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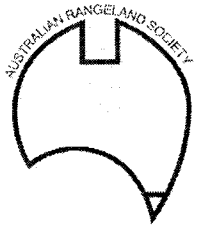

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IMPACTS OF GRAZING UNGULATES ON GONDWANAN LANDSCAPES AND RESPONSES TO THOSE IMPACTS – AN EXAMPLE FROM THE GASCOYNE RIVER CATCHMENT OF WESTERN AUSTRALIA

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ABSTRACT

We estimate that almost 80% of the landscapes of the Gascoyne Catchment have become severely degraded since the introduction of ungulate grazing animals ~150 years ago. This indicates a trend of continuing degradation since the first assessment in 1969-1971. The degradation is most severe in the most productive and ecologically critical parts of the landscape, and the degrading processes now entrained in the landscapes will continue without specific management interventions.

A model of impacts of grazing and trampling on these Gondwanan landscapes highlights the importance of understanding their resilience and determining thresholds of change.

The Ecological Management Understanding (EMU) approach to understanding landscape processes and assessing landscape condition can also underpin attempts at halting and reversing degradation (Pringle and Tinley 2001). Examples of the EMU approach from the Gascoyne catchment are given. It is suggested that the EMU approach to understanding key landscape processes and their remediation is applicable throughout the state's rangelands, and Australia-wide.

INTRODUCTION – THE GASCOYNE CATCHMENT

The Gascoyne catchment is a major part of the southern rangelands of Western Australia. The biophysical characteristics of the catchment have been described by Tinley (in press). For the purposes of this paper, we are referring to the part of the catchment above the confluence with the Lyons River, to be consistent with the previous assessment of Wilcox and McKinnon (1972).

The Gascoyne catchment was opened for pastoral use in the 1870s. This early use involved shepherding along watercourses (Watson 2004). In the ~150 years since those pioneering days, numbers of sheep in the Gascoyne peaked above 800,000 DSE (1910/11), and have gradually fallen through successive drought events to between 200,000 and 300,000, depending on the run of seasons. This is despite the improvements in access to water. Cattle are now tending to replace sheep (2001 data: 32,500 cattle, 80,000 sheep (≡ 340,000 DSE). Further, it was estimated in 2001 that there were around 360,000 unmanaged feral goats in the catchment (Woolnough *et al.* 2004)(≡ 360,000 DSE). These add a new dimension to grazing, browsing and trampling impacts because of their sheer numbers, and because they can survive at greater distance from water than sheep and exhibit a preference for rocky outcrops and halophytic shrublands. The burgeoning population of feral goats are severely degrading those portions of ecosystems and landscapes hitherto little affected by sheep and cattle.

LAND DEGRADATION

Severe flooding at Carnarvon in February 1961 prompted a request for an evaluation of land degradation in the catchment of the Gascoyne River, which might have contributed to that flooding. The consequent detailed survey and assessment, conducted from 1969-1971 by Wilcox and McKinnon, reported 3,634 square miles (9,412 km^2) or 14.9% of the survey area to be "badly eroded and will become irreversibly degraded unless removed from the available grazing area," and a further 12,803 square miles (33,160 km^2) or 52.5% to be "degraded and have some erosion. They need careful use if they are not to degrade further." They found that only 7,944 square miles (20,575 km^2)(32.6%) were in an acceptable condition, and noted that this is mostly hill or stony short grass country (Wilcox and McKinnon 1972). In other words, most of the degraded land is on the lower pediment slopes, run-on plains and that in close proximity to wetlands and drainage lines, the land with most productive potential and also important for biodiversity. Wilcox and McKinnon recommended that stock numbers be reduced from 416,833 to 237,290 DSE to prevent further erosion and to assist rehabilitation.

The assessment by Wilcox and McKinnon was thorough, and they noted a very substantial amount of degradation (total 67.4%). But it was undertaken after 100 years of pastoral activities in the catchment. It is possible, therefore, that certain aspects of the original landscapes and vegetation had already changed beyond recognition by the time of their assessment. As an example, the eminent botanist, J.S. Beard was also working in the Gascoyne area 1963 – 1974 doing field work for his project to map the pre-European vegetation of Western Australia. In the Ashburton catchment, immediately to the north of the Gascoyne, Beard made special note of a "rather remarkable dwarf scrub" in which the *Acacia*'s are reduced to a few stunted specimens so that species of *Senna* and *Eremophila* dominate the vegetation (Beard 1975). Beard noted that the landscapes on which this vegetation type occurred were highly degraded as a result of grazing and trampling by introduced stock. In the course of our field work, we have resurveyed areas of this vegetation, and found that it was formerly a tree scrub of *Acacia xiphophylla* and *A. cuspidifolia* with a chenopod shrub layer both of which would normally indicate good grazing country. However, it had been degraded to the point where the previously-dominant *Acacias* had been grazed out and died and only the discovery of a few residual stumps provide evidence of the original vegetation beneath the now predominant cover of unpalatable cassias and poverty bush.

