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Assessment of Vegetation Condition

AN INDICATOR OF SUSTAINABLE, PRODUCTIVE ECOSYSTEMS

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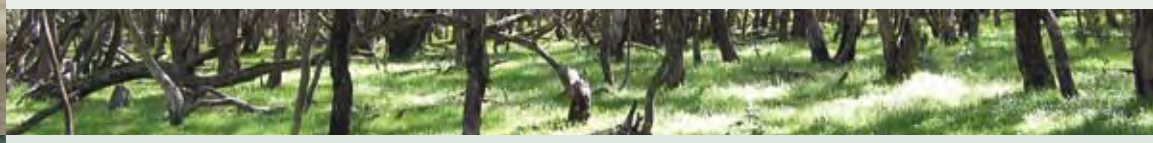

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Its purpose is to make rural science more accessible to those needing to quickly understand the benefits and implications of the most recent research as a basis for decision-making.

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Key Points

1. Improving the condition of Australian native vegetation is an important national goal that is recognised in programmes such as the Natural Heritage Trust.

2. Broadly, vegetation condition indicates capacity to produce 'goods', 'services' and 'values', such as food and timber, clean water or wildlife habitat.

3. Vegetation condition can be assessed from a number of different perspectives. These include production capacity for economic goods, degree of land cover or degradation, ecological productivity and regeneration capacity, extent and type of past disturbance, presence of different plant species, or important habitat features for wildlife.

4. Vegetation in good condition from one perspective may be in poor condition from another.

5. Effective vegetation management involves developing management goals for producing and maintaining different goods, services and values. It also involves monitoring the condition and status of vegetation in relation to these, and reviewing and adjusting management in light of observed changes in condition, new scientific knowledge or changing community expectations.

6. A consistent national approach to assessing vegetation condition would measure attributes that are relevant to the needs of different vegetation users in a repeatable way across jurisdictions and across time. This would effectively inform policy makers on the outcomes of national programmes.

DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

Introduction

This paper aims to inform national, regional and local policy makers, management agencies and land managers about approaches to evaluating vegetation condition.

Vegetation is a vital component of the natural environment. Terrestrial vegetation includes natural ecosystems, such as native forests and woodlands, shrublands, grasslands or wetlands. It also includes human-created ecosystems, including crops, pastures or plantation forests. In many parts of rural Australia, the landscape has been extensively transformed. Vegetation burning by Indigenous people, tree clearing by European settlers, and the introduction of exotic crops and animals, pasture grasses and domestic and feral animals have all impacted on native vegetation. Remnants of natural systems are intimately mixed with these transformed areas, and it is often difficult to determine the boundaries between natural and human-created ecosystems.

This paper aims to inform national, regional and local policy makers, management agencies and land managers about approaches to evaluating vegetation condition

Our society values goods, such as food or timber, and services, such as clean water or wildlife habitat, which are products of vegetation (Box 1).

Assessments of vegetation condition aim to provide an indication of the state of vegetation and its capacity to continue to provide such goods and services. These assessments provide a basis for analysing the benefits and impacts of implementing alternative land management practices on the delivery of different natural resource outcomes. This can result in the adoption of natural resource management approaches that maximise the overall supply of goods and services from different landscapes, and maintain, restore or enhance ecosystems that support vital vegetation.

Regular review of management approaches and methods of assessing vegetation condition will ensure they meet changing social demands and policies, and incorporate new scientific information.

This document provides steps for developing an adaptive vegetation management plan and information on assessing vegetation condition according to different cultural and economic perspectives. The approaches outlined are intended to help standardise national methods of measuring, managing and monitoring vegetation condition.

Assessing Vegetation Condition

There are many different views on what is meant by vegetation condition. Vegetation in good condition for one purpose (e.g. grazing) may be considered in poor condition for other purposes (e.g. providing clean water). Because of this, no single approach to describing vegetation condition can satisfy all stakeholders, and the definition will vary with context (Box 2).

Australian Government programmes, such as the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality, have adopted regionally based approaches to planning and implementing activities to improve the state of our natural environment. Reversing the decline in native vegetation extent and maintaining or enhancing vegetation condition, ecosystem functions and services are important indicators of these programmes' successes (Commonwealth of Australia, 2004).

BOX 1

VALUES OF VEGETATION

Values of vegetation that can be assessed at national, regional and local levels include:

- use as food or fibre (primary industry products)
- conservation status of native vegetation
- ecosystem services provided by vegetation
- recreational and aesthetic values
- cultural and spiritual values.

