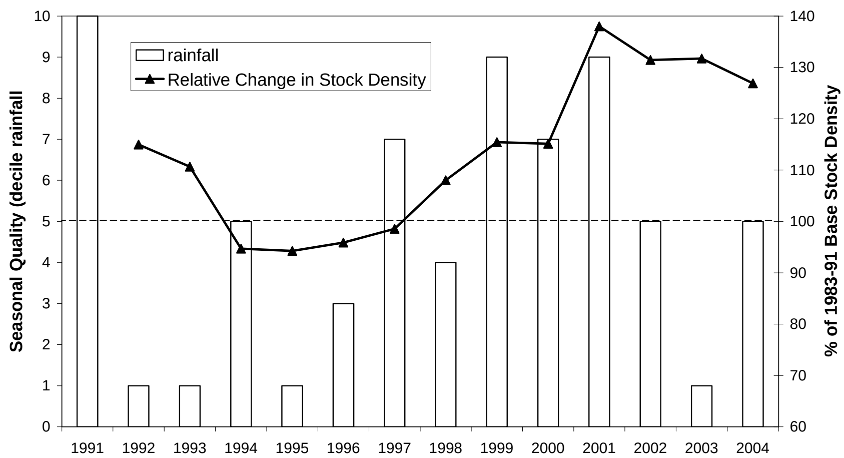

Figure 2. Change in relative stock density related to seasonal quality, based on April to March annual rainfall, for the Desert Uplands bioregion. The dashed line shows both median rainfall and stocking density equal to the 1983-91 average.

The decline in livestock densities between 1992 and 1994 was in line with below-average rainfall in 1992 and 1993. Livestock densities increased appreciably between 1997 and 2001 with a run of higher seasonal quality. Then, contrary to expectation, livestock densities only declined slowly between 2001 and 2004 with the return of drier years. This suggests a miss-match between the management of stock numbers and seasonal conditions.

The Desert Uplands example demonstrates that multiple datasets (stock numbers and rainfall) provide useful information, but fully interpreting changes requires additional sources of information as context (e.g. land management practices, cattle prices, supplementary feeding, infrastructure such as additional waters and fencing that may allow more stock to be safely carried).

Fire

Wildfire is extensive and frequent in northern Australia (Bastin *et al*. 2008). At yet ACRIS lacks data of suitable resolution to directly relate the regional occurrence of fire to its likely impact on site-based change in critical stock forage. However, some of the adverse change in frequency of decreaser perennial grasses in the Northern Kimberley (NK1) and Ord Victoria Plain bioregions reported above (Fig. 1) would seem related to extensive fire.

CONCLUSIONS

This paper provides a glimpse of the more complete account of recent changes in the rangelands available in *Rangelands 2008 – Taking the Pulse* (Bastin *et al.* 2008). Data reporting change in critical stock forage derive from the pastoral monitoring programs of the States and NT and demonstrate the collaborative nature of ACRIS. Significantly, the examples shown illustrate how data representing various drivers of change (season, livestock numbers and fire) can be used to provide more complete understanding of changes in one aspect of sustainable management. Gaps remain in our ability to comprehensively report change in the rangelands. Monitoring is largely restricted to the pastoral estate and is focussed on production attributes in some jurisdictions. Care is required in extrapolating results beyond the locations of monitoring sites as Pringle *et al*. (2006) have shown that neighbouring landscape components can indicate contrasting trends in their functional state. Current consultancies will advise the ACRIS Management Committee on methods that allow more rigorous reporting of trends based on current data and expanded monitoring of biodiversity.

This paper demonstrates that the individual findings of *Rangelands 2008 – Taking the Pulse*, and their integration, provide a more informed picture of sustainable management than was previously available. This information can contribute to improved policy and decision making.

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