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DEVELOPING A COLLABORATIVE BIODIVERSITY MONITORING PROGRAM FOR AUSTRALIAN RANGELANDS

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ABSTRACT

The health of rangeland biodiversity is an important component of reporting on rangeland condition and ecologically sustainable management. However, there is only limited capability to report trends in biodiversity in rangelands at the national scale because of inconsistencies between jurisdictions in data collection, data gaps and limited specific monitoring of biodiversity. Available evidence suggests a continuing decline in at least some elements of rangeland biodiversity.

A comprehensive, broad-scale and collaborative monitoring program is required to adequately report on trends in rangeland biodiversity across all jurisdictions. We propose a monitoring framework with four main elements: targeted monitoring of selected significant (and informative) species; surveillance monitoring of a broad range of taxa at both representative and biodiverse sites in most or all rangeland bioregions; meaningful landscape-scale surrogates for biodiversity (typically derived from remote sensing); and site-based metrics for habitat condition appropriate to rangeland ecosystems and biota. This framework has a strong emphasis on direct monitoring of rangeland biota, rather than on surrogates that have a weak or uncertain relationship with biodiversity. The proposed framework will require long-term investment to enhance existing biodiversity inventory and monitoring capacity in the States and Northern Territory, as well as national coordination, collation and meta-analysis.

INTRODUCTION

The health of rangeland biodiversity is an important component of reporting on rangeland condition and ecologically sustainable management. This has been recognised by the Australian Collaborative Rangeland Information System (ACRIS), with the inclusion in *Rangeland 2008: taking the pulse* (in press) of a substantial section on biodiversity. That report examined ten indicators, believed to be those most informative about biodiversity at landscape scales and for which data was currently available across most rangeland jurisdictions. Specifically, the report identified a number of key issues for rangeland biodiversity:

- Rangeland biodiversity is potentially still in decline;
- There is only limited capability to report trends in biodiversity in rangelands;
- There are no coordinated broad-scale biodiversity monitoring programs in rangelands;
- Data for identified indicators or surrogates of condition are poor;
- Habitat condition indicators need improvement;
- There is inconsistency in regional level indicators;
- Biodiversity monitoring may require substantial resources and development of new indicators; and
- Further investments and efforts are required to develop a comprehensive biodiversity monitoring program in Australia.

It is a clear that a comprehensive, broad-scale and collaborative monitoring program is required to adequately report on trends in rangeland biodiversity across all jurisdictions. Although there have been a number of previous attempts to describe appropriate indicators and frameworks for monitoring rangeland biodiversity (e.g. Smyth *et al.* 2003, Hunt *et al.* 2007), these have not developed into coherent programs. The ACRIS Management Committee and Biodiversity Working Group commissioned a discussion paper that identifies issues and options for a systematic, comprehensive and integrated rangelands biodiversity monitoring program, including responsibilities for implementation (see Fisher *et al.* in prep). Here we provide an overview of that paper.

OBJECTIVES OF THE MONITORING FRAMEWORK

The fundamental purpose of monitoring biodiversity is to detect, demonstrate and quantify change in the abundance of native biota (flora and fauna), and in the condition of habitats that support native biota. In this case we are more specifically concerned with tracking the extent and direction of changes in biodiversity of the rangelands at the national scale with the overall objective of protecting and managing rangeland biodiversity. This overall objective determines the spatial and temporal scale of monitoring required, in particular what, where, when and how elements of biodiversity are monitored.

Having an understanding of the causes of change is also important in protecting biodiversity, in particular whether observed changes are a consequence of anthropogenic factors or seasonal effects. The capacity for broad-scale monitoring to positively establish the cause of observed changes is limited due to the complexity of factors potentially affecting biodiversity and should not be considered a primary role of monitoring at this scale. Nevertheless, the potential for indicating causation and the need to minimise the effect of seasonal variation should be considered in selecting biodiversity indicators for monitoring at the larger national scale. The framework proposed here is intended to provide the foundation for consistency amongst jurisdictions in the type of monitoring and analysis of data. Monitoring can then provide the basis for the development of policies that contribute to the protection and management of biodiversity.

To summarise, the key objectives are to:

- monitor species composition and abundance, habitat condition and extent, and supporting and threatening processes;
- detect change with a high degree of confidence in the results;
- inform management and policy at national scales.

A RANGELAND BIODIVERSITY MONITORING FRAMEWORK

In developing this framework, we were guided by a number of principles, and conclusions from past monitoring experience:

- a variety of indicators or monitoring approaches, incorporating a range of scales and aspects of biodiversity are far more likely to be informative than a single indicator or approach;
- similarly, tracking the status of a broad range of taxa is preferred, because no taxon can be identified that acts as an adequate surrogate for all others; there are disparate responses to environmental variation and management pressure between and within major taxonomic groups; and we have limited capacity to anticipate all potential threats and all species potentially threatened by these.
- collecting information at both local scale (via on-ground sampling) and landscape and regional scales (via remote sensing and collation of GIS data layers) is essential, to provide a balance between detailed insight and broader context, or ability to extrapolate these insights;
- collecting information about the distribution of threats and pressures is very useful, because management investment is often explicitly directed at threats; because these factors can often be readily monitored at broad scales; and because they are often relatively cheap and straightforward to monitor;
- crucially, however, reliance on simple surrogates and landscape-scale pressure indicators for biodiversity is inadequate, essentially because patterns and trends in rangeland biodiversity are too complex to be adequately captured by these surrogates, and our ability to infer the consequences for rangeland biodiversity of trends in these surrogates is severely limited.