BOX 2

DEFINITION OF VEGETATION CONDITION

Vegetation condition, particularly 'good vegetation condition', will depend on the values, perspectives and aspirations of those assessing and managing the vegetation. The same vegetation may be assessed according to more than one definition of condition. The definition of condition should ideally include:

- a statement of perspective and values to which the condition applies
- consideration of the long-term stability of the vegetation under current management conditions
- attributes of the vegetation, such as structure (e.g. open forest, grassland) and species of plants present
- attributes of the environment (e.g. soil, water)
- attributes that may form the basis of particular perspectives (e.g. social, cultural or spiritual perspectives)
- a clearly defined or documented method of assessing the attributes, including benchmarks and reference sites.

Measures of vegetation condition

Effective vegetation management requires the ongoing supply of many economic goods and environmental services. Assessment of vegetation condition needs to provide information on the extent to which management affects the supply of different vegetation values, goods and services. Many measures of vegetation condition have been developed that reflect the interests of different users, including:

- the extent and distribution of the different vegetation types, their structural features and plant species composition
- estimates of growth or health of grasses, crops or trees
- the extent of bare ground
- the number of plant or animal species. Management goals will determine the level of detail in data that is collected, analysed and reported. Where a natural resource issue has national significance, the approach differs from one developed to address an issue within a catchment.

Developing a Vegetation Management Plan

The most effective type of vegetation management plan is an adaptive one (Box 3). Adaptive management plans take into account the different indicators used to measure vegetation condition and the different perspectives on how vegetation condition or value is assessed, in order to agree on an appropriate monitoring approach.

Getting Vegetation Management Right from the Start

Three fundamental principles underpin successful vegetation management (Box 4):

- all vegetation types across the landscape must be considered
- vegetation types should be managed for multiple benefits, across whole catchments or regions
- vegetation is but one part of the complex interrelated ecosystems constituting landscapes.

Therefore, a successful vegetation management plan should take into account the wide range of vegetation types, associated values and uses, and how these change over time.

BOX 3

STEPS ON THE PATH TO SUCCESSFUL ADAPTIVE MANAGEMENT

1. Establish management goals and outcomes:
   - define vision, goals and targets.
2. Separate high-level goals into operational objectives:
   - gather and integrate existing data
   - establish baseline datasets
   - identify and prioritise assets (e.g. an area of vegetation that is valued for the goods and services it provides) and issues (e.g. areas at risk)
   - formulate specific questions and objectives to be addressed.
3. Establish a monitoring framework:
   - select indicators to measure progress with respect to objectives.
4. Survey approaches for measuring variables and attributes:
   - identify control areas and treatments
   - validate relationships between indicators and objectives
   - design a monitoring system
   - implement a system for monitoring indicators
   - analyse trends relative to objectives and recommend management actions.
5. Change management based on monitoring results.

Different Perspectives of Monitoring Processes

Surveying and monitoring vegetation condition needs to take into account the perspective from which the 'condition assessment' is being made. For example:

- a 'native vegetation integrity' perspective would be of interest to a biodiversity manager and should be based on long undisturbed vegetation benchmarks
- a 'fodder production' perspective would be of interest to a grazing property manager and should be based on 'best practice sustainable production' benchmarks
- a 'carbon dynamics' perspective would be of interest to those concerned with accounting for changes in carbon stocks (carbon stored in vegetation, decomposing material, soil and wood, both above and below ground) in vegetation or soils, based on agreed rules and guidelines for the land-use change and forestry sector.

Different thresholds need to be established for each perspective. At any one locality or in any vegetation type, management objectives for the condition assessment will determine which perspective and benchmarks are relevant.

Agreeing on a Monitoring Framework

Consistent, repeated measurements of vegetation across a region or catchment can be used to assess the effectiveness of management systems in meeting desired goals and guiding appropriate directions for future management. A monitoring framework should be capable of discriminating between changes in vegetation condition due to management practices, and those due to other factors, such as natural succession, change in fire regime, climate variability or changes in wildlife populations.

Development of the framework will involve consultation with landholders, community, government and industry groups, who will collect, analyse and report the data.

The resources needed to collect and analyse data and information are a key issue in long-term monitoring and reporting. The process should be sponsored and promoted by those who need the data and information, as well as by those whose wellbeing and livelihoods depend on healthy, productive and sustainable ecosystems. Regional communities and governments may need to develop public–private partnerships to ensure the long-term maintenance of vegetation-related assessment programmes.

Implementing a Vegetation Monitoring Framework

Three broad approaches have been used to survey and monitor vegetation condition: reconnaissance surveys, comparative surveys and repeated comparative surveys. All three approaches generally combine on-ground survey information with broader mapping or modelling of vegetation condition across the landscape. The scale of the survey will be a major determinant of the cost of the final design.

Surveying and monitoring vegetation condition may involve the use of standards or benchmarks against which a locality or patch is ranked or scored relative to that benchmark.