On the basis of our field work over the past six years, we consider that the entire Yinnietharra Hills Natural Region of Beard (1975, 1976) which contains the Yinnietharra, Phillips and Durlacher rangelands types of Wilcox and McKinnon (1972) to now be degraded to the point of unrecognizability over large areas. This represents a total area in the Gascoyne Catchment of 16,550 km^2 (24% of the catchment).

The assessment by Wilcox and McKinnon was based on site and traverse observations but largely ignored landscape-scale processes. In contrast, we have argued the necessity of considering the interactions of component land units within land systems, and interactions of topo-sequences of land systems within a catchment (Pringle and Tinley 2003). The conceptual model of rangelands function described by Pringle and Tinley acknowledges the potential for massive ecosystem change driven by base-level incision, accelerated head-ward gully erosion and lateral sheeting, which is observed to be widespread across arid Western Australia.

Based on this alternative geo-ecological model of land degradation, extensive field work throughout the region, and using 2002 Landsat TM imagery, we have mapped the extent of degraded land throughout the same area of the Gascoyne catchment surveyed by Wilcox and

McKinnon (1972). We estimate that 53,528 km^2 or 77.9% of the Gascoyne Catchment is now severely degraded, showing loss of all or the majority of topsoil, exposure of impervious hardpans, declining soil moisture balances, decline in recruitment of palatable perennial plant species and ongoing woody weed encroachment. The degradation is most severe in the most productive and ecologically critical parts of the landscape. Much of the degradation is irreversible, and the degrading processes now entrained in the landscapes will continue without specific management interventions. The degradation has severely reduced productive values and, we suggest, it has also reduced biodiversity values across the catchment.

Our areal estimate of the extent of land degradation in the Gascoyne catchment is only marginally greater than that of Wilcox and McKinnon (1972), suggesting that the situation has not deteriorated greatly as a result of the past 30 years of continued pastoral use. However, it is our contention that the 52.5% of the catchment that they reported to be "degraded and have some erosion" has now become more severely degraded. And, as noted above, the degrading processes now entrained in the Gascoyne landscapes will continue without specific management interventions.

Production data suggests that the majority of the landscapes in the Gascoyne catchment have crossed the threshold of condition above which they would be able to maintain their original productive (and biodiversity) values, and have reached a new equilibrium. However, these data do not include the substantial number of feral goats that, we contend, are contributing significantly to on-going degradation. Further, the impacts of the level of degradation are now masked by the substantial areal spread of buffel grass in the lower catchment, the general transition from sheep to cattle, and improvements in access to water. Certainly buffel grass has the potential to lead to further declines in biodiversity values because of its capacity to out-compete native plant species and to carry fire into sensitive riparian and bottomland chenopod habitats. The strong germination of annual grasses following recent heavy rains may also conceal the extent of the degradation visually and in terms of pastoral productivity; however, biodiversity and other values may not respond as positively to these recent changes.

RESPONSES

Over the past six years, we have worked with pastoralists and other land managers throughout the Gascoyne catchment (and beyond) through the EMU (Ecosystem Management Understanding) project, established as a part of the Gascoyne-Murchison Strategy (Pringle and Tinley 2001, Pringle *et al.* 2003). The principle objective of the EMU project was to build capacity amongst those living and working in the rangelands to manage these lands sustainably (cf. Stafford Smith, *et al.* 2000).

The landscape process approach of the EMU project focuses on protection and restoration of catchment integrity. By catchment integrity we mean the capacity of a catchment's drainage patterns to shift from tributary to distributary, to maintain relatively slow flow at key-lines on valley slopes, and for relatively high residence times of precipitation across the landscapes especially in wetlands and floodplains. In general terms, this means that a high proportion of rainfall will be available for plant growth and production, and for biodiversity conservation purposes, within the parts of the landscape where it falls.

A set of guiding principles for restoration of catchment function, based on EMU principles, will be provided. These have been developed from theory and through practical experience of restoration of degraded areas of pastoral leases in the southern rangelands of Western Australia. Within the Gascoyne, a number of station owners have de-stocked and begun restoration works focussing on rain retention and redistribution; recovery methods that have already resulted in extraordinary plant growth responses.

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