Following from these points, the proposed framework has a strong emphasis on “direct monitoring” of biota. “Indirect monitoring” of biodiversity - through pressure indicators and other landscape surrogates - is incorporated as an important component of the framework, but it is essential to recognise that reliance on “indirect monitoring” is unlikely to ever provide an adequate picture of trends in rangeland biodiversity.

The rangeland biodiversity monitoring framework has four components:

1. Targeted monitoring of selected species;

2. Multi-species ("surveillance") monitoring, across most rangeland bioregions;
3. Landscape-scale, threat-based indicators for biodiversity;
4. Site-based "biodiversity condition" metrics.

We anticipate that most monitoring activities will be carried out by the relevant state government agencies in each rangeland jurisdiction. A fifth key element is therefore:
5. An effective mechanism for coordination and standardisation of monitoring activities, as well as collation and interpretation for national reporting.
These components are described in more detail below.

Targeted monitoring of selected species
Monitoring of individual species is included because:

- these are often the focus of conservation concern, and there are already institutional obligations to monitor threatened species;
- procedures for monitoring individual species are well-developed, and monitoring is generally (at least conceptually) straightforward;
- monitoring of some species in rangelands is already underway (although generally in an ad hoc or idiosyncratic fashion);
- if species to be monitored are carefully selected, then they are likely to be useful indicators for a broader suite of biota, and the effects of at least some management interventions or environmental changes.

The last point is crucial, and considerable effort should be invested in selecting a range of complementary target species. These may be near-threatened, declining or even common and widespread species, rather than merely listed threatened species. We suggest a target of five species per rangeland jurisdiction, with selected species being complementary in their distribution, habitat requirements and ecological attributes.

Multi-species ("surveillance") monitoring, across most rangeland bioregions
The value, as a biodiversity monitoring tool, of regularly sampling a broad range of taxa at a large number of sites throughout the rangelands is largely self-evident. This approach complements existing pastoral monitoring programs, but needs to be designed to address multiple criticisms of the suitability of those programs for biodiversity monitoring.

The key issue is how to design a surveillance monitoring regime that is achievable and cost-effective, but provides robust information on trends in biodiversity across multiple ecosystems. Important considerations are:

- what taxa to sample, and using what methods;
- where to locate sites;
- how many sites are required;
- what is an appropriate sampling intensity, and resampling period.

We advocate a regime with approximately 1000 monitoring sites for fauna, in c. 10 bioregions, per jurisdiction. Flora is sampled in a larger number of sites (2000-4000) based on this array. Key groups for monitoring are birds, non-volant mammals and vascular plants (although reptiles may be incorporated with little additional cost). Within a bioregion, sites are coarsely stratified according to land type and condition state, but restricted habitats of biodiversity values are targeted in addition to extensive, "representative" land types. Sites are resampled on a rotational basis every 3-5 years, although flexibility must be incorporated into arid regions to target sampling to seasonal conditions. It is important to recognise that a minimum of 3 samples are required to detect trends, so that more frequent sampling (and greater investment) is required where there is an urgency to track change. It is essential that bio-statistical input is included in program design to ensure that monitoring power is adequate to uncover unacceptable levels of change. A core team of 3-4 staff per jurisdiction is likely to be required, with expected annual cost of about $400,000-$500,000.

Landscape-scale, threat-based indicators for biodiversity

Monitoring threat-based indicators at landscape scales is useful for providing context to results from site-based sampling, potentially allows extrapolation of site-based results across landscapes, and helps to assess the effectiveness of management interventions. Indicators derived from remote-sensing (or GIS spatial data layers) that should be included in this component are:

- vegetation clearing and fragmentation;
- water-remoteness;
- fire;
- ground-cover trend;
- ecosystem function.

Data for at least some of these indicators is currently routinely collected in some jurisdictions, although improvements in data quality and geographic extent may be required. Some require substantial further technical development and/or validation.

Some other threat-based indicators, particularly the density of feral animals and weeds, are important for providing context to data obtained from "direct monitoring" but are not amenable to remote-sensing. However, we do not propose additional monitoring activities related to these threats.

Site-based "biodiversity condition" metrics

There is a strong emphasis on "habitat condition" metrics (such as Habitat Hectares) for assessing the condition of native vegetation in southern (non-rangeland) ecosystems. The applicability of these metrics to rangelands ecosystems, and their utility in assessing "biodiversity condition" more broadly, is debatable. Nevertheless, the concept of a robust system for rapidly assessing potential "habitat quality" for biodiversity, and tracking changes in habitat quality, is an attractive one. Once adequately validated, these condition metrics may reduce the need for direct monitoring of biota. We therefore include this approach within the monitoring framework, and suggest that further development can occur as a research program incorporated into the direct monitoring regime.

Institutional arrangements

Most biodiversity monitoring activities under this framework would best be undertaken by state government agencies, as this is where both the responsibility and capacity generally resides. Collaboration and coordination between jurisdictions is required to maximise the effectiveness of the biodiversity monitoring framework. Additionally, data and information from jurisdictions needs to be collated and interpreted for national-scale reporting. We suggest that this best achieved through a collaborative model similar to the existing ACRIS arrangements, including representatives from each jurisdiction, including the Australian government. This group should be supported by a coordinator, with some operational funding, with costs shared between Australian and State/Territory governments.

We emphasise that, possibly more than most other programs, rangeland biodiversity monitoring requires long-term commitment, and that monitoring programs typically fail because of inadequate long-term investment.

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