Benchmark values are determined from either a single reference or an average (or range) of values determined from reference sites representing the variability considered acceptable for the vegetation type. Reference sites or benchmarks should be clearly and precisely located, and documented for their benchmark values at known times and environmental conditions.

Ecosystem Attributes for Measuring Vegetation

While vegetation condition can be assessed in a variety of ways, approaches that use objective measurement methods will generally have greater credibility and reliability. For this reason, the condition of a patch of vegetation at the time of sampling should be assessed relative to some specified state.

The type of vegetation management approach used depends on the region, landscape types and use of vegetation (Hnatiuk et al 2005). However, a common core set of attributes should be assessed in each region to provide a basis for consistent assessment.

From a sustainable production perspective, a simple set of ecosystem attributes can be used to estimate the supply of ecosystem goods and services and to assess the impact of different management practices on them. These include:

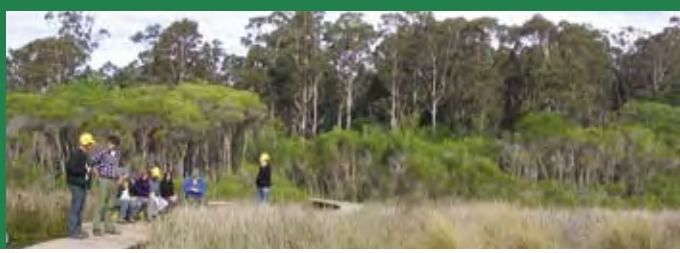
- dominant vegetation cover type (e.g. grassland, crop, shrubland, vines, woodland, forest)
- dominant life cycle (e.g. annual, perennial)

BOX 4

SUSTAINABLE VEGETATION MANAGEMENT

Sustainable management of vegetation requires:

- a clear definition of values and uses of vegetation
- clear understanding of the relationships between human activity and vegetation condition and all other factors involved
- clear understanding of vegetation responses to disturbance over time and an active programme to determine these responses and build them into an adaptive management programme
- clearly described management goals
- appropriate vegetation condition targets
- management frameworks that integrate cooperative approaches, regulation, monitoring, feedback and auditing mechanisms.



- number of vegetation layers (strata)
- percentage of foliage cover (for each vegetation layer)
- depth of rooting (depth ranges)
- age class (regenerative capacity).

This list of attributes is not exhaustive, and additional attributes would be needed to address specific sectoral interests (e.g. monitoring and reporting on the condition of a habitat used for a particular wildlife species, or the condition of pastures used for pastoral production). To plan land management practices, the attributes can be grouped in relation to different factors (such as position in the landscape). The attributes can also be used to assess:

- productive capacity of an ecosystem
- ecosystem resilience to intervention or other forms of disturbances (e.g. fire or defoliation by insect pests)
- the role of vegetation in soil stability and catchment hydrology.

Reconnaissance Surveys

Reconnaissance surveys provide a snapshot of the state of vegetation at the time of the survey. These can be used early in the adaptive management process (point 2, Box 3) to establish the presence or abundance of a feature, or the general relationships between key features of interest (e.g. patterns in aerial photographs and vegetation attributes on the ground). After all the relevant information about an area's vegetation state has been collated, reconnaissance surveys provide the decision maker with a preliminary understanding of an area's vegetation type and extent; its uses and management; and its vegetation succession and disturbance history. Reconnaissance surveys can also provide information on ecological classification and sampling requirements, and help to identify appropriate sampling sites (by taking into account biogeographical regions, biophysical attributes and land management practices).

The setup costs for reconnaissance surveys are relatively low; however, results may be less reliable than other surveys, because the timeframe for collecting and analysing data is limited.

Examples of reconnaissance surveys include land system surveys across central and northern Australia in the 1950–1970s, which helped to assess the suitability of native vegetation for the pastoral industry (Christian and Stewart 1968). The results provided a basis for more detailed survey design and sampling.

Comparative Surveys

Comparative surveys compare similar geographic regions with a different management history or explore the effect of site quality on vegetation goods, services and values. Comparative surveys use repeated, standardised methods and measures (either in space or time, or a combination of both) to detect changes in vegetation. They are designed to assess specific indicators of the productivity or performance of vegetation functioning in the landscape (e.g. biomass, energy, protein, water retention, transpiration, carbon fixation, biodiversity). These indicators all relate to the interpretation of the vegetation's value and use. Interpretation of observed changes by a land manager, user or client defines the state or condition of vegetation. Implementing comparative surveys requires varying levels of resources, from low to moderate and, because comparative surveys use repeated, standardised methods, the data collected are generally more reliable and contain more detailed attributes than reconnaissance surveys.

One example of a comparative survey which required a moderate level of resources, was the assessment of present and pre-European native vegetation types across Australia's water catchments (Walker et al 2002). The survey assessed the relative condition of vegetation in catchments by assigning a ranking ('poorer', 'moderate' and 'better') to assessment units. Options for modifying land use and land management practices were developed for catchments in each condition ranking.

This type of survey provides a more detailed understanding of vegetation assets (point 2, Box 3). Repeating the survey at a later time can provide an indication of response to management (point 4, Box 3) but it is difficult to establish clear trends using this approach.

Repeated Comparative Surveys

Repeated comparative surveys are the most effective option to support adaptive management. They involve a baseline or benchmark for measuring vegetation condition based on an initial set of observations, and repeated observations of the same land unit/s over time. Repeated comparative surveys require a higher level of resources for implementation than reconnaissance surveys; however, they generally provide accurate data on trends in key indicators of vegetation condition and enable more complex time-series analyses of multiple ecosystem attributes. A well-designed, repeated comparative survey will also provide information for multiple natural resource management objectives and outcomes. Generally, successful repeated comparative surveys are characterised by affordable designs that are frequently repeated.

An example of a repeated comparative survey is the National Carbon Accounting System (NCAS). The NCAS is designed to assess changes in carbon stocks across the landscape using a combination of remote sensing, modelling and ground assessment (Australian Greenhouse Office 2001). The current focus is on those areas affected by land clearing and by conversion of forest to nonforest, or vice versa. NCAS is currently being used to fulfill international reporting requirements to the National Greenhouse Gas Inventory, under the United Nations Framework Convention on Climate Change.

The indicator framework developed for monitoring and reporting on the management of forests through the Montreal Process is another example of a repeated survey. This approach provides widely agreed descriptions of values to be considered in assessing sustainable forest management (National Forest Inventory 2003a). A continental monitoring framework has been proposed to capture information on these indicators across all forests in a repeatable way across time and space. This is being tested in northeast Victoria (National Forest Inventory 2003b).

A further good example of a repeated comparative survey is the Healthy Country Tropical Savannas Assessment, which examines criteria for the condition of all vegetation types across northern Australian savanna landscapes (Whitehead et al 2000). Developed through a public consultation process, this project is designed to include many interest groups and is applicable to all land uses. It defines the important environmental, social and economic values of savanna vegetation. Key parties in a region select approaches that best suit their requirements in terms of measuring, interpreting and reporting on vegetation condition. The project seeks to establish a time series for selected attributes, and involves contrasting current against previous vegetation cover. Although the savanna landscape monitoring project has yet to be implemented and was developed for use in tropical savannas, the underlying principles are applicable in a wider context. It requires a moderate level of financial resources for implementation, but is useful in detecting long term trends in vegetation condition.

This approach, with consistent repeatable measurement of attributes relevant to a wide range of users is the most appropriate monitoring framework for adaptive vegetation management (Box 3).

Limitations and Requirements of Monitoring Programmes

Assessing trends in vegetation condition over time requires approaches that are designed to measure a given set of attributes in a consistent and repeatable way. In the past, this has not been the case in many assessments, where ad hoc or one-off reconnaissance surveys have been difficult to build on or repeat at a later date. Ad hoc surveys, often using different technologies or approaches, present difficulties in consistently assessing vegetation condition across the country or detecting trends in vegetation condition over time.

Natural resource management programmes require documentation on trends in vegetation condition over time provided by repeated comparative surveys. Increasingly, regional management agencies and landholders expect multiple outcomes from vegetation across the whole landscape. To achieve this, integrated resource condition assessments involving different land management agencies and land owners are required.

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The most useful information on vegetation condition comes from monitoring programmes that make repeated measurement of reference sites, that is, repeated comparative surveys. However, such survey and monitoring programmes are not in place over most of the country. Although some information on early vegetation condition can be gathered from previous studies, most of these studies were not designed with this objective. The current need for information on regional and national levels to inform policy makers of the outcomes of national programmes is providing the impetus to develop national standards for recording vegetation condition in a number of management systems.

CONCLUSIONS

Values relating to — and uses of — vegetation change over time. Assessment approaches should be designed to respond to changing social demands and new scientific information. The adaptive management approach described above requires regular review of policies and land management goals to ensure that management is meeting current expectations. Assessment methods for vegetation condition should also be regularly reviewed so that they too meet the requirements of all those with an interest in the condition of vegetation.

In the past, many assessments of vegetation condition have been one-off and uncoordinated reconnaissance surveys. There is a need for a consistent national approach based on repeated comparative surveys with set standards for assessing and reporting on vegetation condition that clearly capture the wide range of goods, services and values provided by vegetation. Effective integration of the efforts of different agencies will ensure that scarce monitoring resources are applied efficiently.

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